

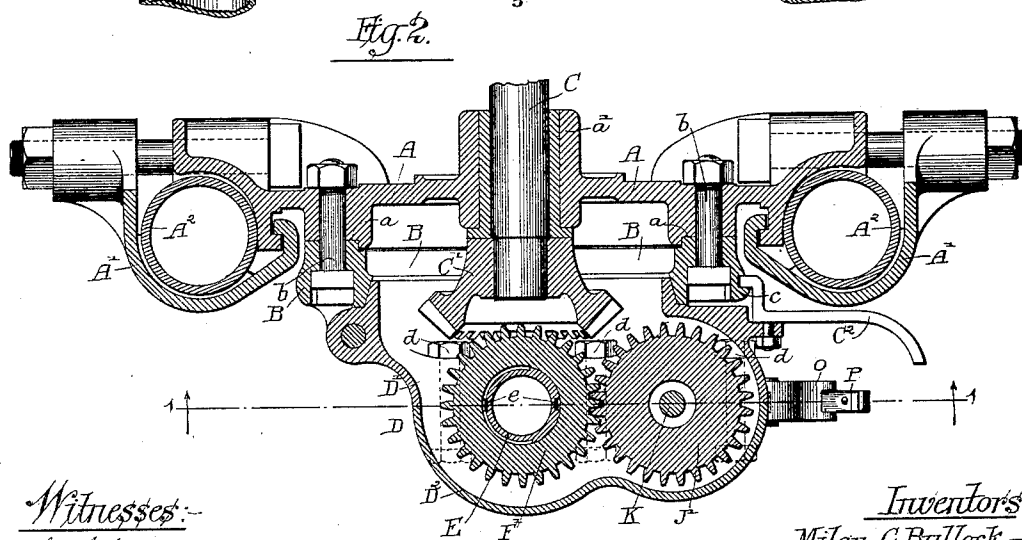
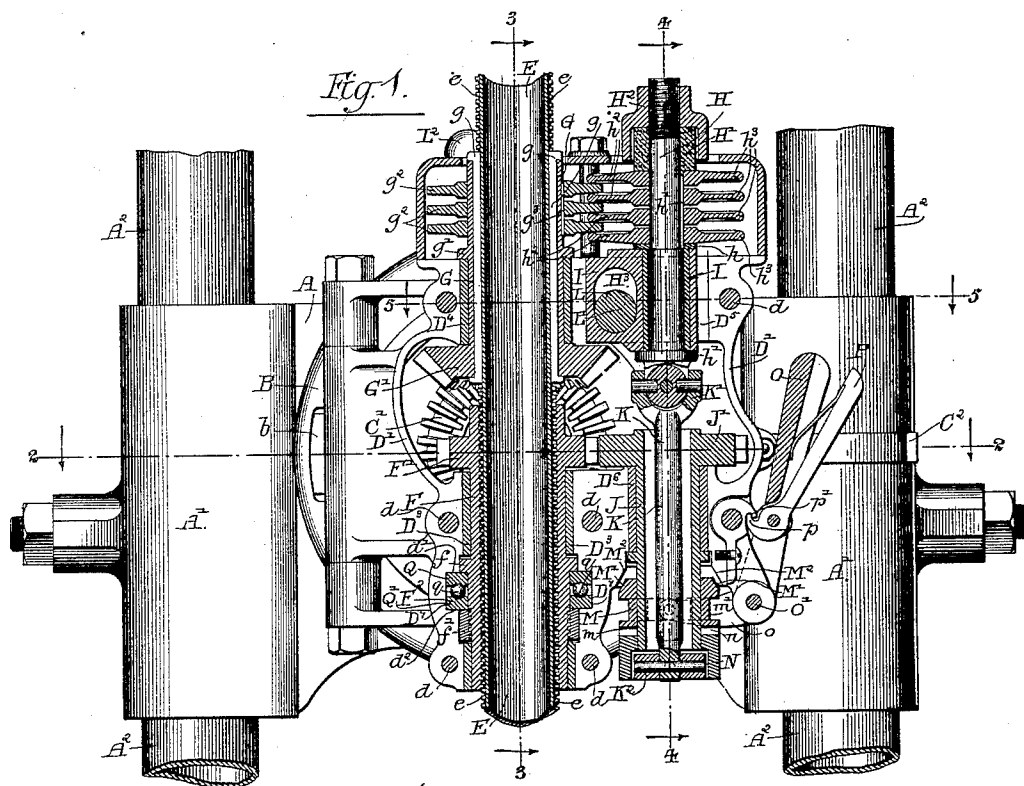
(No Model.)

2 Sheets—Sheet 1.

S. W. DOUGLASS & M. C. BULLOCK.
DRILLING APPARATUS.

No. 462,428.

Patented Nov. 3, 1891.



Witnesses:

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Harry Cobb Kennedy.

Inventors:

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Attorneys.

(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

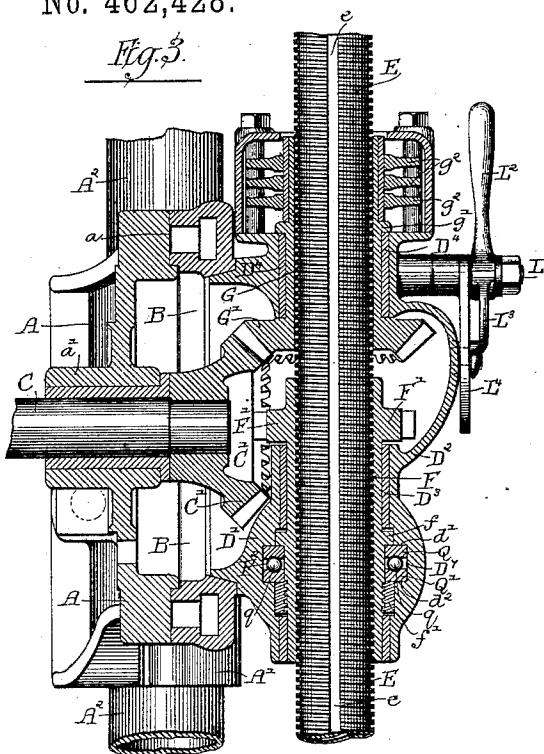


Fig. 4.

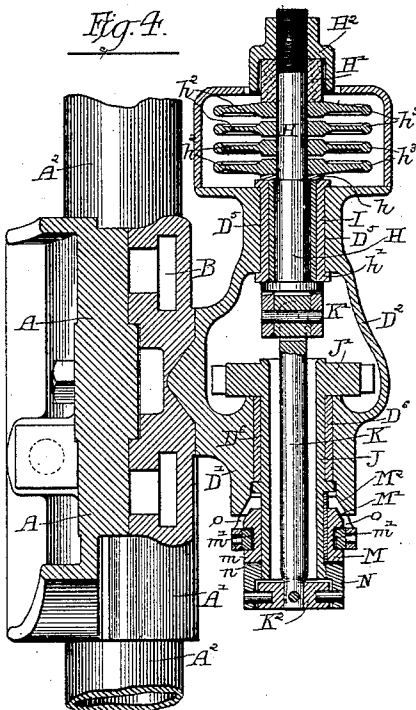


Fig. 5.

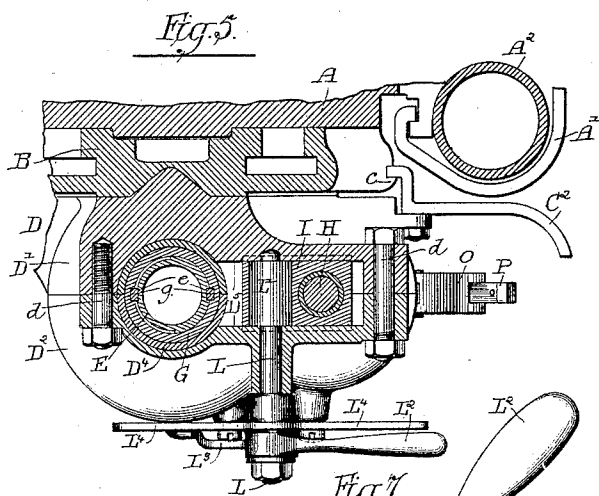


Fig. 6.

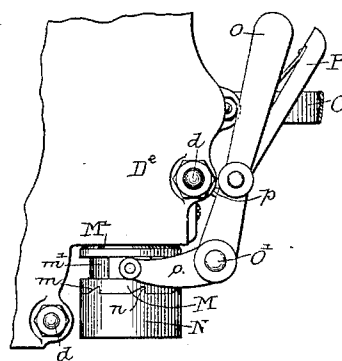
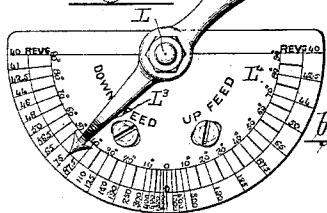


Fig. 7.



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UNITED STATES PATENT OFFICE.

SAMUEL W. DOUGLASS AND MILAN C. BULLOCK, OF CHICAGO, ILLINOIS.

DRILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 462,428, dated November 3, 1891.

Application filed August 24, 1889. Serial No. 321,879. (No model.)

To all whom it may concern:

and MILAN C. BULLOCK, of Chicago, in the

Be it known that we, SAMUEL W. DOUGLASS

county of Cook and State of Illinois, have in-
5 vented certain new and useful Improvements
in Drilling Apparatus; and we do hereby de-
clare that the following is a full, clear, and
exact description thereof, reference being had
to the accompanying drawings, and to the let-
10 ters of reference marked thereon, which form
a part of this specification.

This invention relates to an improvement
in apparatus for rock or earth drilling or bor-
ing, and more especially to that part of such
15 apparatus by which the drill-rod is sustained
in position for boring and is rotated and given
endwise movement.

The invention consists in the matters here-
inafter described, and pointed out in the ap-
20 pended claims.

In the accompanying drawings, illustrating
my invention, Figure 1 is a vertical section
of an apparatus embodying the invention,
taken upon line 1 1 of Fig. 2. Fig. 2 is a hori-
25 zontal section taken upon line 2 2 of Fig. 1.
Fig. 3 is a vertical section taken upon line 3
3 of Fig. 1. Fig. 4 is a vertical section taken
upon line 4 4 of Fig. 1. Fig. 5 is a detail sec-
tion taken upon line 5 5 of Fig. 1. Fig. 6 is
30 a detail side elevation of the clutch device
for starting and stopping the feed-nut. Fig.
7 is a detail face view of a scale and pointer
for indicating the direction and rate of feed
of the feed-screw.

35 As shown in the accompanying drawings,
A is the main supporting-plate of the appa-
ratus, by means of which the same is sus-
tained in operative position. Said plate A is
herein shown as provided with clamps A' A',
40 by which it may be adjustably secured to two
tubular standards A² A², by which the appa-
ratus is supported in position for work.

B is a swivel-plate, which is of annular
form and is mounted on an annular seat *a* of
45 the plate A, the swivel-plate being held there-
on by means of bolts *b b*, having heads which
engage a T-groove in the swivel-plate, so that
the latter may be turned at any angle desired
by loosening said bolts, swinging the plate to
50 a desired position, and then tightening the
bolts. Said swivel-plate is mounted to turn

on an axis coincident with that of an engine
crank-shaft C, by which the apparatus is op-
erated and which has bearing at *a'* in the
plate A.

55 D is a swivel-head or part which immedi-
ately sustains the drill-rod and parts for actu-
ating it, and which is hinged to the swivel-
plate B in the usual manner, the connection
between the parts herein shown consisting of 60
a hinge connecting the said swivel-head and
swivel-plate, located at one side of the latter,
and a locking-lever C², adapted to engage a
lug *c* on the swivel-plate, said locking-lever
65 being employed to hold the swivel-head
against the swivel-plate B and in operative
position when the machine is ready for work.

The swivel-head D is herein shown as hav-
ing the form of a shell, consisting of two parts
D' and D², which cover or inclose the prin- 70
cipal operative parts of the device. The said
shell is divided on a line parallel with the
face of the swivel-plate B, and the part D' of
the shell is located in contact with the said
swivel-plate, while the part D² of said shell 75
forms the front part or wall thereof. The said
two parts D' and D² of the shell are united
by means of horizontal bolts *d d d*.

E is a feed-screw which extends through
the swivel-head and is arranged with its cen- 80
tral axis in line with the central axis of the
engine-shaft C.

F is a tubular feed-nut or interiorly-thread-
ed sleeve, which is mounted in a bearing D³
in the lower part of the swivel-head, and is 85
fitted to the thread of the feed-screw E. Said
feed-nut is provided with a gear-pinion F',
and is held from endwise movement in the
swivel-head by means of a roller thrust-bear-
ing F², constructed to take either an upward 90
or a downward thrust, as hereinafter more
fully described.

G is a sleeve mounted in a bearing D⁴ at
the upper part of the swivel-head and sur-
rounding the feed-screw. Said feed-screw is 95
provided with longitudinal grooves *e e*, which
engage splines *g g* on the said sleeve G, so
that the feed-screw is turned with the sleeve
while being adapted to move endwise through
the same. Said sleeve G at its end nearest 100
the engine-shaft C is provided with a bevel-
led gear-wheel G', which intermeshes with a

beveled gear-wheel C' on said engine-shaft. The sleeve G is held from shifting endwise in the swivel-head by means of the beveled wheel G' , which bears against one end of the bearing D^4 , and a collar g' formed upon the said sleeve above the said bearing.

H is a short counter-shaft located in the upper part of the swivel-head at one side of and parallel with the feed-screw and sleeve G , and driven from the said sleeve by means of friction-gear, as hereinafter fully described. Said shaft is mounted in a sliding block I , which is supported by suitable guides D^5 D^5 upon the swivel-head, so that the block, together with the counter-shaft H mounted therein, may move bodily toward and from the feed-screw. The counter-shaft is held from endwise movement in the block I by means of collars h h' above and below said block.

J is a shaft mounted in a bearing D^6 in the lower part of the swivel-head, at one side of the feed-screw and in the same plane with the counter-shaft H , said shaft J being provided at its upper end with a gear-wheel J' , which intermeshes with the gear-pinion F' on the feed-nut F . The shaft J is adapted to turn with the counter-shaft H by means of a rod K , which is connected at its upper end with the shaft H by means of a gimbal-joint K' , and at its lower end with the shaft J by means of a second gimbal-joint K^2 . For compactness of construction the shaft J is herein shown as made tubular or hollow, and the rod K as passing through the same, the gimbal-joint K^2 being located at the lower end of said hollow shaft. Said rod K , connected with the counter-shafts H and shaft J by means of gimbal-joints in the manner described, transmits rotary motion from said shaft H to the shaft J , while at the same time allowing the shaft H to be shifted toward and from the feed-screw in the manner above described.

A friction-gear is provided for driving the counter-shaft H from the sleeve G , as follows: Upon the upper end of said sleeve G are located a series of flat rings or disks g^2 g^2 g^2 , which are adapted to slide vertically upon said sleeve, but are held from turning thereon by means of a spline g^3 on the sleeve, which engages suitable notches in the disk. The said disks or rings are made slightly narrower at their outer than at their inner edges, so as to make them of wedge shape in cross-section, as clearly shown in the drawings. The shaft H extends above the top surface of the swivel-head, and upon the same is mounted a series of disks h^2 h^2 h^2 h^2 , which are adapted to slide vertically upon the shaft, but which are held from turning thereon by means of a spline h' . Above the disks is located a spring H' , which is held in contact therewith by means of a nut H^2 upon the upper end of the shaft. Said spring is herein shown as consisting of a block of rubber placed around the shaft; but it may

be made of metal and of any desired construction. The disks h^2 h^2 h^2 h^2 are preferably provided at their outer margin with thickened parts or beads h^3 h^3 h^3 h^3 , and the said disks h^2 h^2 h^2 h^2 are made of such size with relation to the disks g^2 g^2 g^2 that the margins of said disks overlap each other, in the manner shown, with the edges of the disks h^2 h^2 h^2 h^2 coming between and bearing against the beveled surfaces of the disks g^2 g^2 g^2 . The several disks arranged to overlap in the manner described, form a friction-gearing by which the shaft H is driven from the sleeve G , the spring H' holding the several disks h^2 h^2 h^2 h^2 in close or forcible contact with the disks g^2 g^2 g^2 , so that a necessary degree of frictional engagement is obtained between the two sets of disks. It will of course be understood that the number of disks employed will correspond with the work to be done or the amount of power to be transmitted, and by suitably increasing the number of disks any required amount of frictional engagement may be secured. By increasing and decreasing the pressure of the spring H' the frictional engagement between the two sets of disks may be increased or decreased as found necessary or desirable.

In the use of a friction driving-gear of the character described the shaft H may be shifted toward and from the feed-screw with the effect of changing the relative speed of the parts, the said shaft H being driven more slowly when brought nearer the feed-screw and more rapidly when moved a greater distance therefrom. The friction-gear described therefore affords a means for varying the speed of the shaft H without the employment of change gears or other similar contrivance, and in such manner that the speed of said shaft may be changed at any time whether the machine is running or not and without changing its speed.

Any convenient device may be employed for moving or shifting the block I in which the shaft H is mounted. The device for this purpose herein shown consists of a shaft L , which extends through and has bearings in the front and rear parts of the swivel-head D , and is provided inside of the swivel-head with an eccentric L' , which engages a vertical slot H^3 , formed in the block I . The shaft L is provided outside of the swivel-head with a hand-lever L^2 , by which the eccentric may be turned about the shaft L .

For convenience in indicating to the operator whether the machine is adjusted to feed backwardly or forwardly and also the rate of feed, the shaft L is preferably provided, in addition to the hand-lever L^2 , with an index hand or pointer L^3 , adapted to move over a scale L^4 , secured to the frame, and which is marked in a suitable manner to indicate the rate of feed—as, for instance, the scale may be marked to show the number of revolutions of the feed-screw for one-inch movement of the same, and the scale herein shown is so

marked. It is also obvious that accordingly as the said pointer stands to one side or the other of a predetermined point the direction of feed can thereby be observed.

5 M is a clutch-sleeve mounted upon the lower end of the hollow shaft J and provided with teeth or projections *m*, which are adapted to engage similar teeth *n* on a clutch-collar N, which is mounted to turn on the lower end of
10 said hollow shaft and is pivoted to the gimbal-joint K². Said collar N preferably has a slight longitudinal movement on the shaft, so as to enable the gimbal-joint and the lower end of the rod K to move slightly in a vertical
15 direction, as is necessary when the shaft H is moved or shifted sidewise. The clutch-sleeve M is provided at its upper end with a conical bearing-surface M', constructed to engage a corresponding bearing-surface M²,
20 formed on the swivel-head D. The clutch-sleeve is held from turning on the shaft J by means of a spline on the shaft engaging the sleeve. Said clutch-sleeve is adapted for movement either downwardly or upwardly, so
25 that it may be slid downward until its projections or teeth are brought in engagement with the projections or teeth of the collar N, or may be moved upwardly until its upper end engages the annular stationary friction-surface M².

30 O is a hand-lever, which is supported on a pin O' and is provided with prongs *o o*, adapted to engage an annular groove *m'* in the sleeve M, said hand-lever affording a
35 means by which the said clutch-sleeve may be shifted on the shaft J, as desired. Said hand-lever is preferably provided with a detent-lever P, having at its inner face a hook *p*, adapted to engage a recess or notch *p'* on
40 the frame and thereby hold the hand-lever O in position when the clutch-sleeve is engaged with the clutch-collar N.

The clutch device described affords detachable driving connection between the counter-shaft H and the nut F, and at the same time
45 is adapted by the engagement of the end of the clutch-sleeve with the stationary friction-surface M² to hold the nut from turning when the clutch is disconnected. In the operation
50 of the device constructed as above described, the rotary motion given to the sleeve G is transmitted to the feed-screw through the medium of the spline and groove connecting said parts, and is also transmitted to the shaft
55 H by the friction-gear described. The shaft H drives the hollow shaft J through the medium of the gimbal-joints and rod K, and rotary motion is transmitted to the nut F from
60 said shaft J through the medium of the gear-wheel J' and pinion F'.

The feed-screw is provided with a left-hand thread, but is revolved to the right, and said feed-screw is fed downwardly by the turning of the nut, which also turns to the right at a
65 rate of speed faster than that of the feed-screw. The feed-screw is advanced when the

several parts are driven one from the other in the manner described, the clutch-sleeve M being engaged with the clutch-collar N, so that the hollow shaft J is connected and turns
70 with the shaft K. In order to run back the feed-screw, said clutch-sleeve M is released from the collar N and brought into contact with the friction-surface M², thereby stopping the rotation of the hollow shaft J and nut F,
75 whereupon the feed-screw, which is still being turned to the right, will be carried upwardly through the nut until it returns to its starting-point. It follows, therefore, that the feed-screw may be advanced or run back by
80 simply manipulating the hand-lever which controls the clutch-sleeve, and no reversal or stoppage of the feed-screw is necessary for running back the same at the termination of its forward movement. By bringing the
85 clutch-sleeve with slight pressure against the stationary surface, so that the clutch may slip on the same to a greater or less extent, the receding speed of the feed-screw may be altered, as desired. It will of course be under-
90 stood that in the use of a device of the character described the drill-rod passes through the feed-screw, which latter is hollow or tubular for this purpose, and that the feed-screw is provided with a chuck, by which the drill-
95 rod may be clamped thereto. In running back the feed-screw for the purpose of advancing a new length of the drill-rod, the chuck is loosened to free the drill-rod from the feed-screw, the latter is run back, the
100 chuck is clamped on the drill-rod at a new place, and the forward movement of the parts again continued.

In similar devices as heretofore made, wherein the nut is held stationary for feeding
105 backward the feed-screw, it has been necessary to disengage the toothed gears forming the driving connections between the feed-screw and the nut and to hold the nut from turning by a device adapted to positively en-
110 gage and interlock with the frame, and this change required the slowing down or stoppage of the engine. By the employment herein described, wherein the nut is held from turning by frictional engagement of a mov-
115 ing part with the frame, the counter-shaft and the gearing run all the time without change of speed, the nut and the sleeve only being stopped or retarded, as desired. The employment of friction to hold the nut from turn-
120 ing is of great advantage, for the reason that in the case the feed-screw runs too far back and the chuck on the end thereof comes in contact with the swivel-head the friction device holding the nut will yield and allow the
125 latter to turn so as to avoid injury to or breakage of the machine.

That feature of the invention by which the feed-screw may be fed forward or run back-
130 ward without changing its speed and by simply moving the clutch-handle is of great advantage, for the reason that a quick up-and-

down movement of the drill-rod while the same is rotating is found to afford a convenient way of loosening the rock-core in case pieces of the same become jammed in a core-lifter or core-barrel, such as is commonly attached to the drill-rod, for the purpose of receiving and holding the core while the same is being removed.

When the shaft H stands at such distance from the feed-screw that the friction-disks come in contact on the pitch-line of the gears J' and F', the speed of the nut will obviously be equal to the speed of the feed-screw, and in such case the nut will be driven at the same speed as the feed-screw and the latter will remain immovable longitudinally or will neither be advanced nor retracted. By moving apart or separating the friction-disks when they are in contact on the pitch-line, as illustrated, the speed of the nut will be increased and the feed-screw will be advanced or carried forward. By bringing the disks nearer together from the pitch-line, however, the feed-screw will be carried backward or upward, the nut at this time turning more slowly than the feed-screw. The tapered form of one set of the disks prevents contact of the disks at more than one point, and a constant or definite pitch-line is thus obtained. Such backward or upward feed is sometimes necessary for drilling backward in caving ground, the cutting-head employed under such circumstances having cutting points or diamonds located in its upper as well as its lower part, so that in case the hole behind the cutting-head becomes choked by the caving in of the rock or earth above it the cutting-head may be run upwardly to clear the hole. It will of course be seen that by moving the friction-disks toward and from each other any intermediate rate of speed may be obtained from nothing up to the highest speed the machine is capable of giving—as, for instance, in the machine from which the accompanying drawings were made, all intermediate rates of feed may be obtained between fifty revolutions to an inch forward to fifty revolutions to an inch backward. The rate of feed may obviously be instantly changed by shifting the shaft H while the machine is in operation and without stopping the engine or lessening its speed.

The thrust-bearing for the nut F is made as follows: Said nut F is provided inside of the bearing D³ in the swivel-head with two collars *ff'*, arranged at some distance from each other, the collar *f* being conveniently made integral with the nut, while the collar *f'* is secured thereto by a screw-threaded joint. Within said bearing, opposite the annular groove formed by the two collars *ff'*, is formed an annular recess D⁷, the upper and lower edges of which form annular seats or shoulders *d' d''* for engagement with two bearing-rings Q Q', which surround the nut between the collars *ff'* and extending outwardly into the recess D⁷, so as to bear against

the said seats *d' d''*. Between said bearing-rings are located rollers *q q*, herein shown as made of spherical form and as running in annular grooves formed in the adjacent faces of the said bearing-rings. The bearing is grooved or recessed to receive the collars *ff'*, and a slight clearance or space is left between the said collars *ff'* and the adjacent walls of the grooves or recesses above and below the same, so that the end-thrust in either direction of the nut comes solely upon the bearing-rings Q or Q'. In case of an upward thrust, such as is produced by the downward pressure of the cutting-head in boring, the collar *f'* presses against the lower bearing-ring Q, and the latter is thereby caused to turn with the nut, while the ring Q is forced or carried against its seat *d'* in the swivel-head and is held from turning by its contact therewith. Similarly in case of a downward thrust, such as is produced by the weight of a long line of drill-rods, the shoulder or collar *f*, acting on the bearing-ring Q, will free the latter from the swivel-head and bring the bearing-ring Q' into bearing with its seat *d''*, so that said bearing-ring Q' in this case becomes a stationary one, and the ring Q turns with the nut. The thrust-bearing is thus adapted to act equally well under strains coming in either direction.

In swivel-heads having roller thrust-bearings as heretofore made, the thrust-bearings have been constructed to operate in one direction only, so that in case the weight of the line of drill-rods exceeds the resistance produced by drilling it became necessary to reverse the entire swivel-head and attach the drill-rod to the opposite end of the feed-screw in order that the thrust-bearing may carry the weight of the drill-rod. The thrust-bearing herein described works in the same whether the thrust is up or down, as hereinbefore described, so that any such reversal of the swivel-head becomes unnecessary.

A special advantage is obtained by making the frame of the swivel-head in two parts in the manner described, for the reason that it enables the nut F, sleeve G, and shaft J to be provided with integral shoulders for engaging opposite ends of the bearings in the swivel-head, and also enables the bearing-rings Q Q' to be inserted without the employment of separate detachable parts on the swivel-head to form one or both of the shoulders or seats against which said bearing-rings rest. The two-part swivel-head, furthermore, may be easily constructed to surround or inclose the main parts of the apparatus, so that the latter are securely housed and the gears, bearings, and other parts protected from dirt or accidental injury.

By properly adjusting the spring which holds the friction-disks in contact with each other, the disks may be adapted to yield or slip on each other in case a definite strain on the drill-rod or cutting-head is exceeded.

The gear thus constructed therefore forms a safety device which will prevent the parts becoming broken or injured in case more pressure is put on the cutting-head than the apparatus will stand, a device of this kind being especially desirable in drilling through rock which is broken or unequal in hardness and in which the cutting-head and drill-rod are liable to be subjected to sudden jars and strains.

It will of course be understood that a flexible shaft or other similar device may be employed in place of the gimbal-joints described to afford connection between the counter-shaft II and the shaft J.

We claim as our invention—

1. The combination, with a feed-screw, a nut engaging the same, and a revolving sleeve splined to the feed-screw, of a counter-shaft movable toward and from the feed-screw and connected with the nut by means of gearing which maintains operative connection between said parts in all positions of the counter-shaft, and overlapping friction-disks upon the said sleeve and counter-shaft, one set of said disks being beveled, substantially as described.

2. The combination, with a feed-screw, a nut engaging the same, and a revolving sleeve splined to the feed-screw, of a counter-shaft movable toward and from the feed-screw and connected with the nut by means of gearing which maintains operative connection between said parts in all positions of the counter-shaft, overlapping friction-disks upon the said sleeve and counter-shaft, one set of said disks being beveled, and a spring applied to hold said friction-disks in contact with each other, substantially as described.

3. The combination, with a feed-screw, a nut engaging the same and provided with a gear-pinion, and a revolving sleeve splined to the feed-screw, of a counter-shaft movable toward and from the feed-screw, overlapping friction-disks upon the said sleeve and counter-shaft, one set of said disks being beveled, a shaft provided with a gear-wheel intermeshing with the gear upon the nut, and a rod connected with the said shafts by gimbal-joints, substantially as described.

4. The combination, with a feed-screw, a nut engaging the same and provided with a gear-pinion, and a revolving sleeve splined to the feed-screw, of a counter-shaft movable toward and from said feed-screw, overlapping friction-disks upon the said sleeve and counter-shaft, one set of said disks being beveled, a shaft J, provided with a gear-wheel, intermeshing with the gear-pinion upon the nut, and a rod connected with the said shafts by gimbal-joints, said shaft J being hollow or tubular and the rod being located within the same, substantially as described.

5. The combination, with a feed-screw, a nut engaging the same, and a revolving sleeve

splined to the feed-screw, of a counter-shaft movable toward and from the feed-screw and connected with the nut by means of gearing which maintains operative connection between said parts in all positions of the counter-shaft, overlapping friction-disks upon the said sleeve and counter-shaft, one set of said disks being beveled, a sliding block affording bearings for said counter-shaft, and a rock-shaft provided with an eccentric engaging said sliding block for moving the latter, substantially as described.

6. The combination, with the machine-frame, a feed-screw and a feed-nut engaging the same, and a revolving sleeve splined to the feed-screw, of a counter-shaft driven from the said sleeve, a shaft J, gearing connecting said shaft J with the nut, a clutch-collar mounted to turn on the said shaft J and connected and turning with the counter-shaft, a clutch-sleeve adapted to engage said collar and movable longitudinally on said shaft J, the said machine-frame being provided with an annular friction-surface adapted for engagement with said collar for holding the nut from turning, and means for actuating said clutch-sleeve, substantially as described.

7. The combination, with a machine-frame, a feed-screw, a feed-nut engaging the same, and a revolving sleeve splined to the feed-screw, of a counter-shaft driven from the said sleeve, a shaft J, gearing connecting said shaft J with the nut, a clutch-collar mounted to turn on the said shaft J and connected and turning with the counter-shaft, a clutch-sleeve adapted to engage said collar and movable longitudinally on said shaft J, the said machine-frame being provided with an annular friction-surface adapted for engagement with said sleeve for holding the nut from turning, a hand-lever for actuating said clutch-sleeve, and a detent-lever on said hand-lever adapted to engage the machine-frame for locking the clutch-sleeve in engagement with the clutch-collar, substantially as described.

8. The combination, with the machine-frame and feed-screw, of a feed-nut mounted in the frame and engaging the screw, and a thrust bearing for transmitting directly to the frame the thrust on the nut in either direction, consisting of two bearing-rings engaging opposite shoulders on both the nut and the frame, and anti-friction balls or rollers located between said bearing-rings, substantially as described.

9. A drilling apparatus comprising a machine-frame, a horizontally-arranged main shaft, a swivel-head connected with the main frame and mounted to rotate on an axis concentric with that of the main shaft, a feed-screw, a feed-nut, a revolving sleeve surrounding the feed-screw, intermeshing gear-wheels upon the main shaft and sleeve, a counter-shaft, intermeshing gear-wheels upon the said counter-shaft and the feed-nut, and change-speed gearing connecting the said

sleeve with the counter-shaft, said swivel-head being constructed to surround or inclose the gear-wheels which connect the main shaft with the sleeve and the counter-shaft with the feed-nut, and being formed to afford bearings for the feed-nut, sleeve, and counter-shaft and divided into two parts in a plane passing through the said several bearings, substantially as described.

In testimony that we claim the foregoing as our invention we affix our signatures in presence of two witnesses.

SAMUEL W. DOUGLASS.
MILAN C. BULLOCK.

Witnesses:

C. CLARENCE POOLE,
HARRY COBB KENNEDY.