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(54) **Drill point grinding machine.**

(57) A drill holder in the form of a chuck (102) is mounted upon a radial arm (56) adapted to be swivelled reciprocatingly, about an axis provided by vertical stub (44), by a stepping motor (70) accommodated in main body (10) of the machine, through gearing (72, 74, 78) engaging with toothed segment (80) clamped onto the lower end of the stub (44). The chuck (102) is adapted to be reciprocated towards and away from grinding wheel (14) by a respective stepping motor (96) and stepping rotation of the chuck is effected by a respective stepping motor (104). All three motors (70, 96 and 104) are independently connected to programmable control equipment in control box (154) permitting programming of the swivelling movement, the reciprocation towards and away from the wheel (14) and the rotary movement of the drill holder in correlation with one another.

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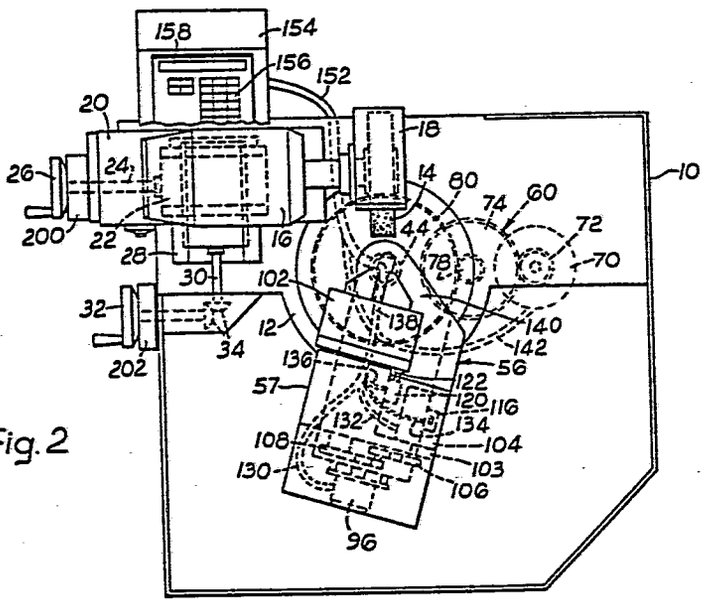
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Fig. 2

DRILL POINT GRINDING MACHINE

This invention concerns drill point grinding machines of the kind comprising a grinding wheel, a drill holder (such as a chuck or the like) to grip a drill to be ground and offer it by its tip towards the grinding wheel, rotary drive means for rotating the drill holder to turn the drill about its longitudinal axis, swivel drive means for swivelling the holder for the drill to swing, relative to the grinding wheel, about an axis at or adjacent the tip of the drill, and reciprocating drive means for displacing the holder to reciprocate the drill in the direction of its axis towards and away from the grinding wheel.

In order to provide for the proper grinding of a drill point, a drill point grinding machine must

include a drill holder such as a chuck or the like to grip the drill whose point is to be ground and a grinding wheel to which the chuck or the like offers the drill point, whilst subjecting it to three different types of movement. These movements are (1) rotation about the longitudinal axis of the drill; (2) swivelling about an axis at or adjacent the tip of the drill; and (3) axial reciprocation, that is to say forward and backward movement of the drill towards and away from the grinding wheel in a direction coinciding with the longitudinal axis of the drill. All three of these movements need to be correlated to one another according to the geometry of the drill point to be ground.

In the known forms of drill point grinding machine, the construction has usually been such that the rotational movement is performed by hand or power through suitable gearing, the other two movements being derived therefrom by mechanical components coupled to the gearing, for instance a crank or eccentric, connected to a housing in which a shaft of the chuck is journalled for rotation, to effect the swivelling movement, and a face cam, driven from the gearing and acting through a thrust bar, to achieve the reciprocation of the chuck.

It will be self-evident that the use of such a known form of machine require a high degree of expertise on the part of the user. The crank or eccentric will, of course, provide only one swivelling angle, and the face cam will provide only one amplitude of axial reciprocation, and whilst provision can be made on the known machines for variation of a median to each side of which the swivelling occurs and of the forward (or rearward) limit of the axial reciprocation, variation of the magnitude of the swivelling angle and the reciprocation amplitude can be achieved only by changing specific components of the machine, i.e. the crank or eccentric and/or the face cam. Thus, the versatility of the known machine is somewhat restricted. Moreover, its use for operations other than the simple grinding of the drill tip, (for example the grinding of the flutes, with or without relief thereon, the grinding of spiral-point drills, or the grinding of the cutting surfaces of the steps of pilot drills or multi-step drills) can be achieved usually only by very experienced operatives.

An object of this invention is to provide a construction of drill point griding machine wherein the

above discussed difficulties or shortcomings of the known drill point grinding machines are obviated and minimised, and which enables the trueing and/or grinding of a wide range of drills to be effected automatically by relatively unskilled personnel with the minimum of instruction and effort.

With this object in view the present invention provides a drill point grinding machine comprising a grinding wheel, a drill holder (such as a chuck or the like) to grip a drill to be ground and offer it by its tip, or by a shoulder thereon, towards the grinding wheel, rotary drive means for rotating the drill holder to turn the drill about its longitudinal axis, swivel drive means for swivelling the holder for the drill to be swung, relative to the grinding wheel, about an axis at or adjacent the tip of the drill, and reciprocating drive means for displacing the holder to reciprocate the drill in the direction of its axis towards and away from the grinding wheel, characterised in that each said drive means is independent of the other and comprises a respective stepping motor, the three stepping motors being coupled to programmable control equipment permitting selective setting of the speed of stepping rotation of the holder and, correlated there-

with, (a) the magnitude of the swivelling angle of the holder, and (b) the amplitude of reciprocation.

Conveniently the machine comprises a main supporting body in which is the stepping motor which constitutes the swivel drive means, the drill holder being carried upon a radial support mounted upon the upper end of a rotatable stub projecting upwards through a working top of the supporting body, the swivel drive means stepping motor being connected to the stub for turning the same.

The radial support preferably comprises a hollow arm enclosing a radially-extending spindle with which the stepping motor of the reciprocating drive means is connected, rotation of the spindle serving to displace the drill holder towards or away from the grinding wheel.

For monitoring the reciprocal movement of the tool holder, a microswitch is preferably provided to co-operate with an actuator to provide, to the control equipment, signals to enable correlation of the reciprocation with the rotational movement and swivelling movement to be achieved by the control equipment.

The stepping motor of the rotary drive means is conveniently carried by the radial support. The drill holder advantageously has a microswitch associated therewith to monitor its rotation and to provide, to the control equipment, respective signals to enable correlation of the rotational movement with the reciprocation and with the swivelling movement as already referred to.

The control equipment may advantageously be adapted to effect rotation of the stepping motor of the swivel drive means, independently of the other two drill grinding movements, to enable the initial angular position of the radial support to be set prior to effecting a drill grinding operational sequence.

For ensuring that leads for the stepping motors of the reciprocating drive means and of the rotary drive means do not have to be draped over the top of the main body of the machine, these leads are preferably taken to the control equipment from the radial support through the rotatable stub to the interior of the main body and thence to a control box of the control equipment motors.

The invention will be described further, by way of example, with reference to the accompanying drawings, the following description being illustrative, and not restrictive, of the scope of the invention. In the drawings:-

Fig. 1 is a perspective view illustrating a preferred embodiment of the drill point grinding machine of the invention;

Fig. 2 is a plan view of the machine of Fig. 1, this view serving to illustrate the positions of all of the principal components of the machine;

Fig. 3 is an enlarged part-sectional view illustrating detail of the mounting of the radial arm on the body, in the machine of Figs. 1 and 2, and showing also its drive means; and

Fig. 4 is an enlarged detached perspective view, to a slightly smaller scale than Fig. 3, illustrating the radial arm and the components carried thereby, but with the housing cover removed, of the machine of Figs. 1, 2 and 3.

Throughout the various figures, similar reference numerals have been allocated to similar parts.

The illustrated embodiment of the drill point grinding machine of the invention comprises a main body in the form of a hollow base structure 10 of relatively heavy construction and supporting a relatively heavy top 12 disposed at a suitable working level. To one side of this working top there is a grinding wheel 14 driven by its own electric motor 16 and provided, of course, with its own respective guard 18 and exhaust means (not visible) to suck away ground-off particles.

The motor 16 carrying the grinding wheel 14 is mounted upon a carriage 20 which can be traversed parallel to the axis of rotation of the grinding wheel 14 along a guide block, indicated diagrammatically at 22 in Fig. 2, by a traverse screw 24 which is rotatable manually by means of a traverse handwheel 26. In turn, the guide block 22 is displaceable for feed or withdrawal, in a direction perpendicular to the direction of traverse, along a guideway 28 by a feed and return screw 30 which is rotatable manually by means of a feed and return handwheel 32, by way of bevel gearing 34. A masking guard 36 for the screw 30 is shown in Fig. 1, but has been omitted from Fig. 2.

Cast into the working top 12 is an integral boss 40 which is counterbored to accommodate a top bearing 42 through which extends a hollow tubular stub 44 (Fig. 3)which is journalled in the top bearing 42 and in a bottom bearing 46 accommodated within a respective counterbore in a separate boss 48 bolted to the underside of top panel 50 of the base structure 10 with the interposition of a reinforcing spacer 52 secured in place by studs 54 engaging through the top panel 50 and into the boss 40.

Mounted on and extending substantially radially from the stub 44 is a hollow support arm, indicated generally by the reference numeral 56, which extends principally away from the grinding wheel 14 and, except where it connects with the stub 44, is substantially rectangular cross section.

Clamped against the underside of, and extending laterally from, the separate boss 48, within the base structure 10, is a gear carrier plate 58 to the underside of which is secured a gearbox, indicated generally by the reference numeral 60 and comprising plates 62 and 64 held apart by spacers 66 and in which are journalled a drive shaft 68 of a stepping motor 70

which constitutes a drive means for swinging the radial arm 56. A gear 72 on the shaft 68 engages a pinion 74 on a secondary shaft 76 of the gearbox 60, and a secondary gear 78 on the shaft 76 engages with a toothed segment 80 bolted to a flange 82 secured onto the bottom end of the stub 44 and keyed thereto by a key 84.

It will be appreciated that stepping movement of the motor 70 in one direction will turn the stub 44 in one direction and correspondingly swing the radial arm 56 in the same direction, and stepping of the said motor 70 in the other direction will turn the stub 44 in the other direction and correspondingly swing the radial arm 56 in the other direction. A zero mark or datum mark (not shown) is provided on the radial arm, and a scale (also not shown) is marked out on the working top 12 of the main body to co-operate therewith, primarily to provide an indication of the rest position of the radial arm 56 as will later be described.

Fig. 4 of the drawings illustrates detail of the radial arm 56, with a cover 57 thereof removed. As can be seen, the construction of the arm 56, radially outwardly from its end connected to the stub 44, is such as to provide substantially parallel sideplates 86, 88 between which is accommodated a drill holder carriage

90 engaged by a drive screw 92 which is coupled to output shaft 94 of second stepping motor 96 which is a second drive means of the machine and which serves to displace the drill holder carriage 90 forwards and backwards, that is to say in a radial direction towards and away from the stub 44.

Mounted in the drill holder carriage 90 is drive holder bearing structure 98 in which is journalled by bearings such as bearing 100, a shaft of a drill holder in the form of a chuck 102. A lateral bracket 103 projecting from the bearing structure 98 serves to support a third stepping motor 104 which constitutes third drive means of the machine. This motor 104 serves to drive the shaft of the chuck 102 by way of toothed belts 106, 108, intermediate gears 110, 112, and driven toothed wheel 114 mounted on the said shaft .

A first microswitch 116 mounted on the sideplate 86 is located to be engaged by an actuator in the form of a finger 118 on the housing of the motor 104 each time the latter, in concert with the bearing structure 98 and chuck 102, is moved forwardly towards the stub 44 and therefore the grinding wheel 14.

The first microswitch 116 effectively senses reciprocation of the chuck 102 to and fro along the radial direction of the arm 56. A second microswitch 120 which senses the actual rotation of the chuck 102 (as contrasted with the rotation of the third stepping motor 104, since there can in practice be some relative slippage therebetween) is provided on the bearing structure 98 to be engaged by a lobe 122 on the body of the chuck 102.

Leads 130 and 132 from the two stepping motors 96, 104, and leads 134 and 136 from the two microswitches 116 and 120 on the radial arm 56 extend within the interior of the arm 56 and merge together as a bundle 138 which approaches the stub 44 (see Fig. 3) closely beneath a top cover plate 140 of the arm 56. As can be seen from Fig. 3, the bundle of leads 138 extends into the top of the stub 44 and down the latter. From the stub 44, the leads emerge in the interior of the main body 10 of the machine where they are joined by respective leads 142 and 144 from the stepping motor 70 and from a microswitch 146 provided on a bracket 148 secured to the gearbox plate 64 and disposed to be actuated by a striker 150 secured to the underside of the toothed segment 80. As can be appreciated from

Fig. 2, the totality of these leads now extend as a single consolidated bundle 152 through an appropriate opening (not shown) in the main body 10 of the machine and enter a control box 154 forming part of programmable control equipment of the machine, this equipment including a keyboard 156, a small VDU screen 158, and a suitable EPROM (not visible) within the box 154.

Shown in Fig. 4 is a graduated setting blade 160 provided on the top of a post 162 carried upon an arm 164 which is mounted on the top cover plate 140 by a pivot 166 and is loaded by a spring 168 into the illustrated out-of-the-way position. By appropriately pivoting the arm 164 against the action of the spring 168, the blade 160 can be brought into an operative position registering with the tip of a drill (such as drill 170 indicated in Fig. 4) fitted into thuck 102 preparatory to regrinding the tip thereof. This arrangement permits the outstand (i.e. the amount by which the drill 170 projects from the chuck 102) of the drill 170 to be adjusted. These components have been omitted from Figs. 1 and 3 to facilitate appreciation of the content thereof.

The mode of operation of the machine will readily be understood from the foregoing description. When it

is desired to grind a drill 170 which requires sharpening or resharpening, the drill 170 is appropriately gripped in the chuck 102 with its tip projecting towards the grinding wheel 14, the outstand being adjusted according to the size and nature of the drill by means of the setting blade 160.

Upon appropriate actuation of the keyboard 156, the control equipment causes appropriate actuation of the stepping motors 70, 96 and 104. Initially, motor 70 operates to bring the radial arm 56 to an initial position with the axis of the drill 170 directed towards the grinding wheel 14 at an appropriate initial angle, according to the nature and size of the drill 170, the VDU screen 150 serving, if desired, to provide appropriate interrogative displays to prompt an operator to key in the necessary commands to activate the control to bring the arm 56 to the said initial position. Thereafter, by appropriate operation of the keyboard 156, again if desired in response to interrogative displays on the VDU, the machine is caused to operate, that is to say (1) the chuck 102 is driven in its appropriate direction (i.e. left handedly for a left hand drill and right handedly for a right hand drill) and at an appropriate stepped speed according to the

number of flutes or the like on the drill 170 by the stepping motor 104; (2) the drill 170 is caused to reciprocate forwards and rearwards towards and away from the grinding wheel 14 by the respective stepping motor 90; and (3) the angle at which the drill tip is offered to the grinding wheel 14 is varied cyclically by appropriate stepwise swinging of the radial arm 56 by the respective stepping motor 70.

It will also readily be understood that by use of appropriate components in the control equipment, the machine of the invention may be set up to grind automatically a very wide range of drills of different kinds and shapes, at least some of which were not capable of being ground at all using the prior known machines of the kind referred to at the introduction hereto. Examples of various kinds of drills which can be ground automatically as aforesaid are: core drills, drills with split points, drills with multiple point angles, quick spiral drills, slow spiral drills, flat angle drills, lipped drills, slot drills, drills with sheet metal points, countersink drills, carbide drills, centre drills, taps, prismatic point drills, multi-step drills, pilot drills and subland drills. In shouldered drills, such as centre drills, multi-step drills, pilot drills and subland drills, the machine can,

of course, be set up to grind the drill at the shoulder in addition to grinding the tip thereof.

CLAIMS

1. A drill point grinding machine comprising a grinding wheel, a drill holder to grip a drill to be ground and offer it by its tip, or by a shoulder thereon, towards the grinding wheel, a rotary drive means for rotating the drill holder to turn the drill about its longitudinal axis, swivel drive means for swivelling the holder for the drill to be swung, relative to the grinding wheel, about an axis at or adjacent the tip of the drill, and reciprocating drive means for displacing the holder to reciprocate the drill in the direction of its axis towards and away from the grinding wheel, characterised in that each said drive means is independent of the other and comprises a respective stepping motor, the three stepping motors being coupled to programmable control equipment permitting selective setting of the speed of stepping rotation of the holder and, correlated therewith, (a) the magnitude of the swivelling angle of the holder, and (b) the amplitude of reciprocation.

2. A machine according to claim 1 characterised in that it comprises a main supporting body in which is the stepping motor which constitutes the swivel drive means, the drill holder being carried upon a radial

support mounted upon the upper end of a rotatable stub projecting upwards through a working top of the supporting body, the swivel drive means stepping motor being connected to the stub for turning the same.

3. A machine according to claim 2 characterised in that the radial support comprises a radially-extending spindle with which the stepping motor of the reciprocating drive means is connected, rotation of the spindle serving to displace the drill holder towards or away from the grinding wheel.

4. A machine according to claim 1, 2 or 3 characterised by the provision, for monitoring the reciprocal movement of the tool holder, of a microswitch which co-operates with an actuator to provide, to the control equipment, signals to enable correlation of the reciprocation with the rotational movement and swivelling movement to be achieved by the control equipment.

5. A machine according to any of claims 1 to 4 characterised in that the stepping motor of the rotary drive means is carried by the radial support and the drill holder has a respective microswitch associated therewith to monitor its rotation and to provide, to the control

equipment, respective signals to enable correlation of the rotational movement with the reciprocation and the swivelling movement.

6. A machine according to any of claims 1 to 5 characterised in that the control equipment is adapted to effect rotation of the stepping motor of the swivel drive means, independently of the other two movements, to enable the initial angular position of the radial support to be set prior to effecting a drill grinding operational sequence.

7. A machine according to any of claims 1 to 6 characterised in that leads for the stepping motors of the reciprocating drive means and of the rotary drive means are taken to the control equipment from the radial support through a rotatable stub to the interior of the main body and thence to a control box of the control equipment.

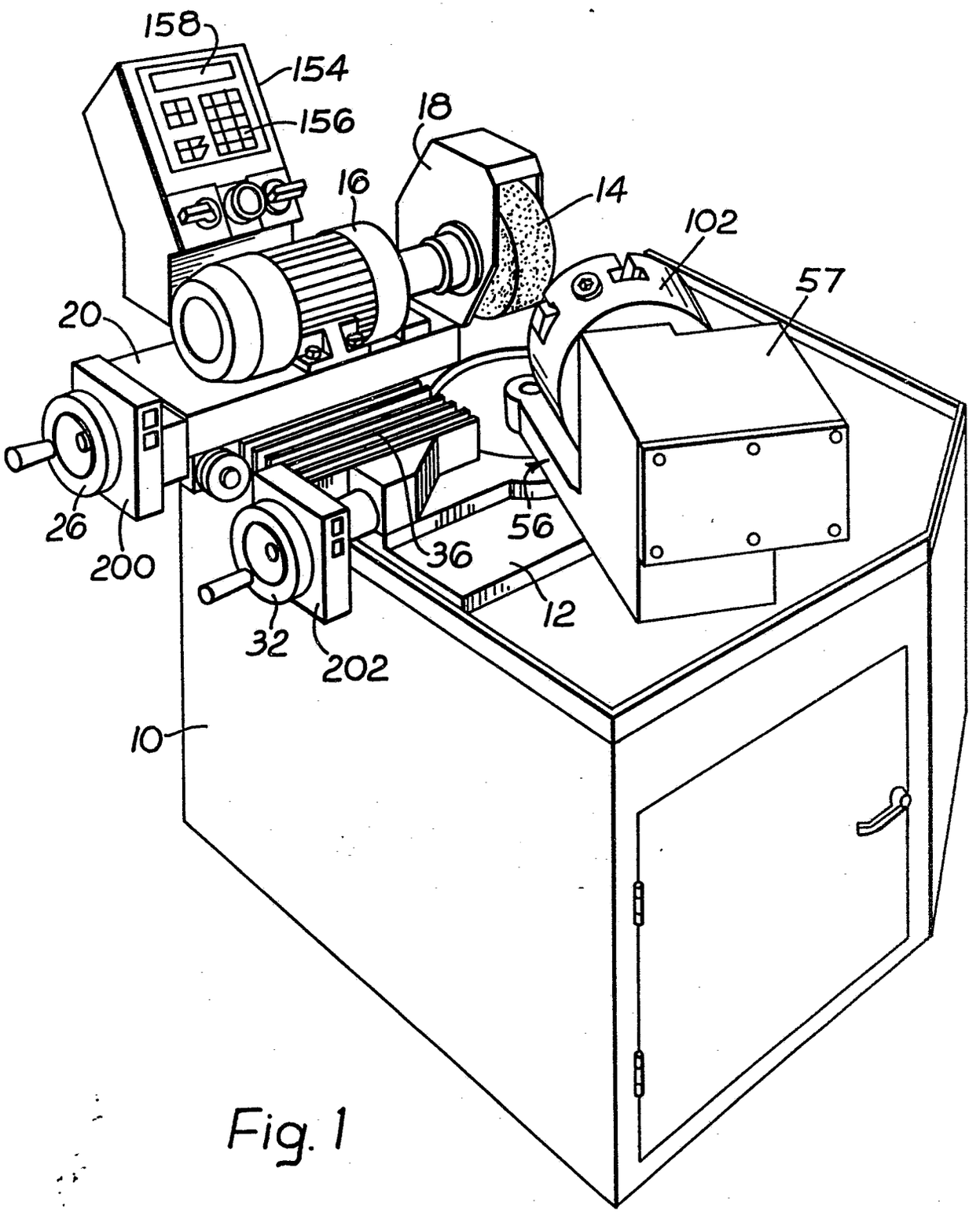

Fig. 1

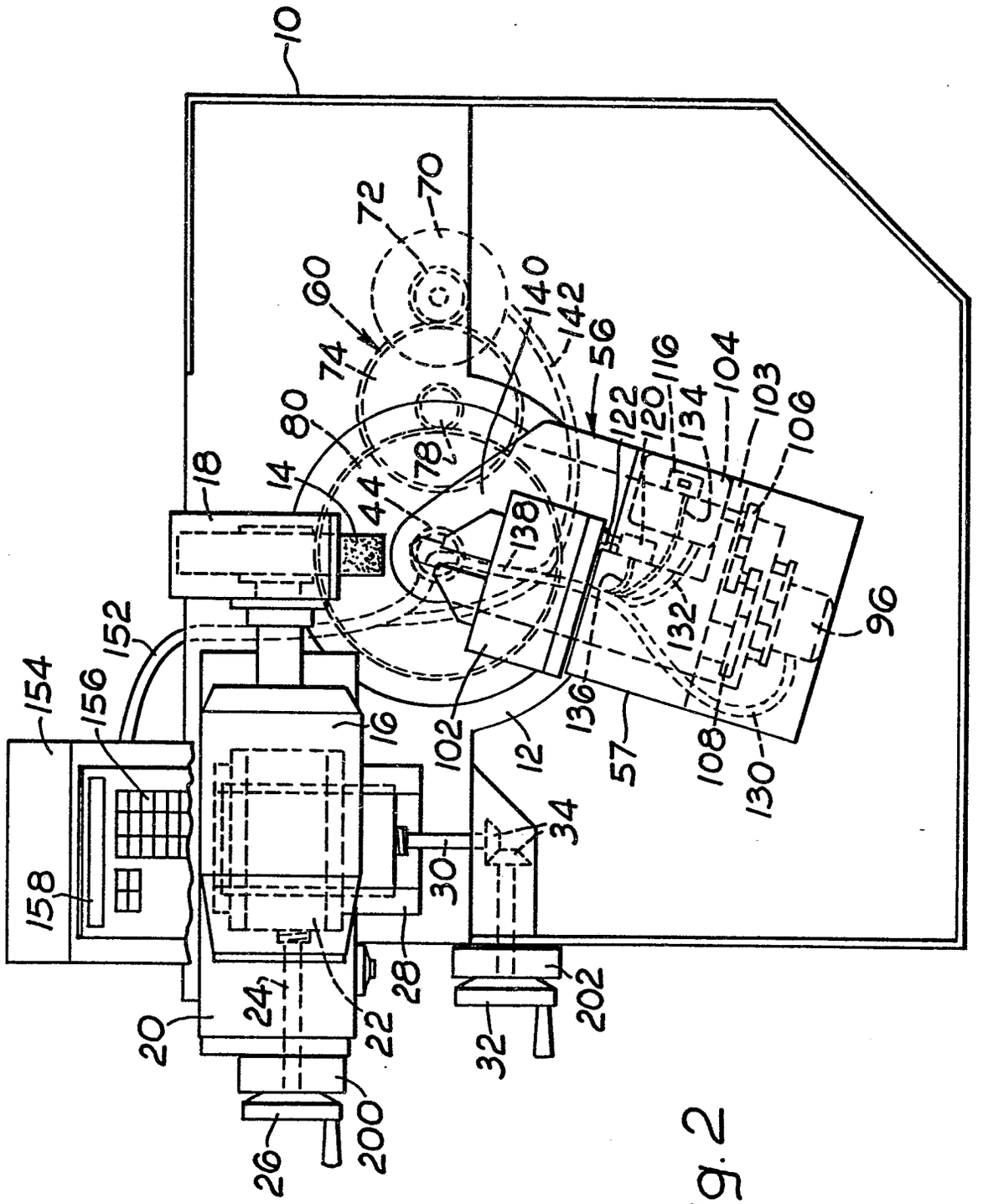
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Fig. 2

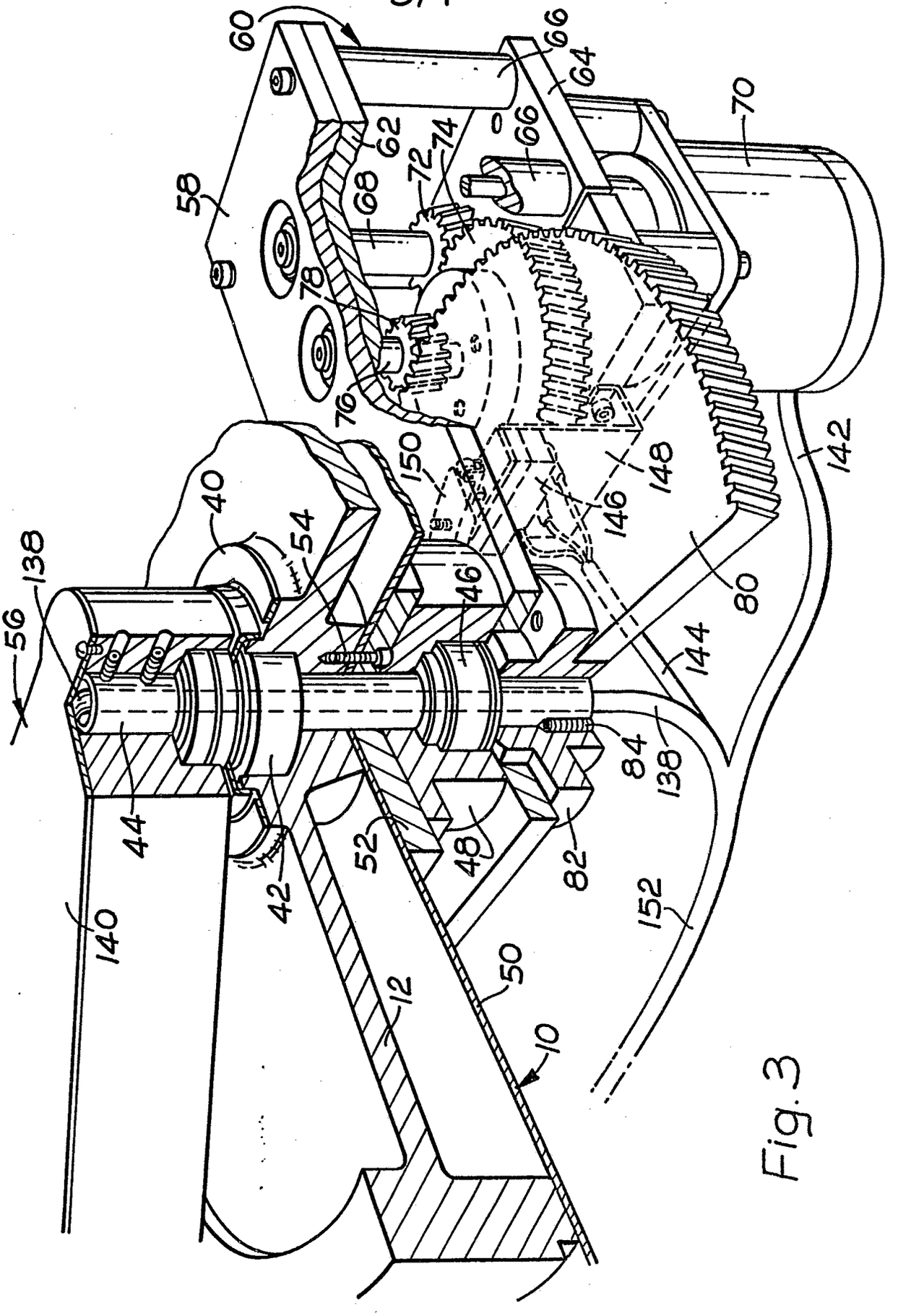
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Fig. 3

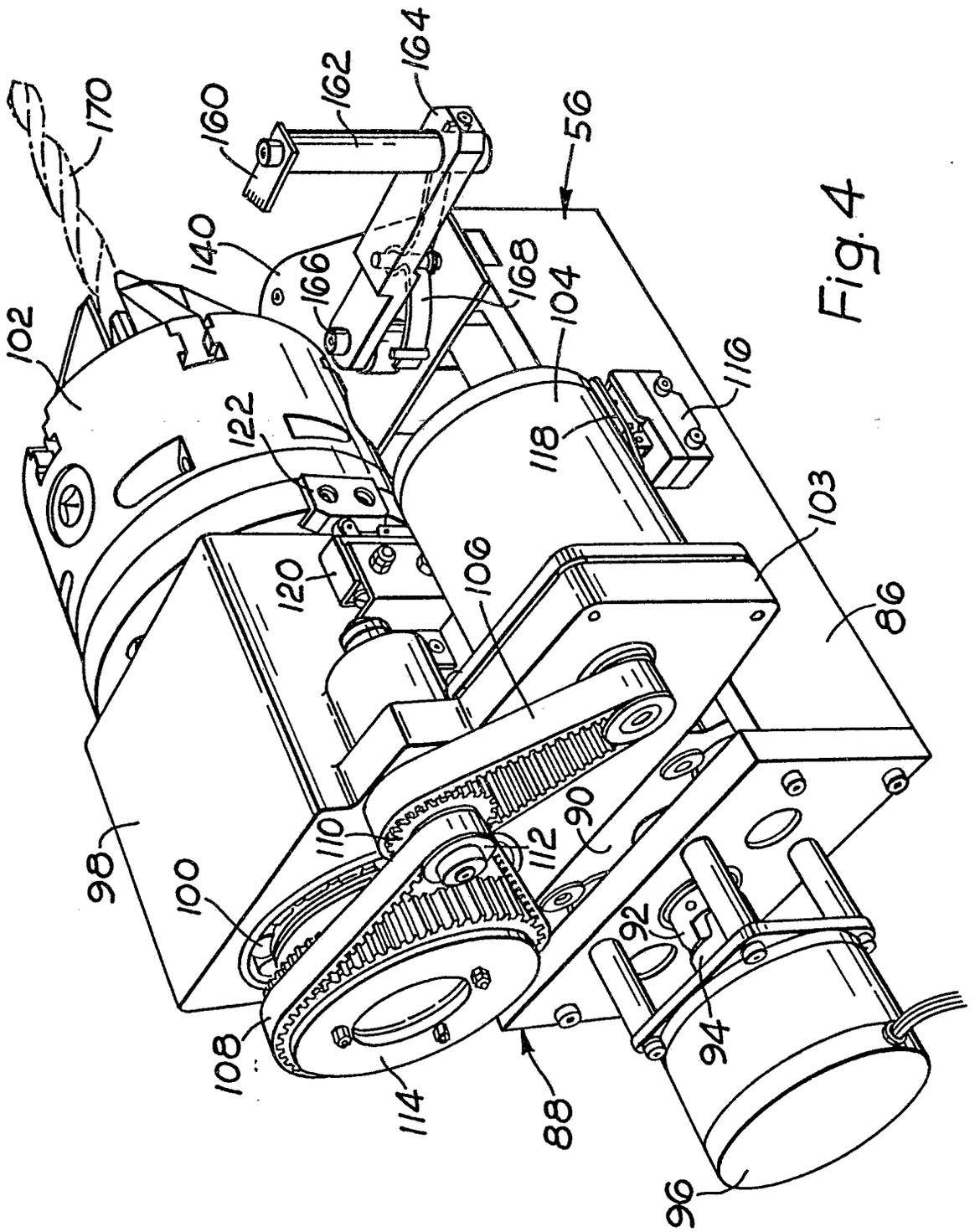
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Fig. 4