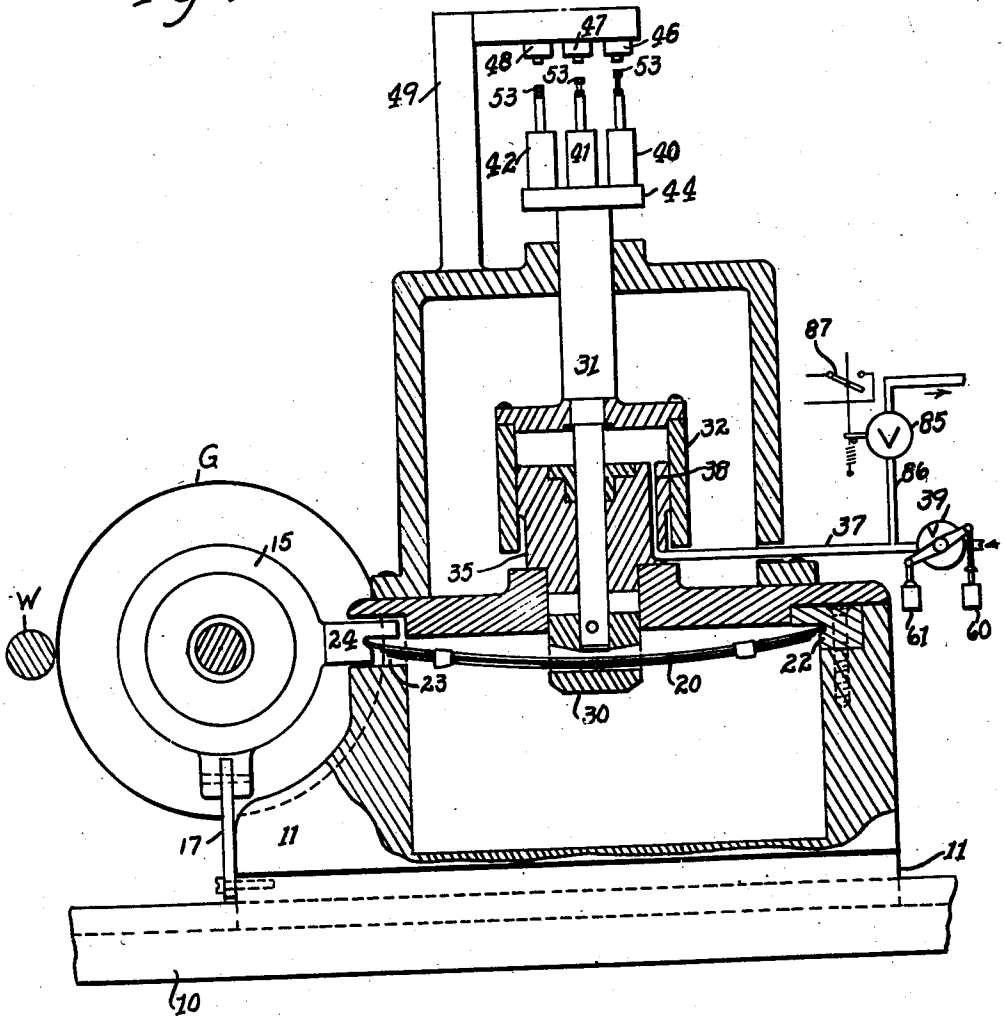
April 3, 1945. G. S. GOULD 2,372,824

APPARATUS FOR GRINDING DUPLICATE PARTS

Filed May 21, 1943 2 Sheets-Sheet 1

Fig. 1.



Inventor.
Gardner S. Gould.
By
Chas. T. Hawley
Attorney.

April 3, 1945. G. S. GOULD 2,372,824

APPARATUS FOR GRINDING DUPLICATE PARTS

Filed May 21, 1943 2 Sheets-Sheet 2

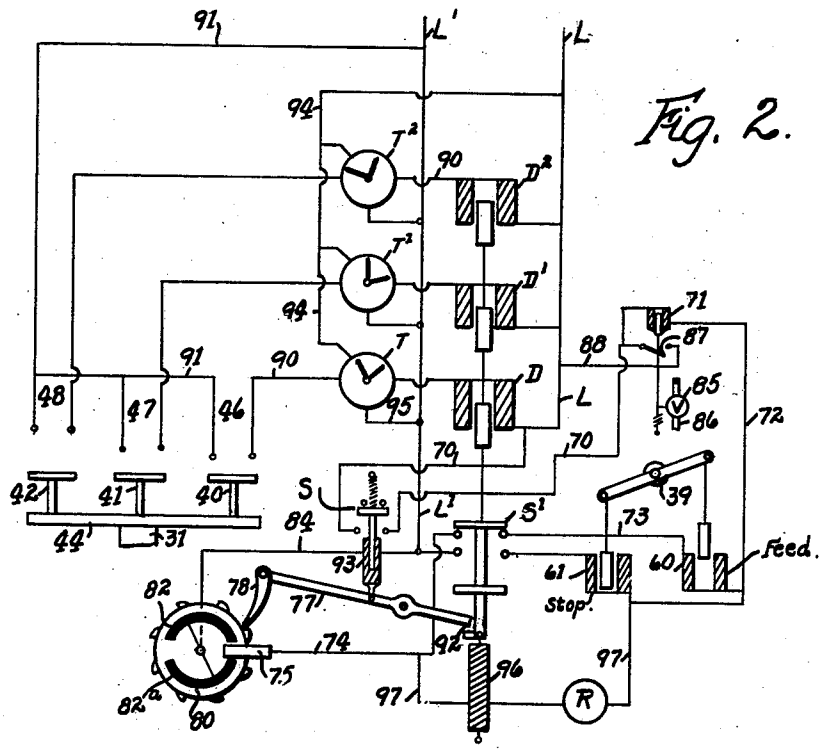
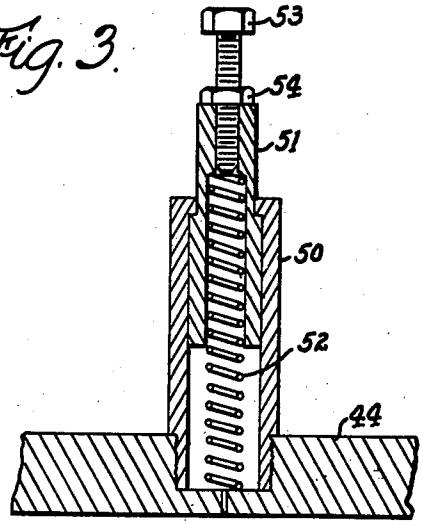


Fig. 2.

Fig. 3.



Inventor.
Gardner S. Gould.
By
Albert F. Hawley
Attorney.

Patented Apr. 3, 1945 2,372,824

UNITED STATES PATENT OFFICE

2,372,824

APPARATUS FOR GRINDING DUPLICATE PARTS

Gardner S. Gould, Lunenburg, Mass.

Application May 21, 1943, Serial No. 487,846

4 Claims. (Cl. 51—166)

This invention relates to certain improvements in grinding apparatus of the general type disclosed in my prior Patent No. 2,032,011, issued February 25, 1936, and further relates to an improved method of carrying out a complete grinding operation on successive work pieces.

In said prior patent, I have disclosed means for advancing a grinding wheel toward a work piece to a predetermined point; means for maintaining the wheel in such advanced position for a predetermined period; and means for thereafter retracting the wheel.

It is the general object of my present invention to provide a grinding machine which may be conveniently operated to take a series of cuts, each of predetermined depth, and to provide a sparking-out period at the end of each cut.

A further object of my invention is to provide an improved method of removing stock from a plurality of work pieces, in such manner that uniform amounts of stock will be removed from each work piece at each cut except the initial or roughing cut.

My invention further relates to certain arrangements and combinations of parts and to certain ordered procedure which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a sectional end elevation of parts of a grinding machine embodying my improvements;

Fig. 2 is a control diagram to be described; and

Fig. 3 is an enlarged sectional elevation of one of the movable contact devices.

Referring to Figs. 1 and 3, I have shown parts of a grinding machine comprising a base 10 on which a grinding head 11 is mounted for sliding preliminary adjustment. A grinding wheel G is rotatably mounted in a bearing structure 15, which structure is secured at the upper end of a slightly flexible metal plate 17, firmly secured to the front end of the grinding head 11. The work is indicated at W and the grinding wheel G is movable forward to engage the work by the outward flexing of the yielding plate 17. Any usual provision may be made for effecting relative axial movement of the work or wheel.

As a convenient means of moving the grinding wheel forward to grinding position, I provide a segmental flat spring 20, preferably made with a series of leaves as shown in Fig. 1. One end of the spring 20 engages an abutment 22 fixed in the grinding head 11, and the other end of the spring 20 projects through an opening 23 in the side of the head 11 and engages an abutment 24 integral with or secured to the wheel bearing structure 15. It will be obvious that when the middle portion of the segmental spring 20 is pulled upward and the spring 20 is thereby straightened, the wheel G will be pushed forward to engage the work W.

As a convenient means of raising the middle portion of the spring 20, I provide a recessed block 30 mounted at the lower end of a plunger 31 having a movable cylinder 32 secured thereto. The plunger 31 is slidable in an axial bearing in a fixed bearing block 35, which block also acts as a fixed piston for the movable cylinder. Hydraulic pressure may be applied in the inside of the cylinder 32 through a pipe 37 and passage 38, and the flow of liquid may be controlled by a valve 39.

The general construction and operation of the grinding machine parts thus far described is similar to that shown in my prior Patent No. 2,032,011, to which reference may be made for a more complete disclosure. This present application relates more particularly to the provision of means permitting a grinding operation to be performed in a series of predetermined successive steps.

For this purpose, I provide a plurality of movable contact devices as 40, 41 and 42, which devices are mounted on a cross bar 44 secured to the upper end of the plunger 31 and in alignment with corresponding contacts or terminals 46, 47 and 48 fixed on a bracket 49.

The construction of one of these movable contact devices is shown in detail in Fig. 3 and comprises a sleeve or casing 50 fixed in the cross bar 44 and slidably receiving a shouldered plunger 51. A compression spring 52 yieldingly holds the plunger 51 in raised position, and a screw 53 is threaded in the upper end of the plunger 51 and may be secured in adjusted position by a nut 54. The head of the screw 53 may form the contacting element which engages the associated fixed contact 46, 47 or 48.

My improved grinding apparatus is designed particularly for the production of duplicate parts, and I have discovered that more accurate and uniform results may be attained when the amount of stock removed from each work piece during each cut after the first or roughing cut is substantially the same for all work pieces.

In order to attain this result, I have devised a method of operation by which the stock is re-

moved from each work piece in a series of partial cuts with predetermined feed, and in which the wheel feed is stopped after each cut to permit the wheel to spark-out. By proceeding in this way, the stock removed by the first or roughing cut only is subject to substantial variation and the stock removed by each additional cut is substantially uniform for all of the work pieces. This is particularly important for the finish cut.

In order to attain this result, I open the feed valve 39 (Fig. 1) to straighten the spring 20 and advance the wheel G until the contact device 40 engages the fixed contact 46. Such engagement then closes the feed valve 39 through a control mechanism to be described and allows the wheel to spark-out. The valve 39 is then opened a second time, advancing the wheel G for a second cut and again closing the valve 39 on engagement of the second contact device 41 with the fixed contact 47. After a sparking-out period, the feed valve 39 is again opened to cause further feed of the wheel toward the work until the third contact device 42 engages the fixed contact 48, which again closes the valve 39 and allows the wheel to spark-out on the finish cut. The cylinder 32 is then vented, causing the wheel to be returned to its initial inoperative position.

By thus performing the grinding operation on each piece by a series of cuts at a single work setting, I attain the advantages of removing uniform amounts of stock from each piece during each cut after the roughing cut, and I avoid any handling of the work between grinding cuts.

While I have shown a construction in which the stock is removed in three cuts, it will be understood that the number of cuts may be varied to suit operating conditions.

In Fig. 2 I have shown a control diagram by which the above described procedure may be carried out automatically. I have indicated the feed valve 39 as being opened by a solenoid 60 and closed by a second solenoid 61, the valve being shown in closed position in Fig. 2.

A normally-open hand-operated main switch S is provided, which, when depressed, closes a starting circuit from a line wire L through a branch wire 70, holding solenoid 71, wire 72, solenoid 60, branch wire 73, double switch S', and branch wire 74 to a spring contact plate 75. Depression of the main switch S also operates through a lever 77 and pawl 78 to advance a ratchet wheel 80 one space, thereby causing the contact plate 75 to be engaged by a contact segment 82 on the ratchet wheel 80. The starting circuit is thus completed from the plate 75 through the segment 82 and branch wire 84 to the return line wire L'. The feed solenoid 60 is thus energized and opens the feed valve 39, so that the plunger 31 (Fig. 1) is moved upward and the wheel W is advanced toward the work.

At the same time, the holding solenoid 71 is energized, closing a normally-open vent valve 85 in a vent pipe 86 for the feed pipe 37 and also closing a holding switch 87 which connects the branch wire 70 through a return wire 88 direct to the line wire L and in parallel to the hand switch S. The circuit through the feed solenoid 60 will thus be maintained after the hand switch S is released, and the vent valve 85 will remain closed.

Hydraulic feed through the valve 39 will then continue until the contact element 40 engages the fixed contact 46, thereby closing a circuit from the line wire L through a solenoid D, timing device T and return wires 90 and 91 to the line wire L'. The solenoid D is thus energized, raising the double switch S', breaking the circuit of the feed solenoid 60 and completing the circuit of the stop solenoid 61, which then operates to close the feed valve 39. Raising the double switch S' also operates the lever 77 through a lost-motion connection 92 to advance the ratchet wheel 80 one space, but without breaking contact between the plate 75 and segment 82. Movement of the lever 77 by the hand switch S does not raise the double switch S', and a telescopic connection 93 is provided which permits the lever 77 to be operated by the switch S' without closing the switch S.

The timer T is of any usual commercial construction and in itself forms no part of my present invention. For present purposes, it is sufficient to state that the timer T maintains the circuit through the solenoid D for a predetermined time interval only, after which the timer breaks the circuit. Setting devices on the face of the timer T may be adjusted for any desired circuit-holding interval, and the timer T may receive power through the branch wires 94 and 95.

When the circuit through the solenoid D is broken by the timer T after a predetermined time interval, the switch S' returns to initial position under the influence of a spring 96, thus restoring the circuit through the feed solenoid 60 and again opening the feed valve 39.

It will be noted that a shunt circuit 97 through a resistance R maintains the holding circuit through the solenoid 71 during the momentary shifting of the double switch S'.

The feed valve 39 having been thus opened a second time, feed of the grinding wheel will continue until the movable contact 41 engages the fixed contacts 47 and closes the circuit through the solenoid D' and timer T', thus energizing the stop solenoid 61 and advancing the ratchet wheel 80 another space.

When the timer T' thereafter breaks the circuit, the feed valve 39 is again opened and further feed for the finish cut takes place until the contact member 42 engages the contact 48, thus closing the circuit through the solenoid D2 and timer T2. The feed is then stopped by the solenoid 61 and the ratchet wheel 80 is simultaneously advanced to bring the contact plate 70 to the space between the segment plates 82 and 82a.

When the timer T2 thereafter breaks the circuit for the solenoid D2, the double switch S' drops but does not complete the circuit of the feed solenoid 60, as this circuit is open at the ratchet wheel 80. Consequently the feed valve 39 does not again open after the finish cut.

The shunt circuit through the resistance R is also opened at the ratchet wheel 80, thus releasing the holding solenoid 71 and the vent valve 85. The vent valve thereupon returns to normal open position, venting the cylinder 32 through the pipes 37 and 86 (Fig. 1) and thus causing the grinding wheel to return to initial withdrawn position. Each timer T, T' and T2 automatically resets after each operation thereof. The holding switch 87 opens when the shunt circuit is broken.

After replacement of the finished work piece with a new piece, the machine may then be again started in operation by manually closing the switch S, after which the above-described cycle of operations will be repeated.

I have thus indicated diagrammatic control mechanism by which a work piece may be finished in a series of predetermined steps and by which

uniform amounts of stock are removed from every work piece at each step, except for unavoidable variations during the first or roughing cut.

By constructing and operating my improved machine as above described, I find that both the accuracy and the quantity of work which can be produced by a machine is substantially increased.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:

1. In a grinding machine, a wheel head, intermittently operated means to feed said wheel head toward the work to be ground to a series of successive predetermined grinding positions, means to maintain said wheel head for a predetermined grinding and rest period in each grinding position, and means to separately and selectively predetermine the length of the grinding and rest period for each position.

2. In a grinding machine, a wheel head and feeding mechanism therefor, control mechanism effective to initiate successive feeding and grinding operations of said mechanism, means to selectively predetermine the extent of each feeding and grinding operation, control means effective to separate successive feeding and grinding operations by intervening intervals of rest, and means to separately and selectively predetermine the length of said rest intervals.

3. In a grinding machine having a wheel head and feeding means to move said head toward the work to be ground, that improvement in control mechanism for said machine which comprises means to advance the wheel head to a series of successive predetermined grinding positions, timing means to hold the wheel head at rest in each position for a predetermined grinding and sparking-out period, means to separately and selectively predetermine the duration of each such period, and devices to render said feeding means again operative at the end of each such predetermined period.

4. In a grinding machine having a wheel head and feeding means to move said head toward the work to be ground, that improvement in control mechanism for said machine which comprises means to advance the wheel head to a series of successive predetermined grinding positions, timing means to hold the wheel head at rest in each position for a predetermined grinding and sparking-out period, means to separately and selectively predetermine the duration of each such period, devices to render said feeding means again operative at the end of each such predetermined period, and coacting means effective to restore the wheel head to initial axial and radial position at the end of the final predetermined grinding and sparking-out period.

GARDNER S. GOULD.