J. S. BARNES & J. R. VINCER.

DRILLING MACHINE.

APPLICATION FILED APR. 27, 1909.

958,604. Patented May 17, 1910.

5 SHEETS—SHEET 1.

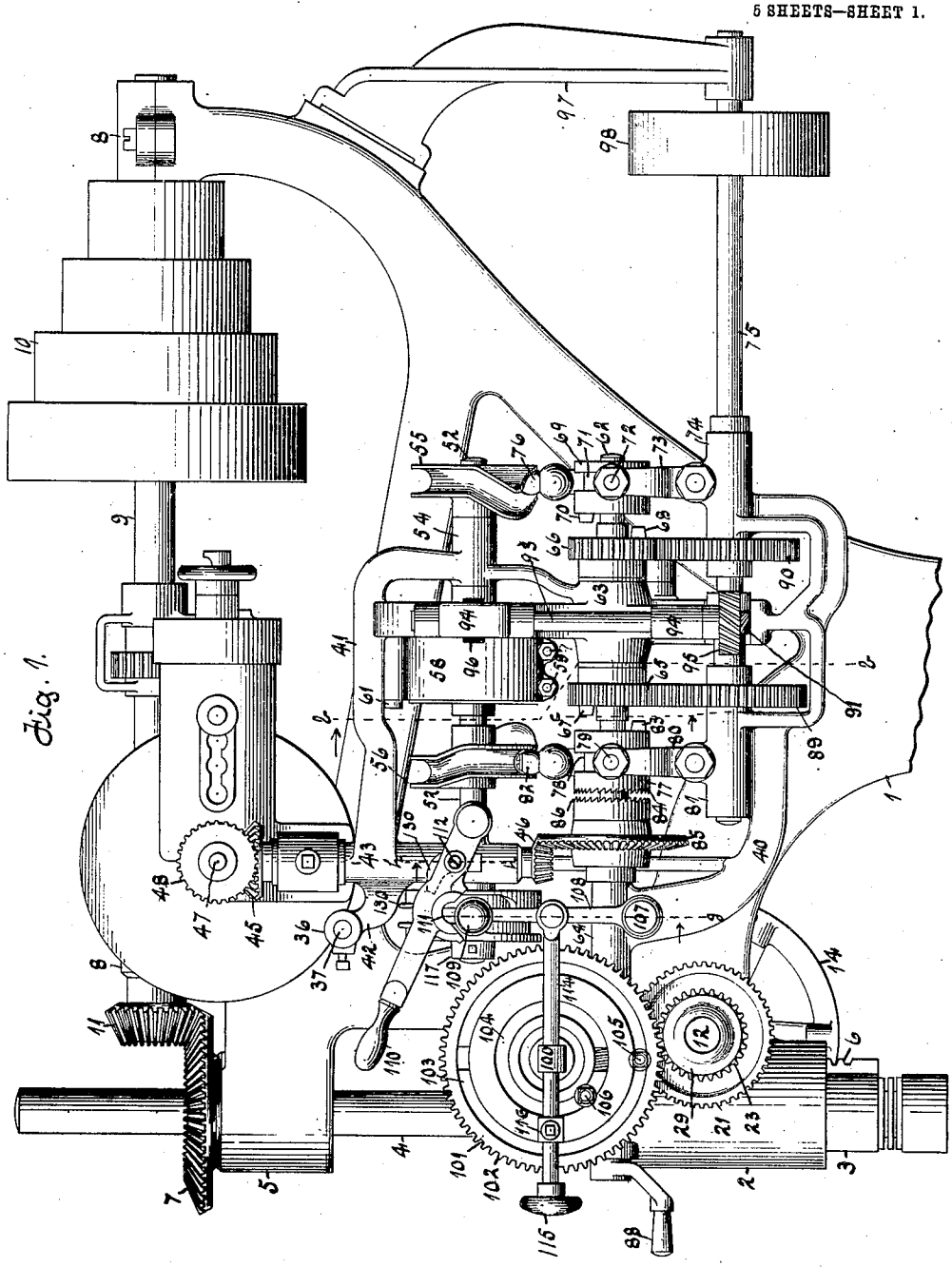

Fig. 1.

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5 SHEETS—SHEET 2.

Fig. 3.

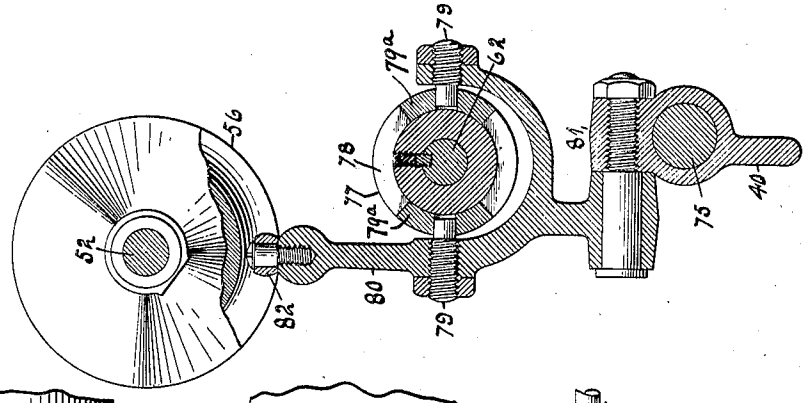

Fig. 2.

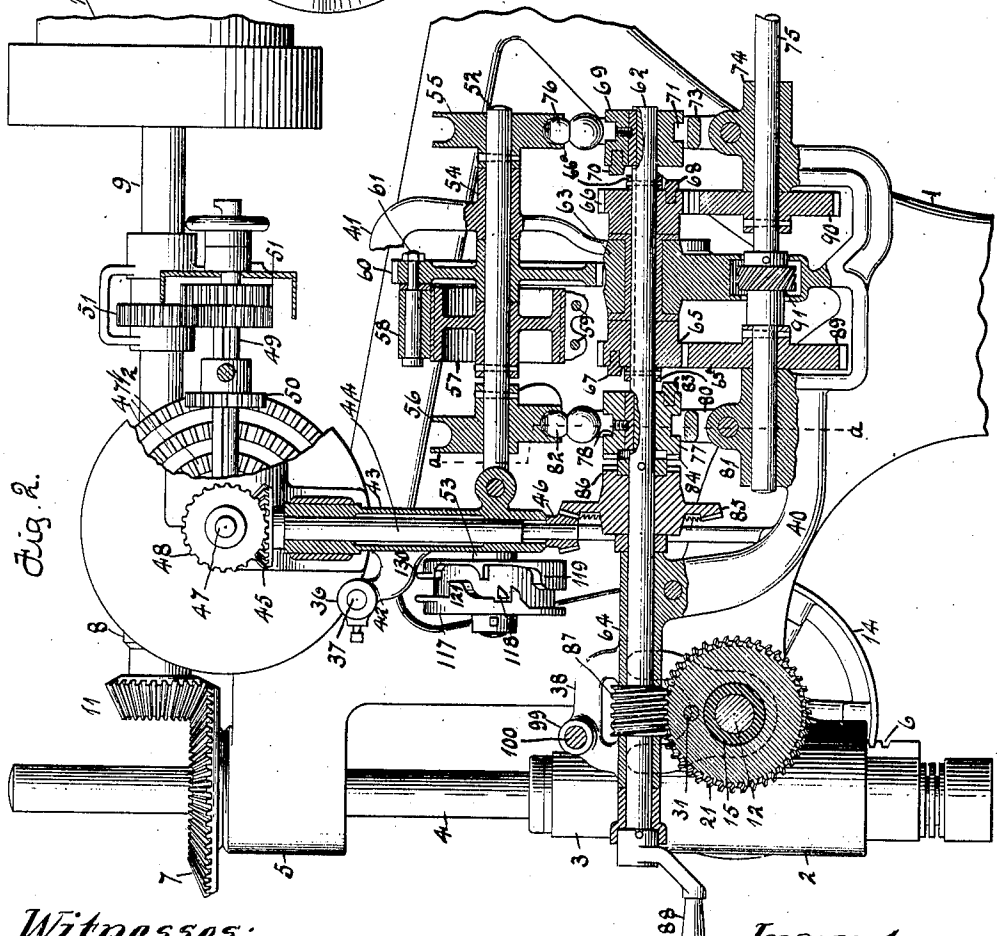

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Fig. 6.

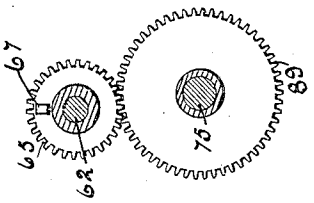


Fig. 5.

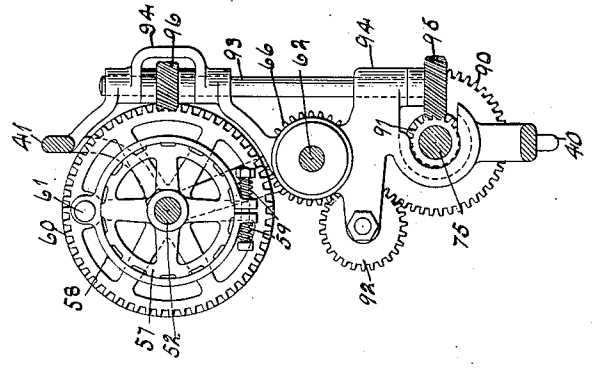
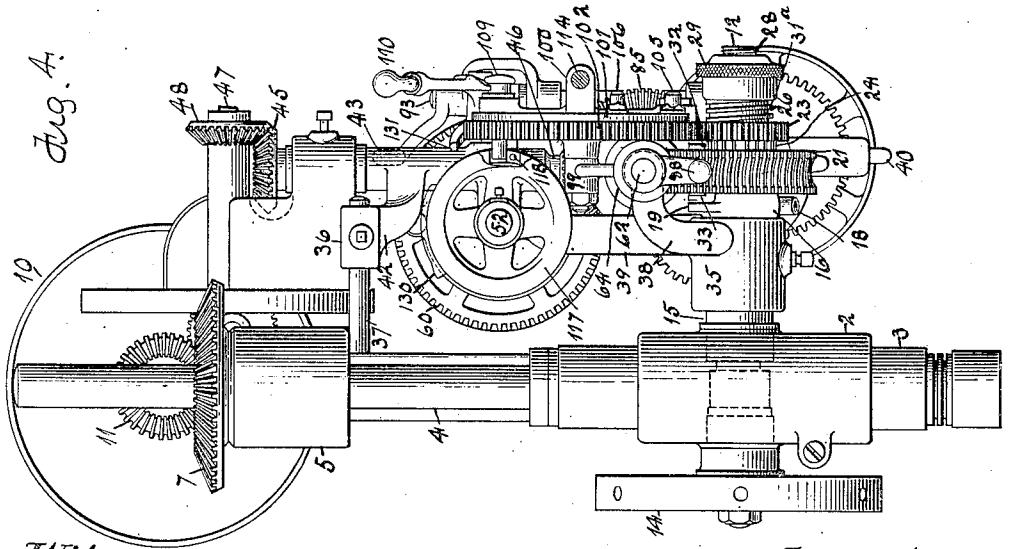


Fig. 4.



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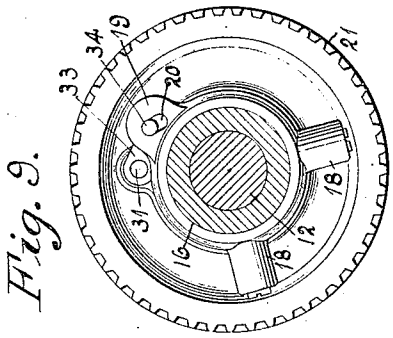

Fig. 9.

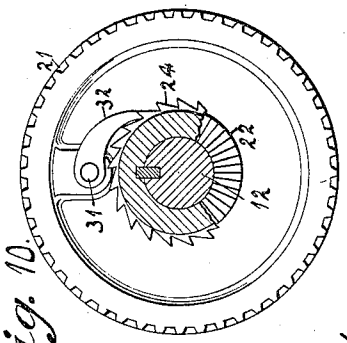

Fig. 10.

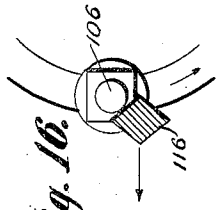

Fig. 16.

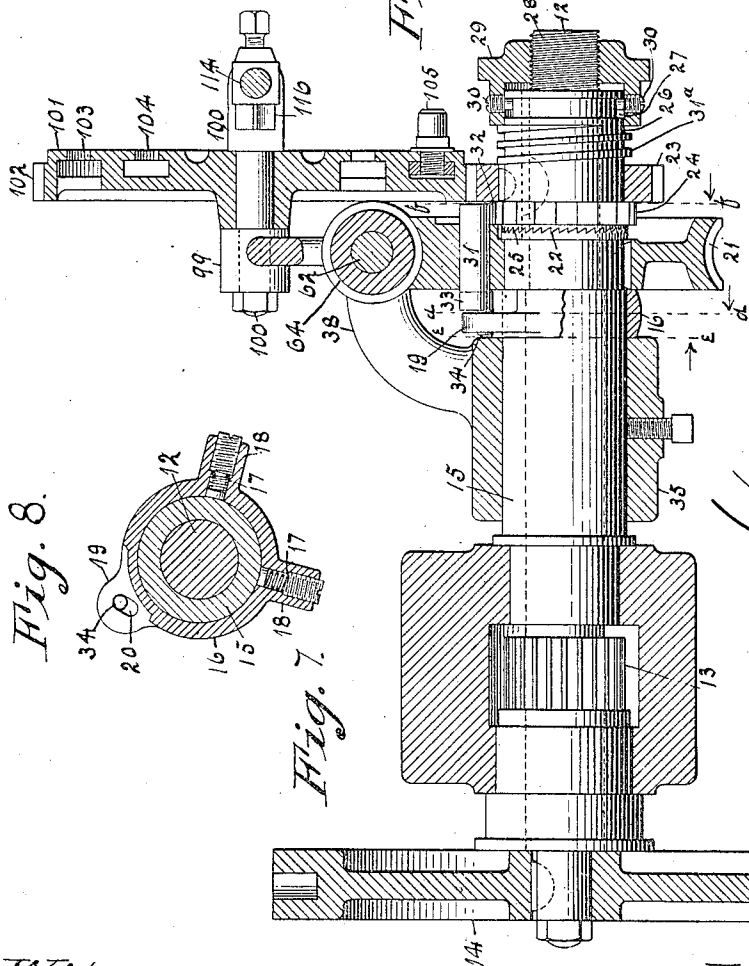

Fig. 8.

Fig. 7.

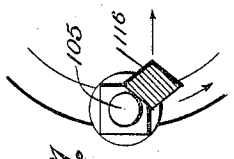

Fig. 17.

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5 SHEETS—SHEET 5.

Fig. 15.

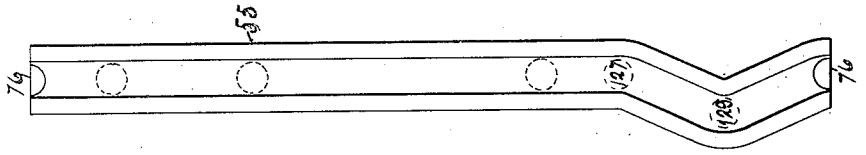

Fig. 14.

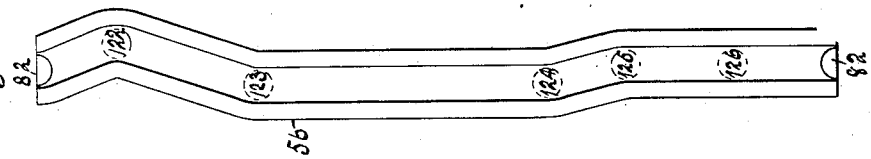

Fig. 13.

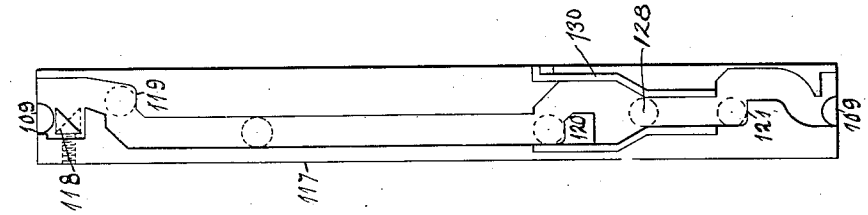

Fig. 12.

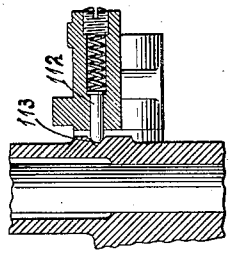

Fig. 11.

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DRILLING-MACHINE.

958,604. Specification of Letters Patent. Patented May 17, 1910.

Application filed April 27, 1909. Serial No. 492,592.

To all whom it may concern:

Be it known that we, JOHN S. BARNES and JOHN R. VINCER, citizens of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Drilling-Machines, of which the following is a specification.

The object of this invention is to impart to the drill spindle a quick advance movement to the work, a slow movement in the same direction while the drill is doing its work, and a quick return movement of the drill spindle to its starting position.

In the accompanying drawings, Figure 1 is a side elevation of a drilling machine to which our improvements have been applied. Fig. 2 is a vertical section through the operative parts. Fig. 3 is a vertical section on dotted line *a a* Fig. 2. Fig. 4 is a front face elevation. Fig. 5 is a vertical section on dotted line *b b* Fig. 1. Fig. 6 is a vertical section on dotted line *c* Fig. 1. Fig. 7 is a vertical section in line with the cross shaft. Fig. 8 is a vertical section on dotted line *d d* Fig. 7. Fig. 9 is a vertical section on dotted line *e e* Fig. 7. Fig. 10 is a vertical section on dotted line *f f* Fig. 7. Fig. 11 is a vertical section on dotted line *g* Fig. 1. Fig. 12 is a vertical section on dotted line *h h* Fig. 1. Fig. 13 is a development view of the trip cam. Fig. 14 is a development of the quick approach and slow feed cam. Fig. 15 is a development of the quick return cam. Figs. 16 and 17 are detail views illustrating the manner in which the stud 116 is operated by the studs 105 and 106.

The main frame of the drilling machine is of a well known type to which we have applied our improvements. This frame comprises the section 1 of a vertical column, from the forward upper portion of which projects a bearing 2 for a sleeve 3 of a drill spindle 4 located in a bearing 5. This sleeve 3 has a toothed rack 6 forming a part thereof. A bevel gear 7 has the usual splined connection with the drill spindle 4 by which the spindle is rotated and permitted a vertical reciprocation. Two bearings 8 are formed as a support for the shaft 9, said shaft being rotated by a belt connection with the cone pulley 10. A bevel pinion 11 has a fixed connection with the shaft 9 and meshes with the bevel gear 7 through which a rotary movement is imparted to the drill spindle.

A cross shaft 12 is supported in the main frame adjacent to the sleeve 3 and has a spur pinion 13 connected to it which meshes with the toothed rack 6. To this cross shaft 12 is fixedly connected a wheel 14 which is formed with openings in its face in which a lever may be inserted, and by which the wheel and cross shaft connected therewith are rotated. The rotations of this cross shaft will raise and lower the sleeve 3 carrying the drill spindle 4 with it, and our improvements have to do with the raising and lowering of the drill spindle in the process of drilling.

From the main frame around the cross shaft extends a hub 15, and around this hub is located a collar 16 which supports a series of spring friction devices 17, which bear against the periphery of the hub and are located in tubular projections 18. From this collar extends an ear 19 which is provided with a diagonally arranged slot 20. Around this hub 15 is located a worm wheel 21 provided with a ratchet face 22.

To the cross shaft 12 is splined a combined spur pinion 23 and saw-toothed ratchet 24. The face of the saw-toothed ratchet 24 is formed with a ratchet 25 which is fitted to contact with the ratchet 22 forming a part of the worm wheel 21. From the spur pinion 23 extends a hub 26 having its end provided with an annular groove 27. The end of the cross shaft 12 is formed with screw-threads 28, and a cap 29 is turned in connection with this screw-threaded end and supports two screws 30 which project into the annular groove 27. A spiral spring 31ª surrounds the hub 26, one end rests in contact with the spur pinion 23 and its other end in contact with the inner end of the cap 29, the action of the spring being to hold the clutch faces 22 and 25 yieldingly in contact. By turning the cap 29 inward, the screws 30 will contact with the main portion of the hub 26 when the clutch faces 22 and 25 will be seated firmly in contact, and by withdrawing the cap the hub 26 carrying the clutch face 25 with it will be held positively out of engagement with the clutch face 22.

An opening is formed transversely through the worm wheel 21, and in this opening is located a rod 31 to one end of

which is secured a dog 32 which is adapted to engage the teeth of the ratchet 24. To the other end of this rod 31 is secured an arm 33 from which extends a stud 34 located in the slot 20 of the collar 16.

When the worm wheel 21 is rotated in the direction necessary to move the drill spindle downward the rod 31 will be carried with it, and as the collar 16 is frictionally held in connection with the hub 15 the rotations of the worm wheel will carry the collar with it which will, through the rod 31, hold the dog 32 free of the ratchet 21. As the clutch sections 22 and 25 are in engagement, a driving connection is formed between the worm wheel 21 and the cross shaft, and through the cross shaft 12 to the drill spindle, in a downward direction. When the worm wheel 21 is rotated in the opposite direction the rod 31 will be rocked and the dog 32 will be moved into engagement with the ratchet 24 which will form a connection between the worm wheel and ratchet, and through the ratchet with the cross shaft 12 which will raise the drill spindle.

When it is desirable to move the drill spindle by hand, the connection between the worm wheel 21 and the cross shaft 12 must be broken, this is accomplished by turning the cap 29 sufficiently to withdraw the clutch section 25 from engagement with the clutch section 22.

The frame for supporting the mechanism for imparting quick advance, slow feed and quick return to the drill spindle is connected to the hub 15 by the collar 35, and a collar 36 held in connection with the stud 37, and from these collars extend the various branches 38, 39, 40, 41 and 42 supporting the various bearings for the shafts.

At the junction of the branches 41 and 42 is located a vertically arranged bearing 43 within which is located a shaft 44 to the upper end of which is secured a bevel pinion 45 and to the lower end a bevel pinion 46. A horizontally arranged shaft 47 has a bevel pinion 48 connected to one end, and to its other end is secured the plate with the concentric toothed rings $47\frac{1}{2}$. The bevel pinion 48 meshes with the bevel pinion 45. A shaft 49 is supported in suitable bearings and supports a toothed wheel 50 capable of being moved into mesh with either of the toothed rings $47\frac{1}{2}$. This shaft 49 has a positive drive connection with the shaft 9 through the gears 51 in any suitable manner to vary the speed of the shaft 49 with respect to the shaft 9. This construction of variable speed gearing between the shaft 9 and the shaft 44 is not new, but is herein shown in order that a complete chain may be had between the shafts, it being understood that other variable speed gearing can be used if deemed best. This shaft 44 is to impart the slow or work feed to the drill spindle and its speed may be varied as above stated to meet the different conditions of work.

A shaft 52 is supported in bearings 53 and 54 in a manner to revolve therein. To this shaft is fixedly connected a cam 55 for moving the clutch for the quick return of the drill spindle. A cam 56 is also fixedly connected to this shaft and is employed to move the clutches for the quick advance and work feed movements imparted to the drill spindle.

To the shaft 52 is secured a friction wheel 57 around which is placed a band 58 having its ends connected by the spring devices 59. A spiral gear 60 is loosely mounted on the shaft 52 and is connected to the band 58 by the stud 61 as shown at Fig. 2. As the spiral gear 60 is continually rotating, the band 58 will be carried with it, which will tend to rotate the friction wheel 57 and the shaft 52 to which it is fixedly connected, but as the shaft 52 is held at rest most of the time the friction will slip.

A shaft 62 is held in bearings 63 and 64 in a manner to be rotated. Loosely mounted on this shaft 62 are two spur pinions 65 and 66 that are held against longitudinal displacement by collars 65^a and 66^a secured to the shaft. The spur pinion 65 has a projection 67 forming one-half of a clutch, and the spur pinion 66 has a stud 68 forming half of a clutch.

A clutch section 69 has a sliding engagement with the shaft 62 and is provided with a projection 70 which in connection with the projection 68 forms a clutch connection between the shaft and the spur pinion 66. This clutch section 69 is formed with an annular groove 71 within which are located studs 72 extending from a shipping lever 73 pivoted to the bearing 74 for the shaft 75. The upper end of this shipping lever 73 supports a ball 76 which is located in the groove of the cam 55.

A double clutch section 77 has a sliding connection with the shaft 62 in a manner to be rotated by the shaft, and is formed with an annular groove 78 within which are located studs 79 extending from a shipping lever 80 pivoted to a bearing 81 for the shaft 75, said studs having shoes 79^a arranged in the groove 78. The upper end of the shipping lever 80 supports a ball 82 which is located in the groove of the cam 56. One face of this clutch section 77 has a stud 83 extending therefrom which in connection with the stud 67 extending from the spur pinion 65 forms a driving connection between the shaft 62 and said pinion. The other face of this clutch section 77 is formed with saw-teeth 84, forming one-half of a clutch.

On the shaft 62 is loosely mounted a bevel gear 85 which meshes with the bevel pinion 46 secured to the shaft 44. This bevel gear

has a saw-tooth face 86 which will receive the teeth 84 of the clutch section 77 thereby forming a driving connection between the bevel gear and the shaft 62.

A worm 87 has a fixed connection with the shaft 62 and meshes with the worm wheel 21, and to the forward end of the shaft 62 is connected a crank 88.

To the shaft 75 are fixedly connected two spur gears 89 and 90, also a spiral pinion 91. The spur gear 90 meshes with an intermediate spur pinion 92 which in turn meshes with the spur gear 66 located on the shaft 62. The spur gear 89 meshes with the spur gear 65 mounted on the shaft 62.

A shaft 93 is supported in bearings 94, and to its lower end is secured a spiral pinion 95 which meshes with the spiral pinion 91 secured to the shaft 75.

A spiral pinion 96 is secured to the upper end of the shaft 93 and meshes with the spiral gear 60 mounted on the shaft 52.

The rear end of the shaft 75 is supported in a bracket 97 connected to the main frame, a pulley 98 is secured to this shaft and is rotated by a belt connection with the counter shaft of the drilling machine.

In a bearing 99 is supported a stud 100 on which is rotatably mounted a drum 101 having its periphery formed with teeth 102 which mesh with the spur pinion 23. The drum is formed with two concentric undercut grooves 103 and 104 within which are adjustably held studs 105 and 106 respectively.

To the branch 40 is connected a stud 107 upon which is pivoted an arm 108. The upper end of this arm supports a spring actuated plunger 109 having its head projected sufficiently to be engaged by a lever 110 pivoted to the frame and formed with a notch 111 having wedge shaped faces of sufficient bevel to properly withdraw the plunger. In order that this lever 110 may be held out of operative position, a spring actuated stud 112 is carried thereby which enters a notch 113 in the frame. To the arm 108 is pivoted a shifting rod 114 which extends forward and is guided in an eye formed in the end of the stud 100 upon which the drum 101 is mounted. A knob 115 is connected to the free end of the rod 114 by which the rod may be moved. To the rod 114 between the stud 100 and the knob 115 is adjustably connected a stud 116 having inclined faces.

To the shaft 52 is fixedly connected a trip cam or stop wheel 117 the development of which is shown in Fig. 13. The face of this cam is formed with an irregular shaped groove and with stops arranged along the path of the groove.

The stop 118 is adjustably connected to the trip cam and is located within the groove of the cam. Stops 119, 120 and 121 are fixed portions or offsets in the cam groove. The plunger 109 is intended to enter the groove of the trip cam and to be engaged by the various stops during the rotation of the trip cam.

By reference to Figs. 13, 14 and 15 which are developments of the three cams 55, 56 and 117 fixedly connected to the shaft 52, the various positions of the plunger 109 and the balls 76 and 82 during the rotations of the cams can be seen. Figs. 14 and 15 are sections through the balls 82 and 76 respectively and Fig. 13, is a section through the plunger 109, and the position of the trip cam shown at Fig. 13 is shifted so as to bring the plunger and balls in the same plane so the movements can be better understood. It is understood that all the cams move in unison and at all times in the same direction, but such rotary movements are intermittent as the trip cam determines the time of movement of the other two cams, and the cam 56 moves the clutches for the quick advance and slow feed movement of the drill spindle and the cam 55 is for moving the clutch for the quick return movement of the drill spindle. In these figures the positions of the plunger and balls are changed while in practice they do not change but the cams revolve.

In starting the mechanism, the rod 114 is moved inward which will move the arm 108 and move the plunger 109 free of the adjustable stop 118 which will permit the trip cam to revolve until the stop 119 engages the plunger. The same extent of movement of the cam 56 will cause the cam 56 to move the roller along the incline of said cam into the position shown at 122, which will move the stud 83 into engagement with the stud 67, thereby forming a driving connection between the shaft 62 and the shaft 75, which through its connection with the drill spindle before described will cause the spindle to descend rapidly until the stud 106 contacts with the stud 116, thereby moving the rod 114 and the plunger 109 so that the plunger will move free of the stop 119 and release the trip cam for further partial rotary movement until the stop 120 contacts with the plunger 109. As the cam 56 is again free to rotate, the ball thereof will be moved from the position shown at 122 into the position shown at 123, which movement will break the driving connection between the studs 67 and 83 and form a driving connection between the clutch faces 84 and 86 thereby forming a driving connection between the shaft 9 through the various gears that will effect a work feed to the shaft 62. When the stop 120 contacts with the plunger 109 and the trip cam is at rest, the ball 82 will occupy the position shown at 124. While the clutch faces 84 and 86 are in engagement, the drill spindle will be moved downward

slowly through its connection with the shaft 9 until the drilling operation is completed when the stud 105 will contact with the stud 116 and move the plunger 109 free of the stop 120 thereby allowing the trip cam to rotate until the stop 121 engages the plunger. The cam 56 will move the ball from the position indicated by 124 into the position 125, which will move the clutch face 84 free of the clutch face 86 thereby breaking the connection between the shaft 9 and the drill spindle. The ball 82 will occupy the position shown at 126 when the plunger 109 contacts with the stop 121.

During the movements of the cam 56 above described until the ball 82 assumes the position at 125, the cam 55 will have partially rotated until its ball 76 is in the position shown at 127, which will hold the stud 70 of the section 69 free of the stud 68 of the spur gear 66, and the only movements remaining are those required to quickly return the drill spindle to its starting position, and allow the mechanism to come to rest. This is accomplished by moving the stud 70 into and out of engagement with the stud 68. While the trip cam is moving along the plunger from the position shown at 128 until the stop 121 engages it, the cam 55 is moving along the ball 76 from the position 127, to the position 129. The cam 55 in making this movement will move the clutch section 69 carrying its stud 70 into engagement with the stud 68, thereby forming a driving connection between the shafts 75 and 62, and as the spur-gear 66 revolves in a direction opposite to the spur gear 65, the drill spindle will be raised until the stud 105 contacts with the stud 116 and moves the plunger 109 free of the stop 121 of the trip cam which will liberate the trip cam and permit it to move until the stop 118 engages it and holds it at rest which will be in its starting position. While the trip cam is making its last movement, the cam 55 will make the same extent of rotation which will travel along the ball 76 from the position 129 into its starting position, and this movement will withdraw the stud 70 from engagement with the stud 68 thereby breaking the connection between the shafts 75 and 62 when all the cams will be in their initial positions, and these operations can be repeated by moving the rod 114 inward to release the trip cam. By turning the stop 118 into the position shown in dotted lines Fig. 13, after one cycle of movements of drill spindle have been completed they will be repeated indefinitely. When the stop 120 is in contact with the plunger, the drill spindle is descending slowly during the drilling process, and may be returned before it has reached its predetermined depth. This is accomplished by moving the lever 110 which will cause the notch 111 to receive the plunger 109 inside the head thereof, thereby withdrawing the plunger from engagement with the stop 120 and permitting the cams 55, 56 and 117 to rotate until the peripheral enlargement 130 contacts with the projection 131 extending from the lever 110 when the lever will be raised free of the plunger thereby allowing the plunger to enter the groove of the cam 117 and the further rotary movement of the cam 117 will bring the stop 121 against the plunger after which the regular quick return movement is imparted to the drill spindle. By adjusting the studs 105 and 106 in their respective grooves in the drum 101 the length of movement of the drill spindle under the quick advance and work feed may be varied.

We claim as our invention.

1. In a drilling machine, the combination of a rotatably and longitudinally movable drill spindle, a cross shaft for the spindle, a second shaft, gear connection between the second shaft and cross shaft, a driving shaft, a cam shaft, gear connection between the second shaft and driving shaft, friction connection between the driving shaft and cam shaft, clutches mounted on the second shaft, cams mounted on the cam shaft, and connections between the clutches and cams.

2. In a drilling machine, the combination of a rotatably and longitudinally movable drill spindle, a cross shaft for the spindle, a second shaft, gear connection between this second shaft and cross shaft, a driving shaft, a cam shaft, gear connection between the second shaft and driving shaft, friction connection between the driving shaft and cam shaft, means for releasing the cam shaft to permit its movement, clutches mounted on the second shaft, cams mounted on the cam shaft and connections between the clutches and cams.

3. In a drilling machine, the combination of a rotatably and longitudinally movable drill spindle, a cross shaft for the spindle, a second shaft, gear connection between the second shaft and cross shaft, a driving shaft, a cam shaft, gear connection between the second shaft and driving shaft, friction connection between the driving shaft and cam shaft, means for holding the cam shaft against rotation, means for releasing the shaft to permit its movement, clutches mounted on the second shaft, cams mounted on the cam shaft, and connections between the clutches and cams.

4. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, means for connecting the driving member to and disconnecting it from the driven member, a rotary element for governing the position of said connecting

means, and mechanism for automatically effecting an intermittent rotation of the rotary element.

5. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, means for connecting the driving member to and disconnecting it from the driven member, and automatic mechanism controlled by the longitudinal movement of said spindle for positively operating said means to connect and disconnect the driving and driven members.

6. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, a clutch for connecting and disconnecting the members, and automatic mechanism controlled by the longitudinal movement of said spindle for positively operating the clutch.

7. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, a clutch for connecting and disconnecting the members, a rotary clutch-shifting member, and automatic means for intermittently holding said member against rotation to prevent the shifting of the clutch.

8. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, a clutch, for connecting and disconnecting the members, a rotary shifting cam, and means for intermittently and automatically rotating said cam to effect the shifting of the clutch.

9. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, a driving member, a clutch for connecting and disconnecting the members, a rotary shifting cam, rotating means therefor constantly operating thereon to rotate said cam, and means for intermittently and automatically holding said cam against rotation.

10. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, means for operating the same, and mechanism controlled by the operation of the driven member for governing the operation of the clutch-shifting mechanism by its operating means.

11. The combination with a rotatable and longitudinal movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the driven and driving members, automatic clutch-shifting mechanism, continuously operated means for driving the clutch-shifting mechanism, and mechanism controlled by the operation of the driven member for automatically controlling the operation of said shifting mechanism by its driving means.

12. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, continuously operated means for driving the clutch-shifting mechanism, and mechanism controlled by the operation of the driven member for effecting an intermittent operation of the clutch-shifting mechanism by the continuously operated driving means.

13. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, continuously operated driving means for the clutch-shifting mechanism having a slip connection therewith, and a stop movable into and out of coaction with the clutch-shifting mechanism to control its movement by the driving means.

14. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, continuously operated driving means for the clutch-shifting mechanism having a slip connection therewith, a stop movable into and out of coaction with the clutch-shifting mechanism to control its movement by the driving means, and means for operating the stop.

15. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, continuously-operated driving means for the clutch-shifting mechanism having a slip connection therewith, a stop movable into and out of coaction with the clutch-shifting mechanism to control its movement

by the driving means, manual means for effecting an initial movement of the stop, and automatic means for effecting after movements thereof.

16. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for longitudinally moving the same, including a driven member connected to the tool spindle, a driving member, a clutch for connecting and disconnecting the members, rotatable clutch shifting mechanism, driving means for the clutch shifting mechanism, a device rotatable with the clutch-shifting mechanism and having a series of stop shoulders, a stop movable into engagement with the different shoulders to hold the clutch shifting mechanism against movement, and means for moving the stop out of such engagement.

17. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for longitudinally moving the same, including a driven member connected to the tool spindle, a driving member, a clutch for connecting and disconnecting the members, a shaft, a clutch-shifting cam mounted on the shaft, means for driving the shaft, a stop wheel mounted on the shaft and having a series of stop shoulders, and a shiftable stop movable into and out of engagement with the shoulders to hold the shaft and clutch-shifting cam in different positions.

18. The combination with a rotatable and longitudinally movable tool spindle, of a feed shaft geared thereto, a driving shaft geared to the feed shaft, a driving member mounted on the driving shaft and having a clutch portion, a clutch mounted on said driving shaft and movable into and out of engagement with said clutch portion, another shaft, a cam fixed to the other shaft, a swinging clutch-shifting arm engaged with the cam and with the clutch member, driving means for the second shaft having a slip connection therewith, a stop wheel mounted on said second shaft and having a plurality of stop shoulders, and a swinging arm having a stop that moves into and out of engagement with the different shoulders to hold the cam in different positions and thus maintain the clutch in and out of coaction with said clutch portion.

19. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the members, automatic clutch-shifting mechanism, means for operating the same, and mechanism operated by the driven member for automatically controlling the operation of the clutch-shifting mechanism by its operating means.

20. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected to the spindle, a driving member, a clutch for connecting and disconnecting the driving and driven members, automatic clutch-shifting mechanism, means for rotating the clutch-shifting mechanism, a stop movable into and out of coaction with the clutch shifting mechanism to control its movement by the driving means, and a rotatable device operated by the driven member for shifting the stop.

21. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for longitudinally moving the same, including a driven member, a driving member, a clutch for connecting and disconnecting the members, rotary clutch shifting mechanism, driving means for the clutch-shifting mechanism, a device rotatable with the clutch-shifting mechanism and having a series of stop shoulders, a stop movable into and out of engagement with the different shoulders to hold the clutch-shifting mechanism in different positions, and means rotatable with the driven member for effecting the shifting movement of the stop.

22. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for longitudinally moving the same, including a driven member, a driving member, a clutch for connecting and disconnecting the members, rotary clutch-shifting mechanism, driving means for the clutch-shifting mechanism, a device rotatable with the clutch-shifting mechanism and having a series of stop shoulders, a stop movable into and out of engagement with the different shoulders to hold the clutch-shifting mechanism in different positions, a rotary device geared to the driven member, and elements adjustably mounted on the said device and engaging the stop for moving the same out of engagement with the shoulders.

23. The combination with a rotatable and longitudinally movable tool spindle, of a feed shaft geared thereto, a driven shaft geared to the feed shaft, a driving member rotatable on the driven shaft, a clutch for connecting and disconnecting the driving member with the driven shaft, a countershaft, means for rotating the countershaft having a slip connection therewith, a cam fixed to the countershaft, a swinging clutch shifting device engaging with the cam, a rotatable stop wheel fixed to the countershaft and having a plurality of stop shoulders, a swinging holding stop movable into and out of engagement with the different shoulders, an actuating device connected thereto, a rotatable stop shifting member geared to the feed shaft, and actuating studs adjustably

mounted on the rotatable member and engaging the actuating device for the stop to shift the same.

24. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, two driving members therefor, a single clutch for separately connecting either driving member to the driven member, and a single device controlled by the operation of the driven member for automatically and positively shifting the clutch to connect the driving members to the driven member.

25. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, two driving members therefor, a single clutch for separately connecting either driving member to the driven member, a clutch shifter, a rotary shifting cam for operating the shifter to carry the clutch successively into coaction with different driving members and automatic means controlled by the operation of the driven member for intermittently rotating the shifting cam.

26. The combination with a rotatable and longitudinally movable tool spindle, of means for effecting its longitudinal movement, including a driven member, two driving members therefor, a single clutch for separately connecting either driving member to the driven member, a clutch shifter, a rotary shifting cam for operating the shifter to move the clutch, automatic means for rotating the cam, and automatic means for intermittently preventing the rotation of said cam by its rotating means to govern the shifting of the clutch.

27. The combination with a rotatable and longitudinally movable tool spindle, of means for longitudinally moving the same, including a driven member connected to the spindle, two driving members, a single clutch for separately connecting either driving member to the driven member, a cam for shifting the clutch into engagement with either driving member and to an intermediate position, and automatic means for intermittently moving the cam to positions to move the clutch and maintain it in engagement with the different driving members and out of engagement with both.

28. The combination with a rotatable and longitudinally movable tool spindle, of a feed shaft geared thereto, a driven shaft geared to the feed shaft, two driving gears loosely journaled upon the driven shaft, a clutch member operating between the gears and movable into and out of engagement with both, a countershaft, a cam fixed to the countershaft, a swinging clutch-shifter engaged with the clutch member and with the cam, said cam being rotatable to positions to engage the clutch member with both driving gears and move it out of engagement with both, driving means for the countershaft having a slip connection therewith, a stop wheel fixed to the countershaft, a stop coacting with the wheel to hold the countershaft in different positions, and means for moving said stop.

29. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving members and the driven member, common means for positively shifting the clutches, and automatic means controlled by the operation of the driven member for controlling the operation of said shifting means.

30. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving members and the driven member, and synchronously rotatable devices for shifting the clutches.

31. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving members and the driven member, and separate cams for shifting the clutches.

32. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving members and the driven member, a shaft, separate cams fixed to the shaft, and devices shifted by the cams and shifting clutches.

33. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving and driven members, a shaft, separate cams fixed to the shaft, devices shifted by the cams and shifting the clutches, driving means having a slip connection with the shaft, a stop wheel and a shiftable stop coöperating with the wheel, for governing the rotation of the shaft by the driving means.

34. The combination with a rotatable and longitudinally movable tool spindle, of mechanism for effecting its longitudinal

movement, including a driven member connected thereto, two driving members, two clutches respectively connecting and disconnecting the driving and driven members, a shaft, separate cams fixed to the shaft, driving means having a slip connection with the shaft, a stop wheel having a channel, and a series of shoulders located in the channel, a shiftable stop coöperating with the shoulders for governing the rotation of the shaft by the driving means, manual means for effecting an initial movement of the stop, and automatic means for effecting subsequent movements of said stop.

35. The combination with a rotatable and longitudinally movable tool spindle, of a feed shaft geared thereto, a driven shaft geared to the feed shaft, quick and work feed mechanisms, including driving gears journaled on the driven shaft, a clutch shiftable into and out of engagement with both driving gears, a quick return mechanism including a driving gear journaled on the driven shaft, a clutch for connecting and disconnecting the latter driving gear with said shaft, clutch shifting devices, a countershaft, cams fixed to the countershaft and engaged with said shifting devices, said cams on their rotation effecting successive movements of the clutch-shifting devices and consequently of the clutches, driving means for the countershaft having a slip connection therewith, a stop wheel mounted on the countershaft and having a plurality of shoulders, a swinging stop movable into and out of engagement with the different shoulders, a rotary controlling member geared to the feed shaft, and studs carried by the controlling member and effecting the movement of the stop.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

JOHN S. BARNES.
JOHN R. VINCER.

Witnesses:
A. W. BARNES,
A. O. BEHEL.