March 13, 1934. H. D. CORWIN 1,950,597

AUTOMATIC DRILLING MACHINE

Filed Jan. 16, 1930 5 Sheets-Sheet 1

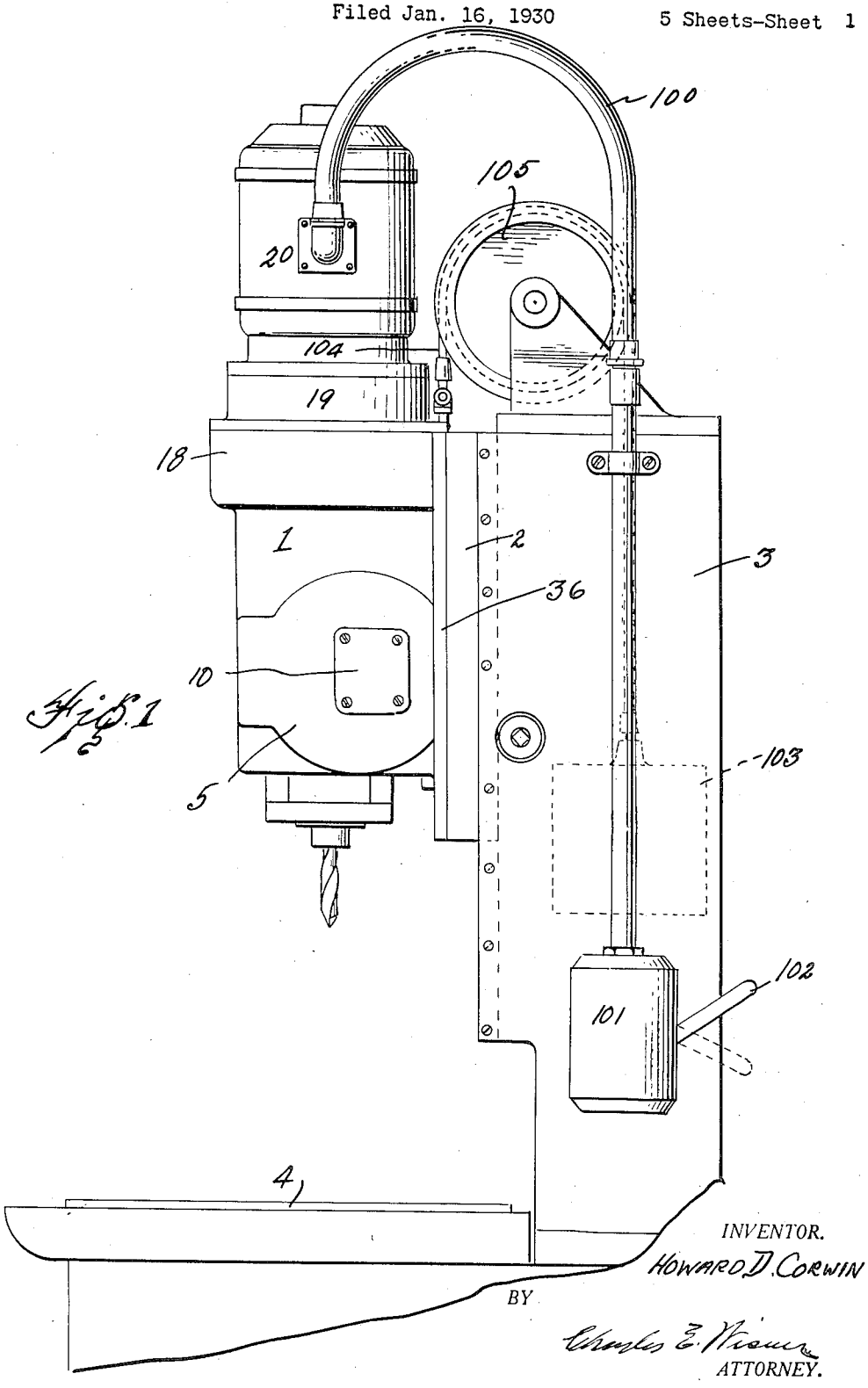

Fig. 1

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AUTOMATIC DRILLING MACHINE

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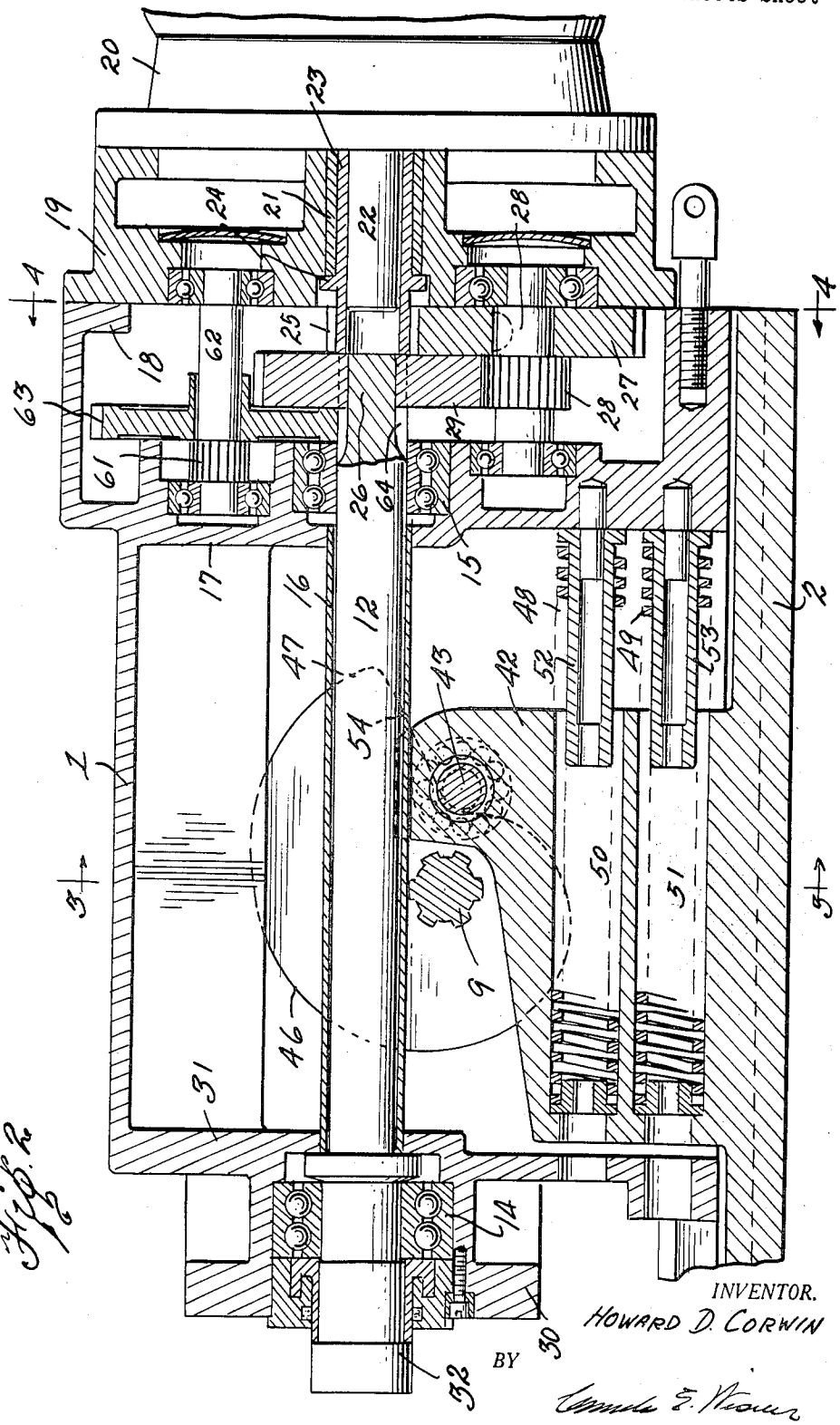

Fig. 2

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AUTOMATIC DRILLING MACHINE

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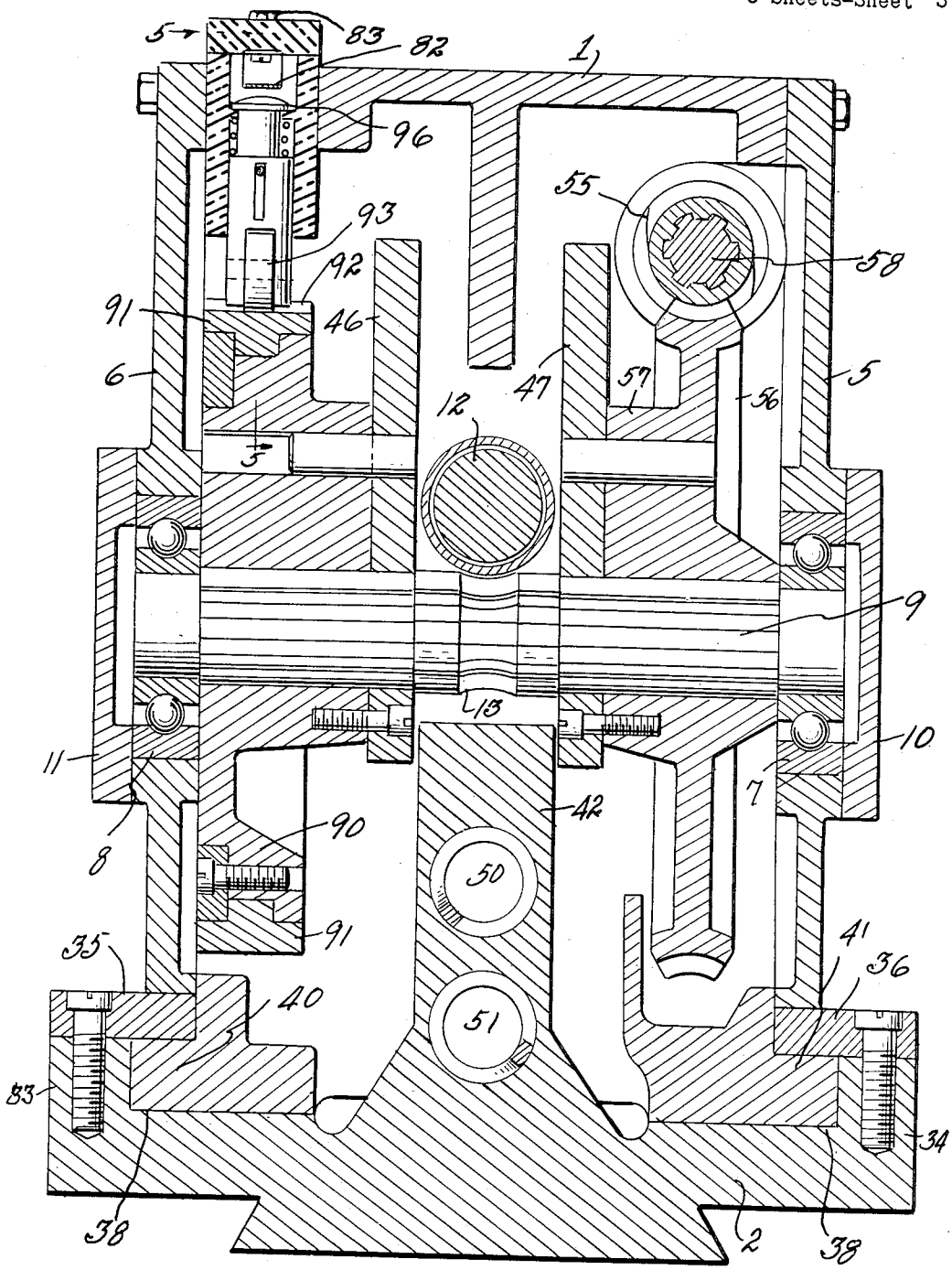

Fig. 3

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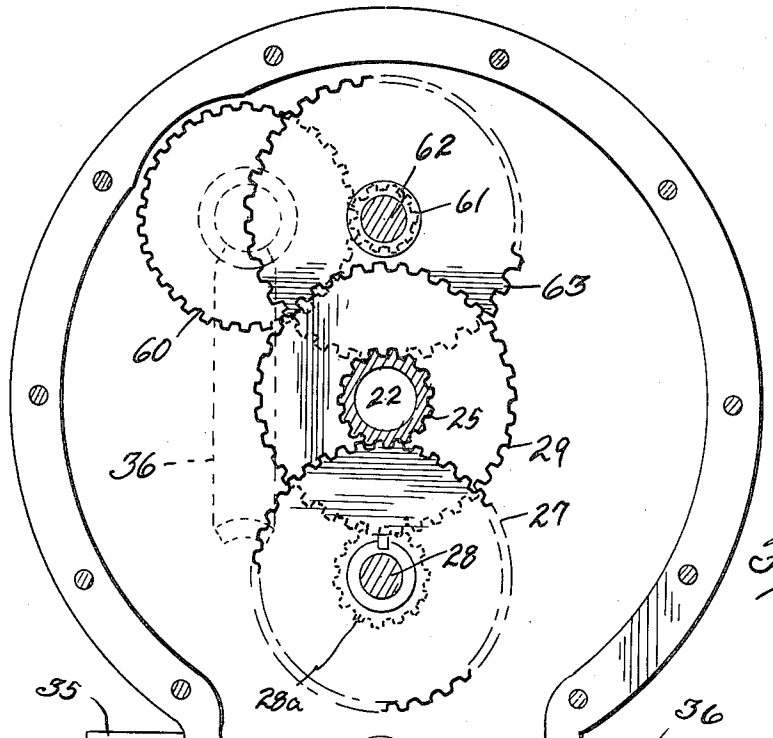

Fig. 4

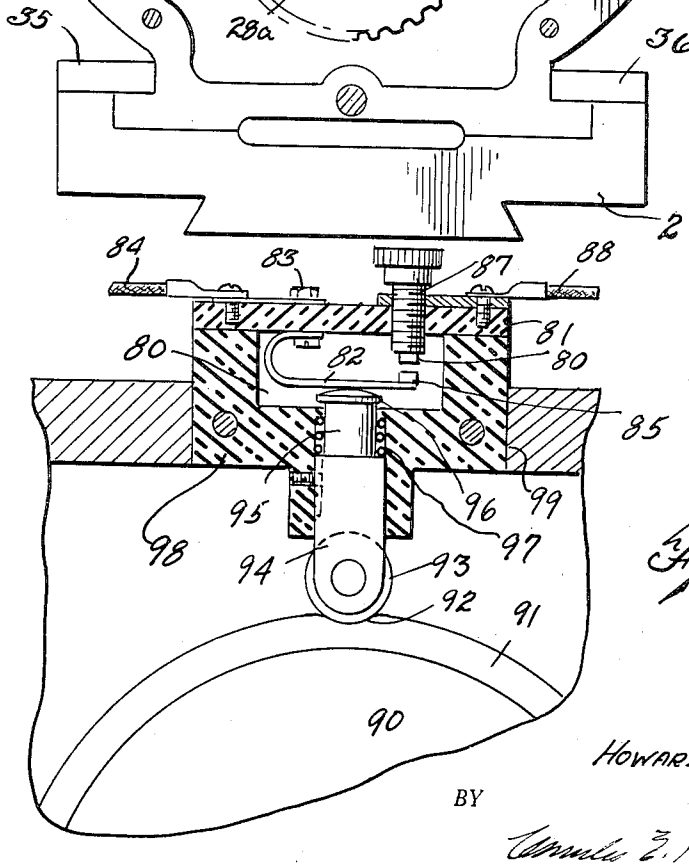

Fig. 5

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AUTOMATIC DRILLING MACHINE

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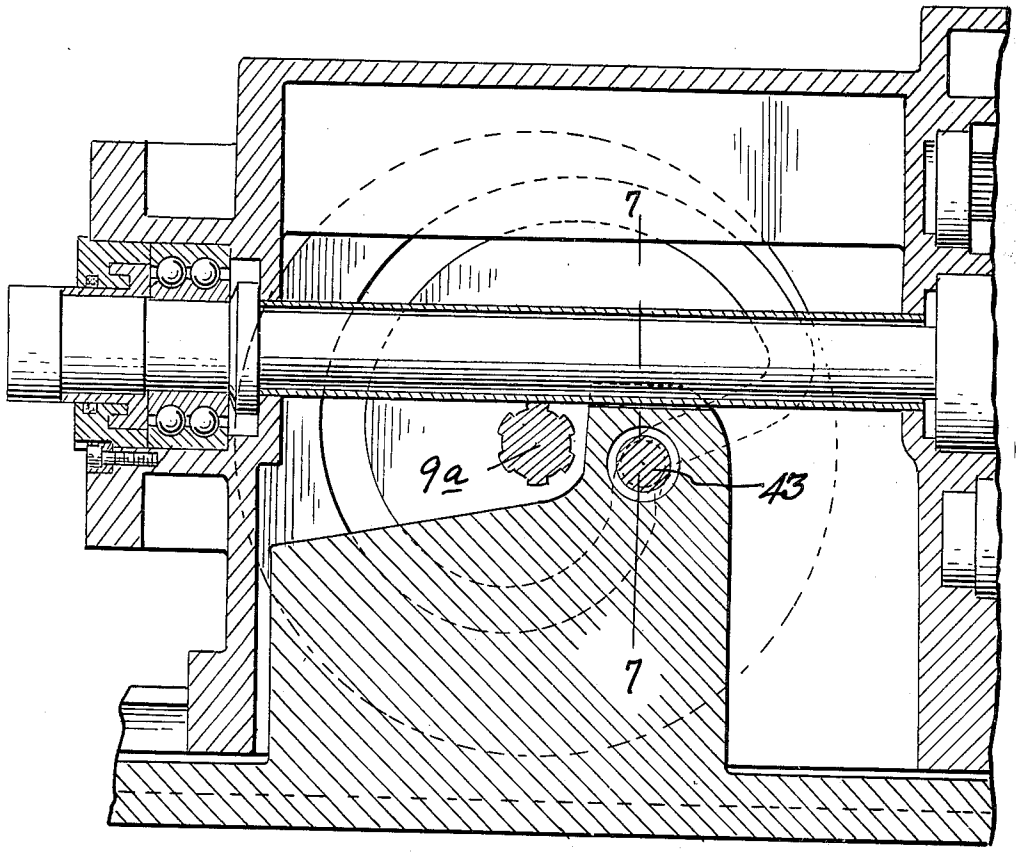

Fig. 6

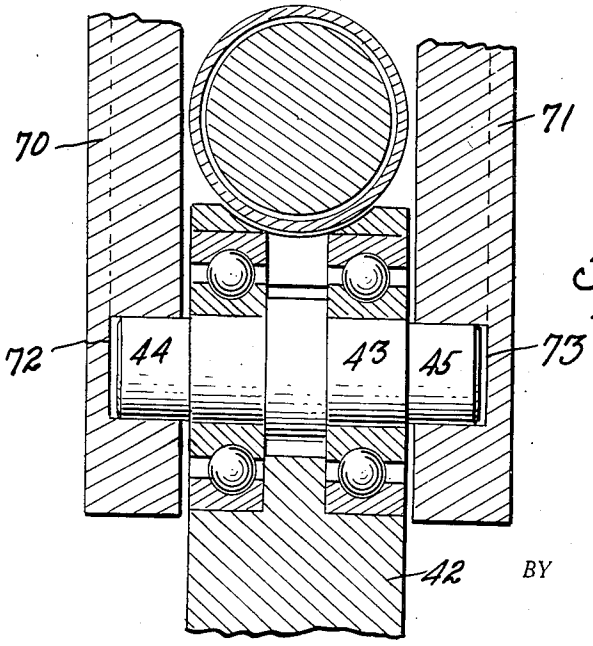

Fig. 7

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Patented Mar. 13, 1934 1,950,597

UNITED STATES PATENT OFFICE

1,950,597

AUTOMATIC DRILLING MACHINE

Howard D. Corwin, Jackson, Mich., assignor to Vulcan Engineering Corporation, Jackson, Mich., a corporation of Michigan

Application January 16, 1930, Serial No. 421,289

5 Claims. (Cl. 77—32)

This invention relates to an automatic drilling and tapping unit of a portable or semi-portable type, the object being to provide a simple and efficient unit for boring, drilling and tapping and like operations that is automatic through a single cycle period of moving the drill or other tool forward into the work in the performance of the various respective operations and the withdrawal therefrom to initial position whereupon the machine is caused to cease operation until again started at the will of the operator.

An additional object of the invention is to provide a machine of the general character stated in which the entire machine is positively moved on a stationary base in the performance of work and automatically returned to limited position for successive operations.

In the preferred construction a spring or springs are compressed during the work stroke and upon completion thereof the machine is released to action by the springs which withdraws the same to initial position and causes cessation of operation through the breaking of the circuit to an electric motor utilized in driving the device.

Heretofore, in machines for drilling, boring, tapping and like operations a more or less heavy and combersome standard or body is provided and the drill shaft is moved outwardly or downwardly as the case may be in the performance of the work and a fault in the operation of machines having such characteristic is found in the fact that the projection of the shaft carrying the drill or tool on its work stroke away from supporting bearings gives rise to inaccuracies of its operation as the shaft is more or less flexible and more or less loosely supported in bearings and the farther the tool is projected from the bearing the greater the liability is for the tool to move out of line. With my improved device the drill and supporting shaft are at all times in a relatively fixed relation and the housing and driving apparatus supporting the shaft and bearings are movable as a unit both toward and from the work whereby greater stability is secured as well as greater accuracy in the operation the machine is called upon to perform.

Various features of the invention are involved in the construction hereinafter described, one of which it may be pointed out resides in the provision of a part fixed to the base or support for the machine in which a roller element or shaft is supported in spaced bearings, and cams are provided on opposite sides of the tool operating shaft to engage the roller and move the machine positively during the work portion of the cycle, the center or rotation of the cam and the center of the drill or tool shaft being as close as the respective shaft diameters will permit.

By this arrangement the thrust is distributed uniformly and occurs as near to the longitudinal axis of the drill shaft as the construction will permit. A greater efficiency in the tool is thus secured, it being more powerful in operation due to the manner of application of pressure and direction in which it is applied during the work portion of the cycle.

These and other various objects and novel features of the invention are hereinafter more fully described and claimed, and the preferred form of construction of an automatic drilling and tapping unit involving my invention is shown in the accompanying drawings in which—

Fig. 1 is an elevation of the unit positioned in conjunction with a standard and work supporting table to move vertically relative thereto.

Fig. 2 is a vertical longitudinal section of the unit.

Fig. 3 is a vertical cross section through the unit taken on line 3—3 of Fig. 2.

Fig. 4 is an elevation partly in section on line 4—4 of Fig. 2.

Fig. 5 is a sectional view of the motor control switch taken on line 5—5 of Fig. 3.

Fig. 6 is a sectional view of an alternative form of construction of the mechanism adapted for positively moving the unit through its cycle of operation.

Fig. 7 is a section taken on line 7—7 of Fig. 6.

It is firstly to be understood that this unit will operate with equal facility and efficiency in either a horizontal or vertical position or at an angle to the vertical or horizontal. In Fig. 1 I have shown the unit indicated generally at 1 mounted on a base 2 which is adjustable vertically in ways provided on the face of a standard 3 and below the unit is provided a work table or surface 4 forming a part of the frame and in Fig. 2 I have shown the base 2 for the unit as occupying a horizontal plane relative to which the unit 1 is moved. The construction of the unit whether for movement vertically or at an angle to the vertical is identical and the description of the operative parts applies irrespective of the mounting of the unit. The base, however, may be varied in form to correspond to the supporting element which is to be fastened. Preferably the unit is provided with the base plate which may be adjusted in position on the supporting element and thus positions the tool in the desired relation with the work. Slidable on the base 2 is the

casing 1 which, as shown in Fig. 3, has the removable side plates 5 and 6 provided with bearings 7 and 8 respectively for the splined shaft 9. Caps 10 and 11 are provided for the bearing ends which are recessed to provide a lubricant containing space for the bearings. This shaft 9 extends transversely of the casing in close association with the tool shaft 12 extending at a right angle thereto directly over the shaft 9 which has a circumferential groove 13 to enable the respective shaft centers to be spaced as small a distance apart as is practicable.

The shaft 12, as will be understood more clearly from Fig. 2, is supported at the forward end of the casing in the bearing 14 and toward the rear end of the case by a bearing 15, the casing in both instances being recessed adjacent the bearings providing lubricant containers, and a tube 16 extends from the forward to the rear bearing recesses in spaced relation with the shaft permitting lubricant to pass from the rear bearing toward the forward bearing. The rear bearing 15 is supported in a wall 17 forward of the rear end 18 of the casing which is chambered for a purpose hereinafter described and to this outer open end of the casing is secured a casting 19 on which is supported an electric motor 20. This casting 19 has a central bearing 21 through which the motor shaft 22 projects. Splined on the shaft 22 is a member 23 formed with a flange 24 at the end of the bushing or bearing 21 and on the outer end is a gear 25. The inner end 26 of the shaft 12 projects into the gear end of the member 23 which is made hollow or recessed for the purpose and it will be noted the longitudinal axis of the motor shaft 22 aligns with that of the tool shaft 12. This gear 25 is on the casing side of the casting 19 and the chamber formed at the rear of the casing 1 is an oil tight chamber and may be filled to a greater or less extent with lubricant which lubricates the train of gears and bearings therefor enclosed therein.

The drill shaft is driven by the said train of gears which includes the gear 25 connected with the motor shaft 22 meshing with a gear 27 splined to a shaft 28 supported at one end in a bearing carried by the member 19 and at the other end in a bearing supported in a housing therefor in the wall 17. On this shaft is also a gear 28*a* meshing with the gear 29 splined to the tool shaft 12 and thus rotation of the motor rotates the tool shaft and the tool. The tool, which may be of various characters all of which require rotation for operation, is connected with the forward end of the shaft 12 which projects into the housing 30 on the forward wall 31 of the casing which also supports the bearing 14 for the tool shaft. The forward end of the tool shaft is here shown as provided with a chuck 32 for a single drill or tap or other tool but it is to be understood that a multiple drill head or like instrumentality for a number of tools may be attached to this head so that several holes may be bored, drilled, tapped or countersunk at one operation. Such multiple head is well known in the art and therefore is not described, it being readily understood by persons skilled in this art that a chuck for a number of tools may be substituted for the chuck here shown for a single tool.

In drilling, boring or other operation these described parts are moved toward and from the work automatically. For this purpose the base 2 is provided with the vertical flanges 33 and 34 on opposite sides finished on the upper face to which is secured the plates 35 and 36 of greater width than the said flanges 33 and providing ways 37 and 38 on opposite sides for the base of the casting 1 which is provided on opposite sides with lateral flanges 40 and 41 extending into these ways.

The casing therefore is capable of sliding relatively to the base and is held from vertical or lateral movement relative thereto. Mechanism is provided to slide the unit on the base which may be either of two forms shown. The form shown in Fig. 1 consists of a vertically extending portion 42 preferably integral with the base and positioned centrally thereof beneath the shaft 12 terminating below the transverse shaft 9. Rotatably supported in the upper end of the member 42 is a shaft 43 the axis of which is parallel with the axis of the shaft 9 as will be understood from Figs. 1 and 7. This shaft 43 is mounted in antifriction bearings as shown and projects on opposite sides of the member 42 providing the stub ends 44 and 45.

In the form of construction shown in Fig. 1 there are two cams, as shown in Figs. 1 and 3, at 46 and 47 and these two cams lie with their two edge faces engaging the projecting ends 44 and 45 of the shaft 43. The cams each have a low point shown in engagement with the shaft in Fig. 1 and the cams are rotated in the direction of the arrow shown in Fig. 1 by mechanism hereinafter described.

Due to the fact that the shaft 43 is held stationary in the casting 42 in fixed relation with the base the casing 1 and gear train, shaft 12 etc., are moved as a unit by the cams on the work stroke and, as the high point of the cams pass the stub ends 44 and 45, the casing and the mechanism carried thereby is moved backwardly by the springs 48 and 49. These springs are supported at one end in apertures 50 and 51 for the respective springs and at the opposite end engage over stems 52 and 53 carried by the casing.

It will be seen in Fig. 1 that upon movement of the cams and consequent movement to the left of the casing, gear train, shaft etc., the springs will be compressed and thus, as the high point of the cams pass the shaft ends 44 and 45, the springs will return the casing to the position shown in Fig. 1 but not too rapidly as the face 54 of the cam extending from the low to the high point may be shaped to prevent too sudden return movement.

The shaft 9 is driven by a worm 55 and worm gear 56 which latter is splined on the shaft 9. The cam 47 is preferably attached directly to a hub 57 formed on this worm gear as shown in Fig. 3 and the cam 46 is likewise secured to a wheel 70 splined on the shaft 9. The worm 55 is splined on a shaft 58, the forward end of which is supported in a bearing 59 at the upper forward end of the casing and the rear end of which is supported in a bearing in the wall 17 of the casing projecting into the gear chamber at the rear end of the casing and is there provided with a drive gear 60. This gear 60 is in mesh with a gear 61 on the shaft 62 vertically above the drill shaft. Keyed to the shaft 62 is a gear 63 which meshes with gear teeth 64 formed on the end of the tool shaft 12 to which the gear 29 is splined. Thus rotation of the tool shaft causes rotation of the worm and rotation of the cams.

It is to be noted that all the gears are housed in this chamber at the rear end 18 of the casing and thus may run in lubricant contained therein and that the bearings for various shafts are all directly open to this chamber and thus supplied

with lubricant with the exception of the forward bearing 14 which opens to the said chamber indirectly by the provision of the tube 16 extending from the housing for the forward bearing 14 to the housing for the rear bearing 15 for the tool shaft 12. By this described construction the unit is positively moved on the work portion of its cycle and is returned by the springs which are compressed during the work movement.

The casing, tool shaft etc., may be moved on both the work portion of its cycle and return movement by means of the cams 70 and 71 which are mounted on the shaft 9*a* shown in Fig. 6 and have cam grooves 72 and 73 in the opposite faces which engage over the projecting ends 44 and 45 of the shaft 43. This cam groove has the same shape as the face of the cams 46 and 47 heretofore described and consequently there is the same comparatively slow work movement on the unit and the comparatively rapid return movement. The function and operation of the device is practically identical with either of the forms of cams shown. As previously stated, this unit automatically operates through a single cycle—that is, after the work is positioned on an appropriate holder the machine is started and the casing, the motor, tool and driving mechanism move forward as a unit on the base and upon completion of the work stroke the mechanism is moved to initial position and operation ceases until it is again started at the will of the operator.

I accomplish the single cycle operation preferably through the control of the circuit for an electric motor although it may be accomplished otherwise if desired by appropriate mechanism without departing from the spirit of this invention. The motor circuit (which is not here shown in its entirety) should be provided with an automatic cut-out switch therein requiring to be manually closed to complete the circuit. The machine is provided with a cam wheel 90 on the opposite side of the casing 1 from that occupied by the worm gear 56 as will be understood from Fig. 3 and the cam 46 or 70 as the case may be is attached to the hub of this wheel in the same manner as the cam 47 or 71 is attached to the hub of the worm wheel. Preferably the cam wheel 90 is formed of a casting with a rim 91 secured thereto of hardened material in order to avoid wear. This rim 91 is circular in form and at one point in its periphery is provided with a notch 92 into which a roller 73 which rides the cam, may seat may move. This roller is attached to the lower end of a vertically movable rod 94 having a large diameter base portion and the small diameter portion 95 at the upper end to which is attached a button 96 of insulating material. This rod 94 rides in a recess 97 of a casting 98 secured in a notch 99 formed in the side face of the upper portion of the casing 1. A spring is provided in the recess 97 engaging the shoulder between the parts 94 and 95 forcing the roller 93 to contact with the face 91 of the cam. The casting 98 is also recessed as at 80 and a cover member 81 is provided therefor which is formed of insulating material.

Within the casting is an electric terminal 82 of spring form being attached at one end to a contact bolt or screw 83 with which one wire 84 of the electric circuit is connected. The opposite end of the member 82 has a contact point 85 and a contact 86 is provided, the bottom end of a screw 87 threaded in the insulating member 81 and electrically connected with the other wire 88 of the electric circuit. The screw 87 permits an adjustment of the distance apart of the contact points 85 and 86. The button 96 on the upper end 95 of the operating stem engages the spring terminal 82 when the roller is in the notch 92 of the cam wheel and when the roller is in the notch 92 the circuit is broken causing the shutoff switch to operate to break the main circuit.

The operation of this structure is as follows—

It will be noted that if the motor circuit may be closed by a switch of any approved form, the roller must be on the high part of the cam to hold the contacts 85 and 86 closed and considering the circuit closed the machine will operate rotating the cam wheel 90 one revolution and as the notch 92 comes beneath the roller the circuit will be broken but the momentum of the parts is such that the cam wheel will still turn to some extent causing the roller to ride out of the notch and again close the circuit but in the interval during which the roller drops into the notch and the circuit is broken the kickoff switch will open the line so that the almost instantaneous breaking and closing of the contact points 85 and 86 through the momentum of the parts will not again energize the motor.

Thus, by the arrangement described a single cycle operation of the tool is produced, the operator manually closing the kickoff switch energizing the motor circuit and causing the unit to start on its work movement and on completion of the work movement of return to initial position just previous to the finish of which the contacts 85 and 86 are broken as stated.

The circuit wires for the motor 20 may be enclosed in a flexible conduit 100 leading to the switch box 101 after the manner shown in Fig. 1. This is provided with a hand controlled lever 102 for manual operation after the switch is thrown out automatically by the above described automatic control shown in Fig. 5 and this conduit 100 is made flexible due to the necessary movement of the motor with the casing and tool and may be positioned in any convenient relationship with a circuit for the device. The arrangement when the unit is moved vertically may be such as is shown in Fig. 1 and irrespective as to whether the tool is to move vertically, horizontally or at an angle thereto the casing should be counterweighted as by a weight 103 shown in dotted lines in Fig. 1 to which a cable 104 is attached running over a pulley 105 mounted on the upper end of the standard 3 or otherwise arranged corresponding to the position and direction of movement of the unit.

The description has been quite closely confined to use of the tool for a drilling or boring operation and with such tools the form of the cam will vary in shape to cause feeding movement of the mechanism and tool at a speed approximating that of the speed of penetration of the tool which depends largely upon the character of the material being operated upon. It is also to be noted that this machine may be used in a tapping operation in which case a tap supporting and operating head is mounted on the end of the shaft 12 to which the chuck 32 is shown applied in Fig. 2. The tap head includes a reversing device as is now commonly the practice which is tripped at the end of the work stroke whereby through continuous rotation of the shaft 12 in one direction, the tap or taps carried by the head attached to the shaft are reversed in direction of rotation to enable the same to be withdrawn by reverse movement of the operating mechanism

on the base. With such tap head of the commonly known construction, the contour of the cam will be changed from that shown in Fig. 2 to a shape adapted to cause forward and backward movement of the casing and operating mechanism carrying the shaft 12 at a speed as may be required by the speed of movement of the tap which is determined by the pitch of its threads.

By the described construction and arrangement of parts it will be evident that the machine is simple and comparatively inexpensive in construction and is unique in operation in that the entire mounting for the tool—that is, the shaft to which the tool is attached, casing carrying the shaft, the gear train for operation of the device and the power device are all movable as a unit relative to a fixed element toward and from the work, and that by the described construction the various objects of the invention are attained.

Having thus fully described my invention, its utility and mode of operation, what I claim and desire to secure by Letters Patent of the United States is—

1. In a device of the character described, a base, a hollow casing supported thereon capable of movement relative to the base, the casing having an opening on the side engaging the base, a member on the base extending into the casing through the said opening, a rotatable tool shaft supported by the casing and arranged for the support of a tool at the forward end of the casing, power actuated mechanism for rotating the shaft, a second shaft supported in the casing in close association with and at a right angle to the toolshaft, a cam on the second shaft on each side of the tool shaft, means for rotating the second shaft and cams thereon, a roller element carried by the extending base member and engaged by the cams, operating mechanism for the tool shaft, means for rotating the second shaft, power means for actuating the said operating mechanism for the said shafts, a control device for said power means including an electric circuit, a manually operable switch in the circuit, closing of said manually operable switch causing the power means to operate the shaft operating means thereby causing the casing and parts supported thereby including the tool to move forward on the work stroke, means for causing the casing and associated parts to automatically return to the initial position upon completion of the work stroke, automatic means for operating said control device to break and then make the circuit near the completion of the return stroke, and means associated with the operable switch causing the same to automatically break on cessation of current flow requiring the switch to again be moved to close the circuit for succeeding operations.

2. In a drilling mechanism and the like, the combination with a base, of a self contained drilling unit comprising a hollow casing guided for vertical movement along said base and having an opening on the side adjacent thereto, tool and feed actuating mechanisms supported in vertical alignment at the upper end of said casing, a central vertically disposed tool shaft extending through the interior of said casing and being supported in the upper and lower ends thereof for positioning a tool below the lower end of said casing, a second shaft supported centrally in said casing between the upper and lower ends thereof contiguous and at right angles to said tool shaft, cams carried by said second shaft equally spaced upon opposite sides and confining said tool shaft, a portion of said base extending through said opening into said casing, means carried by said portion engaging said cams to effect relative movement between said base and unit, and interconnections between said mechanisms and said shafts.

3. In a drilling mechanism and the like, the combination with a base, of a self contained drilling unit comprising a hollow casing guided for vertical movement along said base and having an opening on the side adjacent thereto, tool and feed actuating mechanisms supported in vertical alignment at the upper end of said casing including a motor having a vertical shaft, a tool shaft substantially coaxial with said motor shaft extending through the interior of said casing and being supported in the upper and lower ends thereof for positioning a tool below the lower end of said casing, a second shaft supported centrally in said casing between the upper and lower ends thereof contiguous and at right angles to said tool shaft, cams carried by said second shaft equally spaced upon opposite sides and confining said tool shaft, a portion of said base extending through said opening into said casing, means carried by said portion engaging said cams to effect relative movement between said base and unit, and interconnections between said mechanisms and said shafts.

4. In a drilling mechanism and the like, the combination with a base, of a compact self contained drilling unit of substantially uniform cross section comprising a hollow casing guided for vertical movement along said base and having an opening on the side adjacent thereto, tool and feed actuating mechanism supported upon the upper end of said casing, a tool shaft extending through said casing and being supported in the upper and lower ends thereof, a portion of said base projecting out of the guiding plane thereof through said opening into the interior of said casing including roller means, cam means located centrally in said casing and between the upper and lower ends thereof engaging said roller means to effect relative movement between said base and unit, and interconnections between said mechanism and tool shaft and cam means.

5. In a drilling mechanism and the like, the combination with a base, of a compact self contained drilling unit of substantially uniform cross section comprising a hollow casing guided for vertical movement along said base and having an opening on the side adjacent thereto, tool and feed actuating mechanism supported upon the upper end of said casing, a tool shaft extending through said casing and being supported in the upper and lower ends thereof, a portion of said base projecting out of the guiding plane thereof through said opening into the interior of said casing including roller means, cam means located centrally in said casing and between the upper and lower ends thereof engaging said roller means to effect relative movement between said base and unit, and interconnections between said mechanism and tool shaft and cam means, spring means urging said cam and roller means into engagement positioned for compression between said portion and the upper end of said casing, the engagement between said cam and roller means being intermediate said tool shaft and spring means.

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