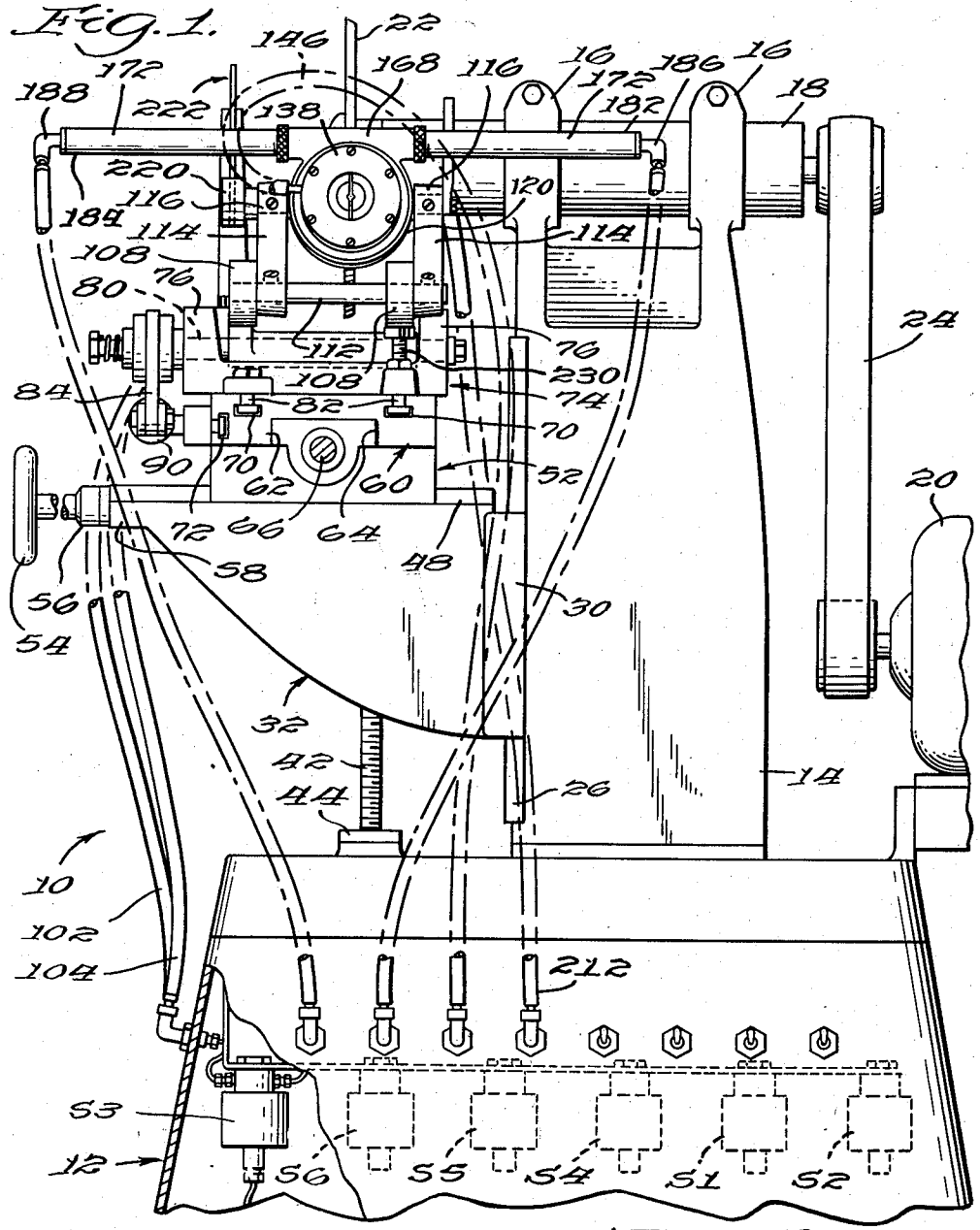
Jan. 27, 1959 H. S. SIEMSEN ET AL 2,870,579

AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

Filed Feb. 28, 1955 6 Sheets-Sheet 1

Fig. 1.



Inventors:
Henry S. Siemsen
and Kenneth E. Foote.
BY Robert C. Comstock
Atty.

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AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

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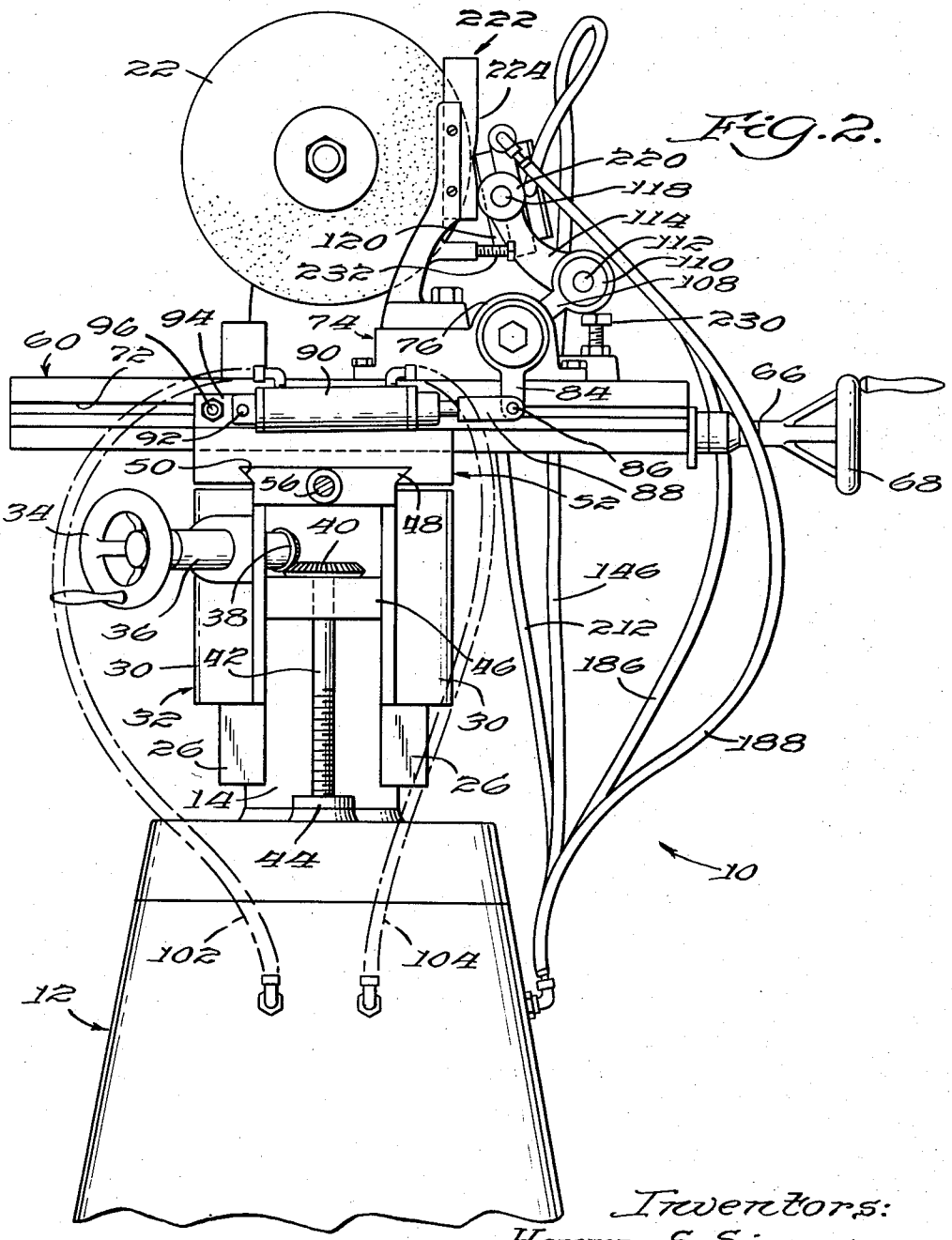


FIG. 2.

Inventors:
Henry S. Siemsen
and Kenneth E. Foote.
BY Robt C. Comstock
Atty's.

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AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

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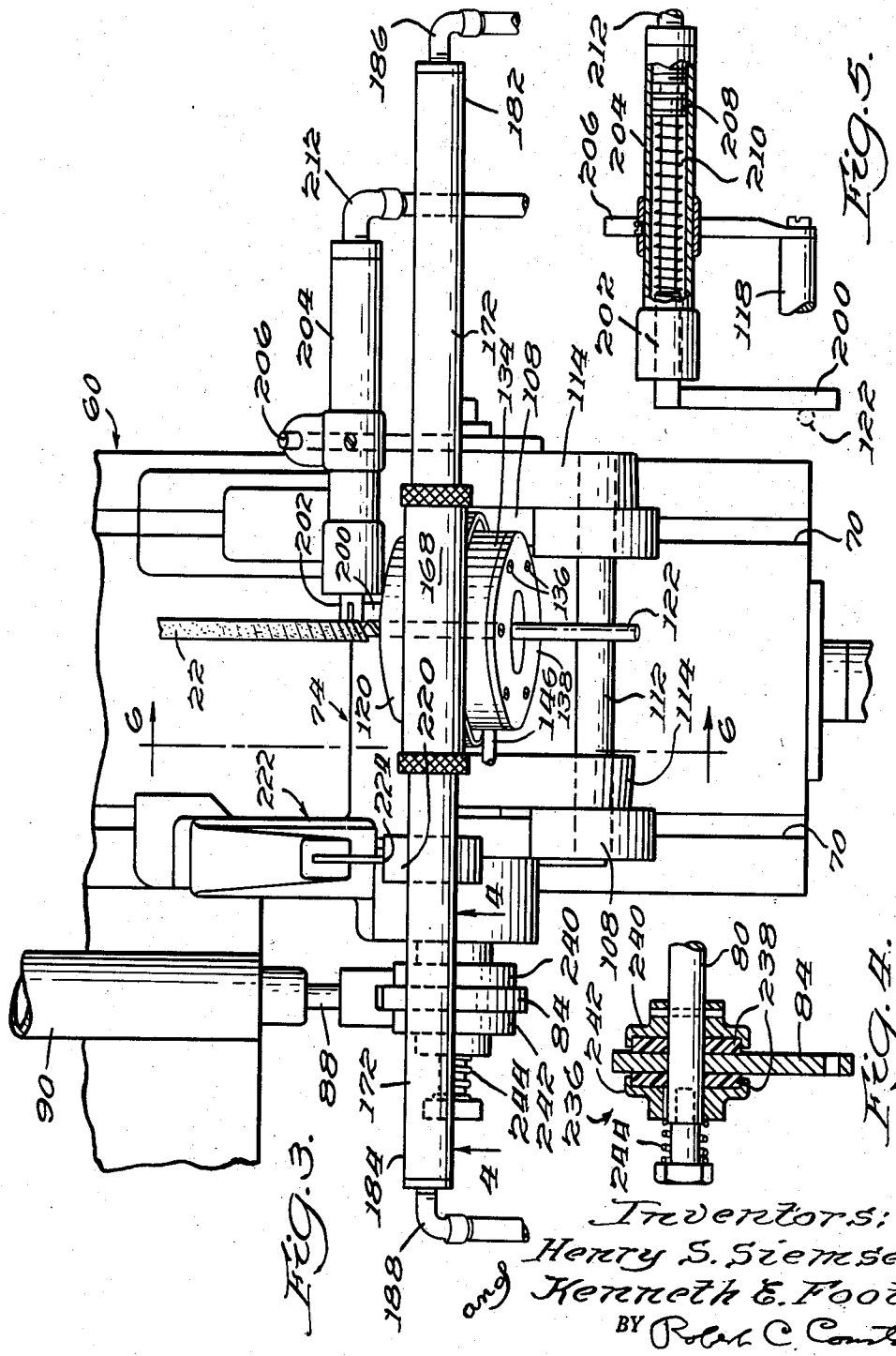


Fig. 3.

Fig. 5.

Fig. 4.

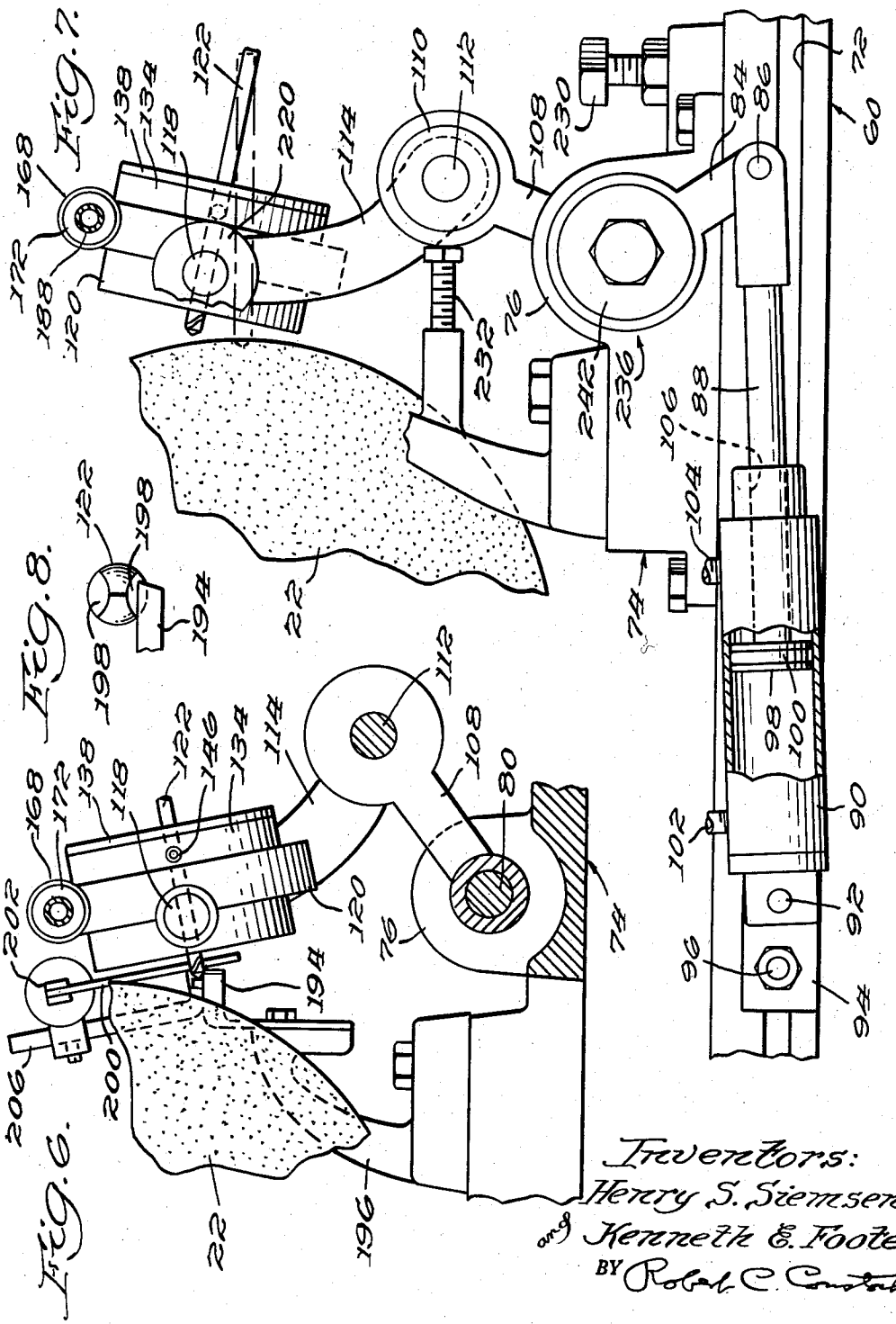
Inventors:
Henry S. Siemsen
and Kenneth E. Foote.
BY Robt C. Comtock
Atty

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AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

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AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

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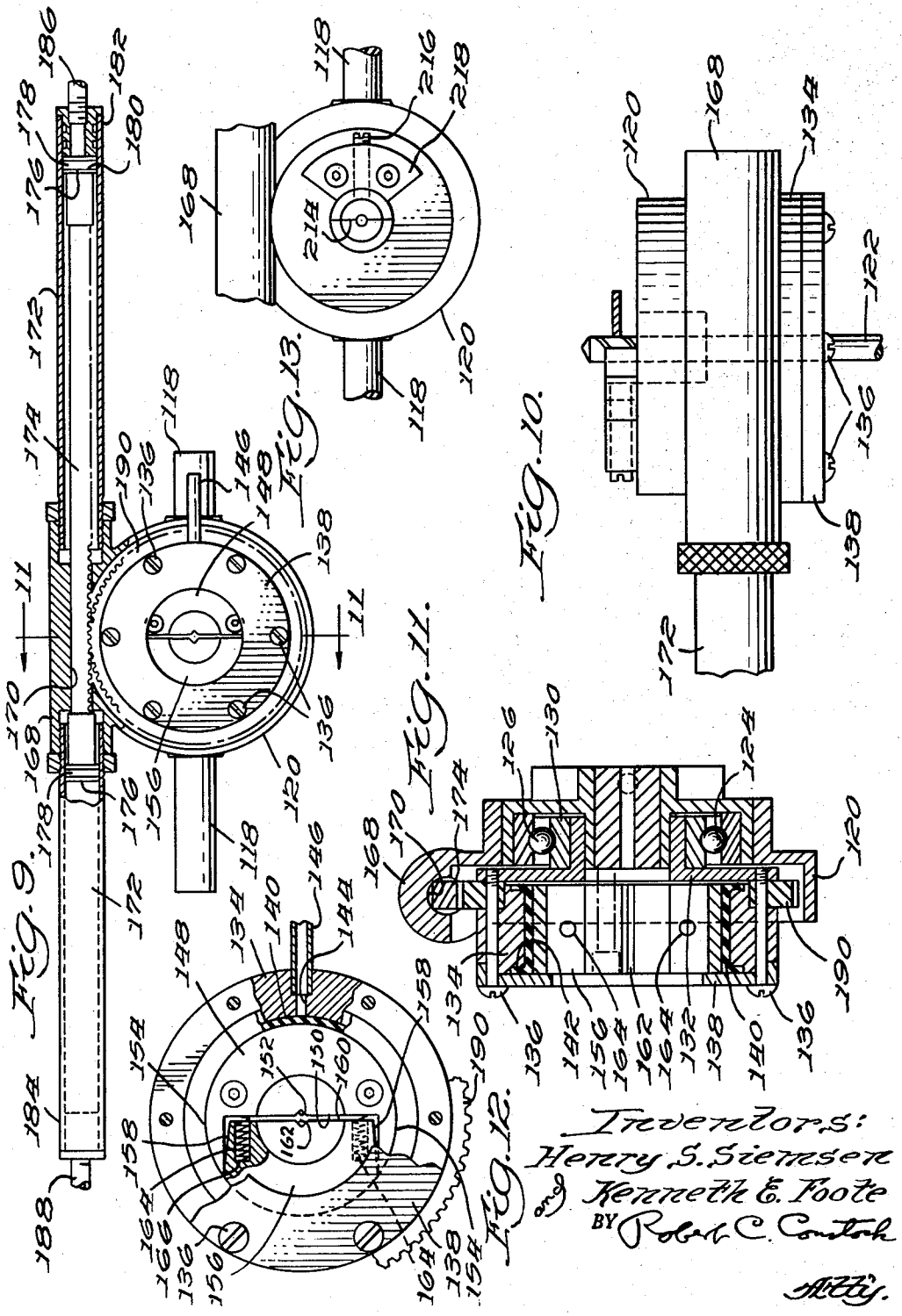


Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

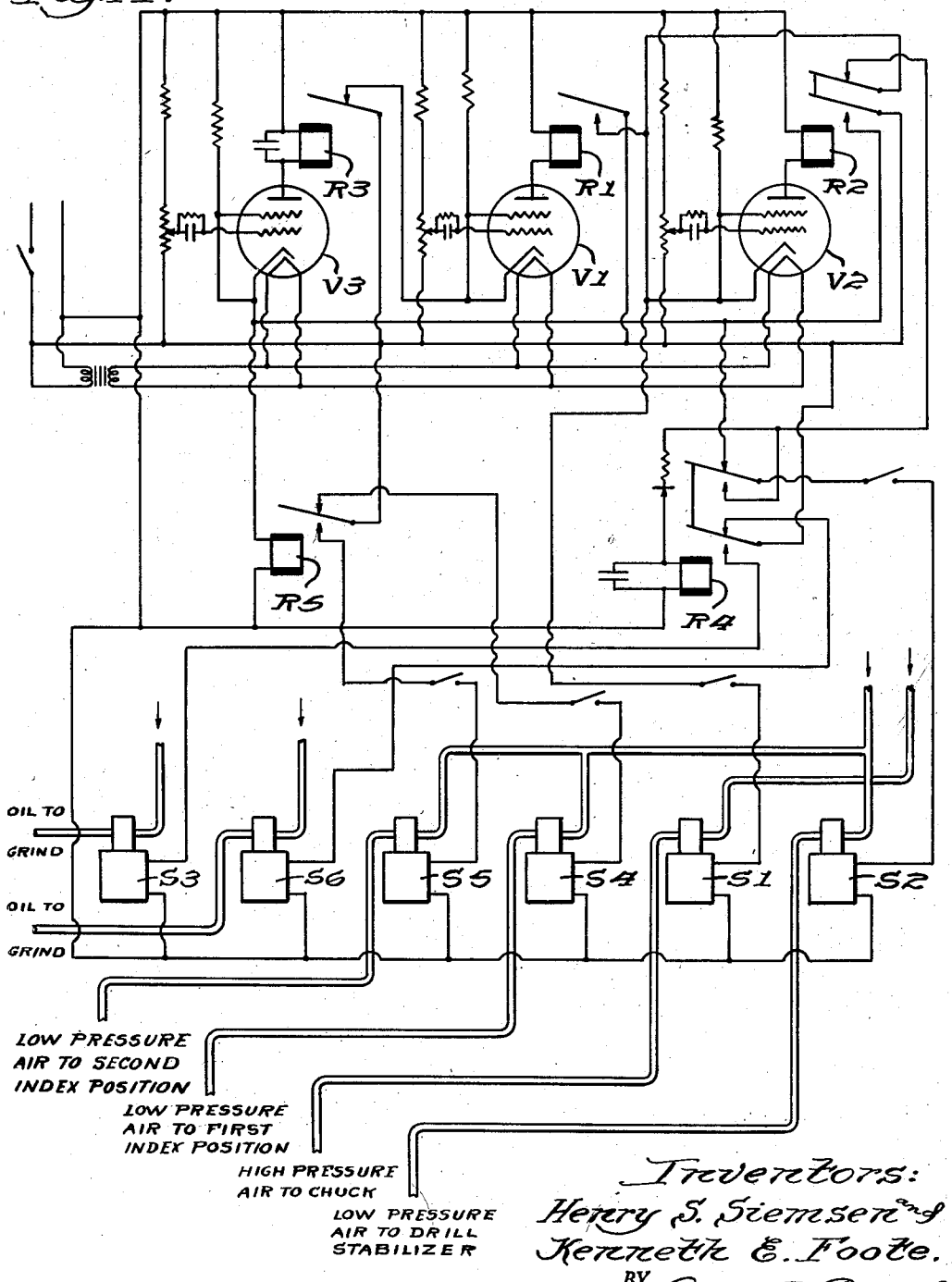
Inventors:
Henry S. Siemsen
and Kenneth E. Foote
BY Robert C. Comstock
Atty.

Jan. 27, 1959 H. S. SIEMSEN ET AL 2,870,579

AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

Filed Feb. 28, 1955 6 Sheets-Sheet 6

FIG. 14.



Inventors:
Henry S. Siemsen and
Kenneth E. Foote.
BY Robert C. Comstock
Atty.

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AUTOMATIC GRINDING MACHINE FOR SPIRAL DRILLS

Henry S. Siemsen and Kenneth E. Foote,
Los Angeles, Calif.

Application February 28, 1955, Serial No. 490,772

8 Claims. (Cl. 51—94)

This invention relates to an automatic grinding machine for the points of spiral drills. This invention relates to similar subject matter and is an improvement upon the invention set forth in our co-pending application, Serial No. 367,517, filed July 13, 1953, now Patent No. 2,815,610, dated December 10, 1957.

A large number of spiral drills are used in various manufacturing industries. These drills become dull through use, requiring that their points be sharpened. In the past, this sharpening has been done by hand, requiring the services and skill of a trained operator. It is an object of our invention to provide a machine which will automatically perform this sharpening operation and produce results equal to or better than those obtained by manual grinding. Our machine can be operated by an unskilled person with substantially no training whatsoever, since the operation of the machine is entirely automatic except for insertion and removal of the drills. The result is that an unskilled person can sharpen more drills with our device than a skilled operator by manual operation, and each drill is sharpened uniformly and perfectly, eliminating all human error, inefficiency and inaccuracy.

It is more particularly an object of our invention to provide such a device in which the method of grinding simulates that used in manual grinding, namely moving the drill vertically past the grinding wheel. With our device, the drill is held and moved toward the grinding wheel. The drill is moved vertically to grind one side and is then rotated 180° and moved vertically to grind the other side. The time required for grinding each drill is reduced to substantially a minimum, while the grinding operation itself duplicates that of a skilled manual operator.

It is among the further objects of our invention to provide such a device in which the grinding of the drill, its rotational orientation, its positioning, the movement of the drill to, from and through the grinding operation and the release of the drill are all efficiently and automatically accomplished.

It is also among the objects of our invention to provide an improved means for grinding, improved means for holding, positioning, and release of the drill and to provide numerous other advantages of construction and operation. Because of the complex nature of our device, further aims and objects of the invention will be more fully understood by reference to the accompanying drawings and detailed explanation of our invention. Our invention accordingly comprises such other objects, advantages and capabilities as will later more fully appear and which are inherently possessed by our invention.

While we have shown on the accompanying drawings a preferred embodiment of our invention, it should be understood that the same is susceptible of modification and change without departing from the spirit of our invention.

Referring to the drawings,

Fig. 1 is a front elevational view of our device, with the bottom of the base being cut off;

Fig. 2 is a side elevational view of the same, taken on the left side of Fig. 1;

Fig. 3 is a fragmentary top plan view of the grinding mechanism;

Fig. 4 is a vertical sectional view of the clutch taken on line 4—4 of Fig. 3;

Fig. 5 is a detailed elevational view partly in section of the drill stabilizer;

Fig. 6 is a fragmentary sectional view taken on line 6—6 of Fig. 3;

Fig. 7 is a fragmentary side elevational view of the chuck;

Fig. 8 is a front elevational view of the drill point and drill locator;

Fig. 9 is a front elevational view partly in section of the chuck and two cylinders;

Fig. 10 is a fragmentary plan view of the chuck;

Fig. 11 is a vertical sectional view of the chuck taken on line 11—11 of Fig. 9;

Fig. 12 is an enlarged front view of the chuck shown partly in section;

Fig. 13 is a rear elevational view of the chuck;

Fig. 14 is a schematic diagram of the electronic and solenoid controls.

A preferred embodiment which has been selected to illustrate my invention comprises a grinding machine **10** having a base **12** within which there are mounted various control means as will be more fully described later. Upon this base **12** there is located a vertical support **14** to the top of which there are secured bearings **16** which carry a shaft **18** which conveys power from a motor **20** to a grinding wheel or disc **22**. Belt means **24** are used to connect the shaft **18** with the motor **20**. The motor **20** is attached to the base **12**.

Upon the vertical support **14** there are mounted guide rails **26** which are engaged by complementary shaped guides **30** formed upon a table **32** in such a manner that table **32** may be moved vertically with respect to the vertical support **14** when a hand wheel **34** is turned so as to rotate a shaft **36** and an attached beveled gear **38**. The beveled gear **38** is positioned so as to co-act with another beveled gear **40** mounted upon the top of a threaded shaft **42** projecting upwardly from the base **12** through a conventional threaded bearing **44**. The bottom of the beveled gear **40** is supported upon an appropriate conventional cross brace **46** forming a part of the table **32**.

Upon the table **32** there are mounted guide rails **48** which are engaged by complementary shaped guides **50** formed upon a first carriage **52** so that the first carriage **52** may be moved with respect to the table **32** in a direction at a right angle to the direction of movement of table **32**. The actual movement of the first carriage **52** may be carried out through rotation of a hand wheel **54** which is attached to a threaded shaft **56** located within bearings **58** formed upon the table **32**. The shaft **56** is in engagement with an appropriate threaded member (not shown) secured between the first carriage **52** and the table **32**.

Upon the first carriage **52** there is mounted a second carriage **60** through the use of guide means **62** similar to the guide rails **26** and **48** previously described. These guide means **62** are engaged by complementary shaped guides **64** formed upon the second carriage **60** so that as a threaded shaft **66** is turned through the use of a hand wheel **68**, the threaded shaft **66** moves with respect to an appropriate threaded member (not shown) mounted upon the first carriage **52** so that the position of the second carriage **60** is adjusted in any desired manner.

It will be realized from the foregoing description that

the second carriage 60 moves in a direction at right angles to the direction of travel of both the table 32 and the first carriage 52. It will be further realized that the precise means by which the table 32 and the first and second carriage 52 and 60 are mounted are of a substantially conventional nature known to the art and are similar to the guide means or ways used on any lathe or milling machine. The purpose of the table 32 and the first and second carriage 52 and 60 is to provide a means whereby the position of the other mechanically operative parts hereinafter described may be readily adjusted with respect to the grinding disc 22 so as to obtain operation of the complete machine 10 with any size drill, and with any size grinding disc.

Upon the top surface of the second carriage 60 there are located two parallel inverted T-shaped slots 70 such as are manufactured by cutting with a Woodruff key cutter. On one side of the second carriage 60 there is located a third slot 72 of the same category, the third slot 72 being parallel to the slots 70.

Upon the second carriage 60 there is secured a bearing support 74 having upstanding ends 76, within which there are mounted bearings which carry a first shaft 80 in such a manner that this shaft 80 may be rotated during the operation of the machine 10. Bolts 82 engaging the slots 70 are employed in the location of the bearing support 74. Adjacent to the slot 72 a lever arm 84 is connected to an extremity of the shaft 80. This lever arm 84 is in turn connected through the use of a pivot pin 86 to a connecting rod 88 which projects from a hydraulic cylinder 90, the extremity of which remote from the pivot pin 86 is attached to the second carriage 60 through the use of another pivot pin 92 secured to a mounting bracket 94. This mounting bracket 94 is in turn secured to the slot 72 through the use of bolts 96.

Within the hydraulic cylinder 90 there is located a piston 98 having a conventional elastomeric O-ring seal 100 serving to seal the piston within the hydraulic cylinder 90 so as to divide the cylinder into two parts, which are connected by hydraulic lines 102 and 104 to solenoid valves S–3 and S–6, which are in turn connected to a suitable source of hydraulic pressure fluid, which is preferably oil. Thus, as hydraulic fluid is introduced into the hydraulic cylinder 90 through either of the hydraulic lines 102 and 104, the piston 98 is moved within the hydraulic cylinder 90, causing the connecting rod 88 to move out from the cylinder through an end opening 106. This movement of the connecting rod 88 is transmitted through the lever arm 84 to the shaft 80, causing shaft 80 to rotate within the bearings of bearing support 74.

The motion of the shaft 80 is in turn transmitted through parallel radial arms 108 attached to the shaft to cause the radial arms 108 to move with respect to the second carriage 60. Bearing means 110 are aligned within the ends of the radial arms 108 in order that a movable shaft 112 may be carried by the arms 108. The movable shaft 112 is thus mounted parallel to the shaft 80 in such a manner that it may be rotated about the shaft 80 during the operation of the machine 10. Rigidly secured to the movable shaft 112 are trunnion arms 114 to the ends of which remote from the movable shaft 112 are attached appropriate trunnions 116. These trunnions 116 carry shafts 118 projecting from the opposite sides of a cylindrical housing 120 forming a part of chuck means hereinafter described, which hold a drill 122 in an operative position during the use of the machine 10.

The cylindrical housing 120 is formed so as to include a bearing groove 124 located internally thereon. This bearing groove is designed to form one part of a bearing race for a plurality of ball bearings 126. The other part of the race is constituted by a similarly constructed groove 128 formed in a cylindrical flange 130 attached to an annular plate 132, which is in turn secured to a cylindrical member 134 on one side thereof through the use of bolts 136. The same bolts 136 are employed to secure

a second plate 138 to the other side of the cylindrical member 134 in such a manner that a generally cylindrical flexible diaphragm 140 formed out of an appropriate elastomeric material, such as rubber, neoprene or the like, is held with its edges positioned in recesses 142 located on the surface of the cylindrical member 134 adjacent to the plates 132 and 138. The diaphragm 140 is firmly held in this position so that escape of the fluid introduced between this diaphragm 140 and the cylindrical member 134 through a passage 144 formed in a wall of the cylindrical member 134 is impossible. This passage 144 is connected through a hose 146 to a solenoid valve S–1, which is in turn connected to a suitable source of hydraulic or pneumatic pressure fluid, which is preferably high pressure air.

With this arrangement the hydraulic or pneumatic fluid may be introduced between the diaphragm 140 and the cylindrical member 134 in order to expand the diaphragm 140 inwardly toward the center of the cylindrical member 134 in order to actuate movable jaw means located within the cylindrical member 134. The movable jaw means comprises a first jaw 148 having a flat surface 150, within which there is formed a groove 152. This groove 152 is located generally parallel to the axis of the cylindrical member 134 and the cylindrical housing 120 immediately adjacent to this axis, and is intended to engage one side of the drill 122. Between generally parallel ends 154 formed upon the first jaw 148 is located a second jaw 156 having the shape of base illustrated in Fig. 12 of the drawings. The second jaw 156 has sloping sides 158 so that during movement of the jaws 148 and 156 there is substantially no danger of binding between the two jaws. The second jaw 156 also includes a flat surface 160 which is located parallel to the flat surface 150. This flat surface 160 includes a groove 162 corresponding generally to the groove 152 and serving the same purpose.

Coil springs 164 held within cavities 166 in the second jaw 156 bear against the first jaw 148, normally forcing the two jaws 148 and 156 away from one another. Thus, the two jaws are forced away from one another against the diaphragm 140 so as to force fluid out of the space between the diaphragm 140 and cylindrical member 134 when insufficient pressure to overcome the pressure of the springs 164 is supplied through the hose 146.

Secured to the cylindrical housing 120 is a supporting member 168 having formed therein an elongated passage 170 which is open at its ends. To each of the ends of the passage 170 there are attached aligned cylinders 172 so that a rack 174 may be reciprocated between these two cylinders as pressure is applied to pistons 176 located within the cylinders 172 and attached to the ends of the rack 174. Appropriate O-ring sealing means 178 are located within grooves 180 on the pistons 176. Thus, hydraulic fluid or air, preferably low pressure air, may be introduced into the ends 182 and 184 of the cylinders 172 remote from the housing 120 through hoses 186 and 188 so as to move the pistons 176 and the attached rack 174 with respect to the cylindrical housing 120. The hoses 186 and 188 are attached to solenoid valves S–4 and S–5, which control the flow of hydraulic fluid thereto from a suitable source of pressure supply.

The motion of the rack 174 is transmitted through a pinion gear 190 to the cylindrical member 134 attached to the pinion gear 190 through the use of the bolts 136 previously described. Thus during the operation of the machine 10 the pistons 176 may be moved, causing movement of the rack 174 and rotation of the cylindrical member 134 and the other parts secured thereto. This construction represents a very efficient chuck means which is useful during the operation of the grinding machine 10.

A drill locator 194 is mounted upon a bracket 196 which is secured to the second carriage 60. The purpose of the drill locator 194 is to orient the drill rota-

tionally so that the grinding operation is performed upon the proper surfaces thereof. The drill **122** is provided with one or more grooves **198**. When the drill is inserted, it is rotated in a clock-wise direction by the operator of the machine until one of the grooves **198** contacts the drill locator as shown in Fig. 8 of the drawings. The drill **122** is then properly oriented.

A drill stabilizer **200** is provided to prevent undesired vibration or movement of the point of the drill during the grinding operation. The drill stabilizer **200** projects at a right angle from the shaft **202** of a cylinder **204**. The cylinder **204** is mounted upon a bracket **206** which is attached to the second carriage **60**, and includes a piston **208** which is attached to the shaft **202** within the cylinder **204**. The piston **208** is normally held by a coil spring **210** so that the shaft **202** is withdrawn into the cylinder **204**.

A hose **212** is connected at one end to the end of the cylinder **204** remote from the drill stabilizer **200** and at its opposite end to a solenoid S–**2**, which is in turn connected to a suitable source of hydraulic pressure fluid, which is preferably low pressure air. The drill stabilizer **200** is brought into operation by hydraulic fluid being introduced into the cylinder **204** through the hose **212**, forcing the piston **208** against the pressure of the coil spring **210** to move the shaft **202** a sufficient amount to hold the drill stabilizer **200** against the drill **122**.

The side of the drill **122** opposite from the drill stabilizer **200** bears against an arcuate shaped support **214**, the positioning of which is determined by a set screw **216**. A mounting bracket **218** for the support **214** is attached to the cylindrical housing **120**.

In order to guide the movement of the drill during the grinding operation, a guide means **222** is provided (Fig. 2), which is mounted with the use of bolts upon an appropriate bracket which is attached to the second carriage **60**. The guide means **222** is provided with an arcuate cam surface **224** which corresponds to the surface which it is desired to place upon the point of the drill **122**. A small wheel **220** is rotatably mounted on one of the shafts **118** and rotatably bears against the cam surface **224**.

In operation, the wheel **220** travels up and down the cam surface **224** as the trunnion arms **114** move the trunnions **116**. This results in an arcuate point being ground on the drill **122**, which point is substantially identical with the point which would be ground by a skilled manual operator.

A pair of adjustable bolts **230** and **232** are mounted upon the second carriage **60** to act as stop means to limit the movement of the radial arms **108**. This might result in damage if means were not provided to compensate for unnecessary movement of the piston **98** within the hydraulic cylinder **90**. Such means are also a safety precaution in case something should become caught in the machine **10**. Such means preferably comprise a friction clutch **236** as shown in Fig. 4 of the drawings. The clutch **236** is used to attach the lever arm **84** to the shaft **80** and comprises two rubber discs **238** which surround the shaft **80** on both sides of the lever arm **84**. One of the discs **238** is held within a cup-shaped member **240** which is rigidly secured to the shaft **80**. The other disc **238** is held in a similarly shaped member **242**, which is merely positioned around the shaft **80** so as to be forced against the lever arm **84** and the cup-shaped member **240** through the use of a coil spring **244**, which is secured under tension to the shaft **80** by means of a bolt attached to the end of the shaft **80**.

The operation of the machine **10** is controlled by six solenoid valves S–**1** through S–**6**, which are mounted in the base **12** as shown in Fig. 1 of the drawings. The solenoid valves are of conventional manufacture and are preferably of the type manufactured by Automatic Switch Co., Orange, New Jersey, and identified by them as Bulletin 8314, Three-Way Valves. The solenoid valves are connected to the hoses set forth above and to suitable sources of hydraulic pressure fluid. The movement of the fluid through the hoses is controlled by the operation of the solenoids and by the resilient means bearing against the pistons. The hydraulic fluid used may be oil, high pressure air or low pressure air, and the term hydraulic as used in the specification and claims includes all types of hydraulic and pneumatic fluids. The operation of the solenoid valves is controlled by electronic circuits.

Referring to Fig. 14 of the drawings, the electronic control system comprises three R-C timing circuits which control the operation of the solenoids through the opening and closing of relay contacts which control the electrical circuits to the solenoids.

It will be noted that each of the three tubes has its cathode either open or connected to the ground side of the circuit. When the cathode is open, the cathode and control grid act as a diode, causing some current to flow through the resistor and condenser which are connected in parallel in the control grid circuit of each tube. This current flow causes a negative charge to accumulate on the control grid side of the condenser, biasing the tube past cut-off. When the cathode is connected to ground, current will not flow through the plate circuit until the charge on the condenser passes off through the resistors which are in series and parallel with it.

A cycle of operation begins with the insertion of a drill **122** into the grooves **152** and **162** of the chuck. The drill is rotated until its groove **198** contacts the drill locator **194** to properly orient the drill. The movable jaw means are then automatically closed to grip the drill **122** firmly between the jaws **148** and **156**. This movement starts the cycle and is caused by the flowing of current through tube V–**1**, which current flow occurs when the cathode is connected to ground through the normally closed contact of relay R–**3** and the condenser in its control grid circuit as discharged through its associated resistors. When current flows through tube V–**1**, it operates relay R–**1** to close its normally open contact.

The closing of this contact of relay R–**1** acts to connect the cathode of the second tube V–**2** to ground, so that this tube will start to conduct as soon as the condenser in its control grid circuit is discharged through its associated resistors. The closing of this contact also closes a circuit to operate solenoid S–**1**, causing high pressure air to move through the hose **146** and passage **144** to exert pressure on the diaphragm **140** and move the jaws **148** and **156** of the chuck on the drill which has been inserted therein. The closing of this contact also closes a circuit through the normally closed contact of relay R–**2** to operate the grind relay R–**4**. The coil of the grind relay R–**4** has a condenser in parallel with it which acts as a time delay to delay the closing of the relay contacts and thus delay the drill stabilizer and grinding movements of the machine until after the chuck has been closed.

The closing of the normally open contacts of the grind relay R–**4** after this time delay results in the operation of solenoid S–**2** to cause high pressure air to move into the cylinder **204** through the hose **212**, forcing the piston **208** to move the drill stabilizer **200** against the drill **122**. At the same time, the solenoid S–**3** is energized to cause oil to move through the hydraulic line **102** to move a piston **98** within cylinder **90** away from the mounting bracket **94**. This in turn moves the connecting rod **88**, and this motion causes the lever arm **84** to move, with resultant rotation of the shaft **80** about its own axis. This rotation is transmitted through the radial arms **108**, resulting in the trunnion arms **114** being moved from the initial position shown in Fig. 6 of the drawings to the position shown in Fig. 7.

During this movement, one side of the point of the

drill 122 is brought into grinding engagement with the grinding wheel 22 and is moved upwardly past the grinding wheel until the drill 122 is again out of engagement therewith. This movement, being partially controlled by the arcuate cam surface 224, imparts a curved surface to the point of the drill 122.

When the grinding of one side of the drill 122 has been completed, the drill stabilizer 200 must be withdrawn from contact with the drill 122. The drill 122 must also be rotated through an angle of 180° from the first index position in which it was ground to the second index position for the second grinding operation.

This occurs when the condenser in the control grid circuit of tube V–2 discharges and current flows through the plate circuit of tube V–2. This operates relay R–2 to close its normally open contact and open its normally closed contact. The closing of the normally open contact of relay R–2 closes a circuit through the coil of the index latching relay R–5. This reverses the contacts of relay R–5, opening the circuit to solenoid S–4 and closing the circuit to solenoid S–5.

Hydraulic fluid from solenoid S–5 is introduced through the hose 186 to move the rack 174 within the elongated passage 170, causing the pinion gear 190 of the cylindrical member 134 to rotate 180° from the initial position. As this is done, the drill 122 is also rotated 180°. Relay R–5 is a latching relay, so that its movable contact arm stays in either position until the coil of the relay is energized, at which time it moves to the opposite position and stays there until the coil is again energized. The chuck will thus stay in the second index position until the index latching relay R–5 is again energized during the middle of the next cycle of operation, at which time solenoid S–5 will be de-energized and solenoid S–4 energized to move the chuck to its first index position.

The opening of the normally closed contact of relay R–2 also opens the circuit to the drill stabilizer solenoid S–2, so that the coil spring 219 causes the drill stabilizer 200 to retract. The circuit to the drill stabilizer solenoid S–2 is not completed again until the grind relay R–4 is de-energized to close the drill stabilizer solenoid circuit through its normally closed contacts and through the normally open contact of relay R–2.

The opening of the normally closed contact of relay R–2 also opens the circuit through the coil of the grind relay R–4. The release of its contacts is, however, delayed by the condenser which is in parallel with the coil. This delays the second grinding and drill stabilizing movements until after the index reversal has taken place. The opening of relay R–4 also opens the circuit through the oil solenoid S–3 and closes the circuit through the oil solenoid S–6 to move the machine through its second grinding operation.

During the second grinding operation, hydraulic fluid is introduced through the hydraulic line 104, causing the piston 93 to be moved within the cylinder 90 back to its initial position. This will cause corresponding rotation and movement of all of the movable parts in the exact reverse of the movement previously described and will return the drill 122 vertically downwardly from the position shown in Fig. 7 to the position shown in Fig. 6 of the drawings.

The closing of the normally open contact of relay R–2 also connects the cathode of tube V–3 to ground so that this tube will start to conduct as soon as the condenser in its control grid circuit is sufficiently discharged. It will be noted, however, that there is a condenser in parallel with the coil of relay R–3. This condenser acts as a time delay to prevent the immediate closing of relay R–3. When relay R–3 is energized to open its normally closed contact, it opens the cathode circuit of tube V–1, stopping this tube from conducting and returning the contact of its relay R–1 to its normally open position. This opens the circuit to solenoid S–1 to permit coil springs 164 to move the jaws 148 and 156 apart and release the drill from the chuck. This also opens the cathode circuit of tube V–2, so that this tube stops conducting and the contacts of its relay R–2 return to normal position. The opening of relay R–2 operates the grind relay R–4 after a time delay caused by the condenser in parallel with its coil. The opening of relay R–2 also opens the cathode circuit of tube V–3, causing its relay R–3 to open after a time delay caused by the condenser in parallel with its coil. During this time delay, the drill is released from the chuck and another drill is inserted. When relay R–3 opens, it closes the cathode circuit of tube V–1 to start another cycle of operation.

While our machine is particularly adapted for grinding spiral drills, it can also be used for grinding points on other types of drills or for other grinding operations. A plurality of toggle switches are provided on the base 12 for controlling the various electrical circuits and other suitable switches may be provided as indicated in Fig. 14. In use, one electric timing control circuit as shown in Fig. 14 can be used to control the operation of a large number of solenoids and machines.

The drill locator 194 is also provided with a small block which is attached thereto and which extends into the path of the drill 122 to act as a stop to limit the forward movement of the drill 122.

It should be noted that because the flutes of the drill 122 are disposed horizontally instead of vertically with respect to the grinding drill 122, the grinding lines extend at a right angle to the cutting edge instead of parallel thereto. This provides a better cutting edge, which is less likely to become faulty due to irregularities which inevitably occur in the grinding operation.

The duration of the various timing intervals of the machine can be varied as desired by manual adjustment of the variable resistors to which the resistor condenser timers are connected, as indicated in Fig. 14 of the drawings.

It will be noted that our machine operates at substantially the maximum possible speed. This is important, since it results in greater output per hour of operation, thus increasing the profit increment resulting from operation of the machine.

We claim:

1. A device for grinding the points of drills comprising a carriage, bearing means mounted on said carriage, a first shaft rotatably mounted within said bearing means, radial arms rigidly secured to said first shaft, a second shaft mounted on said radial arms at a point remote from said first shaft, trunnion arms rigidly secured to said second shaft, trunnion means attached to said trunnion arms, a chuck having shafts projecting therefrom, said shafts being held within said trunnion means, a lever arm connected at one end thereof to said first shaft, a piston connected at one end thereof to the opposite end of said lever arm, the opposite end of said piston being reciprocally mounted in a cylinder, a rotatable grinding wheel mounted adjacent to said carriage, a pair of inlets at the opposite ends of said cylinder, pneumatic means including valves to control fluid supplied under pressure to said cylinder through said inlets to reciprocate said piston in either direction and provide vertical upward and downward movement of said chuck with respect to said grinding wheel, a cylindrical member rotatably mounted within said chuck, a resilient cylindrical diaphragm disposed within said cylindrical member, means securing the edges of said diaphragm to said cylindrical member, movable jaw means for gripping the end of a drill disposed within said flexible diaphragm, pneumatic means including valves to control fluid supplied under pressure between said resilient diaphragm and said cylindrical member to cause said resilient diaphragm to expand and move said movable jaw means to grip and release said drill, a pinion gear attached to said cylindrical mem-

ber, an elongated rack in engagement with said pinion gear, said rack being mounted with its midportion slidably extending through an elongated passage adjacent to said pinion gear and its opposite ends comprising piston rods extending into one end of each of a pair of hollow cylinders disposed on the opposite ends of said elongated passage, pneumatic means including valves to control fluid supplied under pressure to the opposite ends of said cylinders to reciprocate said rack and rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

2. The structure described in claim 1 and a stationary arcuate cam surface mounted on said carriage adjacent said trunnion arms, a cam follower carried by said trunnion arms and engaging said arcuate cam surface, and a pair of stop members carried by said carriage, one of said stop members limiting the upward movement of said first shaft and the other of said stop members limiting the downward movement of said first shaft, said stop members being adjustable to control the positioning of said first shaft so that said cam follower travels along different parts of said cam surface to change the radius on the drill being ground.

3. A device for grinding the points of drills comprising a basal supporting means, a movable member mounted on said supporting means for vertical movement with respect to a rotating grinding wheel, a chuck carried by said movable member, a piston connected at one end thereof to said movable member, the opposite end of said piston being reciprocally mounted in a cylinder, a pair of inlets at the opposite ends of said cylinder, pneumatic means including valves to control fluid supplied under pressure to said cylinder through said inlets to reciprocate said piston in either direction and provide vertical upward and downward movement of said chuck with respect to said grinding wheel, a cylindrical member rotatably mounted within said chuck, a resilient cylindrical diaphragm disposed within said cylindrical member, means securing the edges of said diaphragm to said cylindrical member, movable jaw means for gripping the end of a drill disposed within said flexible diaphragm, pneumatic means including valves to control fluid supplied under pressure between said resilient diaphragm and said cylindrical member to cause said resilient diaphragm to expand and move said movable jaw means to grip and release said drill, a pinion gear attached to said cylindrical member, an elongated rack in engagement with said pinion gear, said rack being mounted within its midportion slidably extending through an elongated passage adjacent to said pinion gear and its opposite ends comprising piston rods extending into one end of each of a pair of hollow cylinders disposed on the opposite ends of said elongated passage, pneumatic means including valves to control fluid supplied under pressure to the opposite ends of said cylinders to reciprocate said rack and rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

4. A device for grinding the points of drills comprising a basal supporting means, a movable member mounted on said supporting means for vertical movement with respect to a rotating grinding wheel, a chuck carried by said movable member, pneumatic means including valves to control fluid supplied under pressure to provide vertical upward and downward movement of said chuck with respect to said grinding wheel, a cylindrical member rotatably mounted within said chuck, a resilient cylindrical diaphragm disposed within said cylindrical member, means securing the edges of said diaphragm to said cylindrical member, movable jaw means for gripping the end of a drill disposed within said flexible diaphragm, pneumatic means including valves to control fluid supplied under pressure between said resilient diaphragm and said cylindrical member to cause said resilient diaphragm to expand and move said movable jaw means to grip and release said drill, a pinion gear attached to said cylindrical member, an elongated rack in engagement with said pinion gear, said rack being mounted with its midportion slidably extending through an elongated passage adjacent to said pinion gear and its opposite ends comprising piston rods extending into one end of each of a pair of hollow cylinders disposed on the opposite ends of said elongated passage, pneumatic means including valves to control fluid supplied under pressure to the opposite ends of said cylinders to reciprocate said rack and rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

5. The structure described in claim 4 and said movable jaw means comprising a stationary jaw disposed on one side of said cylindrical member, said stationary member having a triangular groove formed therein adjacent to the axis of said cylindrical member and a movable jaw disposed on the opposite side of said cylindrical member, said movable jaw having a triangular groove formed therein adjacent to the axis of said cylindrical member, said grooves being complementary to each other to form a substantially square opening, a passage disposed on the side of said cylindrical member remote from said movable jaw for introducing fluid between said cylindrical member and said resilient diaphragm whereby when said fluid is introduced, said resilient diaphragm causes said movable jaw to move toward said stationary jaw, said movable jaw having a pair of elongated spring receiving openings disposed therein on opposite sides of the axis of said cylindrical member, and a coil spring mounted in each of said openings, one end of said coil springs bearing against said movable jaw and the other end bearing against said stationary jaw to normally urge said movable jaw away from said stationary jaw.

6. A device for grinding the points of drills comprising a basal supporting means, a movable member mounted on said supporting means for vertical movement with respect to a rotating grinding wheel, a chuck carried by said movable member, pneumatic means including valves to control fluid supplied under pressure to provide vertical upward and downward movement of said chuck with respect to said grinding wheel, said chuck having movable jaw means for gripping the end of a drill, pneumatic means including valves to control fluid supplied under pressure to move said movable jaw means to grip and release said drill, a pinion gear attached to said cylindri-

cal member, an elongated rack in engagement with said pinion gear, said rack being mounted with its midportion slidably extending through an elongated passage adjacent to said pinion gear and its opposite ends comprising piston rods extending into one end of each of a pair of hollow cylinders disposed on the opposite ends of said elongated passage, pneumatic means including valves to control fluid supplied under pressure to the opposite ends of said cylinders to reciprocate said rack and rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

7. A device for grinding the points of drills comprising a basal supporting means, a movable member mounted on said supporting means for vertical movement with respect to a rotating grinding wheel, a chuck carried by said movable member, pneumatic means including valves to control fluid supplied under pressure to provide vertical upward and downward movement of said chuck with respect to said grinding wheel, a cylindrical member rotatably mounted within said chuck, a resilient cylindrical diaphragm disposed within said cylindrical member, means securing the edges of said diaphragm to said cylindrical member, movable jaw means for gripping the end of a drill disposed within said flexible diaphragm, pneumatic means including valves to control fluid supplied under pressure between said resilient diaphragm and said cylindrical member to cause said resilient diaphragm to expand and move said movable jaw means to grip and release said drill, pneumatic means including valves to control fluid supplied under pressure to rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically in one direction to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

8. A device for grinding the points of drills comprising a basal supporting means, a movable member mounted on said supporting means for vertical movement with respect to a rotating grinding wheel, a chuck carried by said movable member, pneumatic means including valves to control fluid supplied under pressure to provide vertical upward and downward movement of said chuck with respect to said grinding wheel, said chuck having movable jaw means for gripping the end of a drill, pneumatic means including valves to control fluid supplied under pressure to move said movable jaw means to grip and release said drill, rack and pinion means secured to said chuck, pneumatic means including valves to control fluid supplied under pressure to reciprocate said rack and rotate said chuck, and means for automatically and sequentially closing the movable jaw means of said chuck to grip a drill, moving said chuck and drill vertically to bring one side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, rotating said chuck and drill through an angle of 180° about the longitudinal axis of said drill, moving said chuck and drill vertically in the opposite direction to bring the opposite side of said drill into grinding contact with said grinding wheel and past said grinding wheel and out of contact therewith, and releasing said drill from said chuck.

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