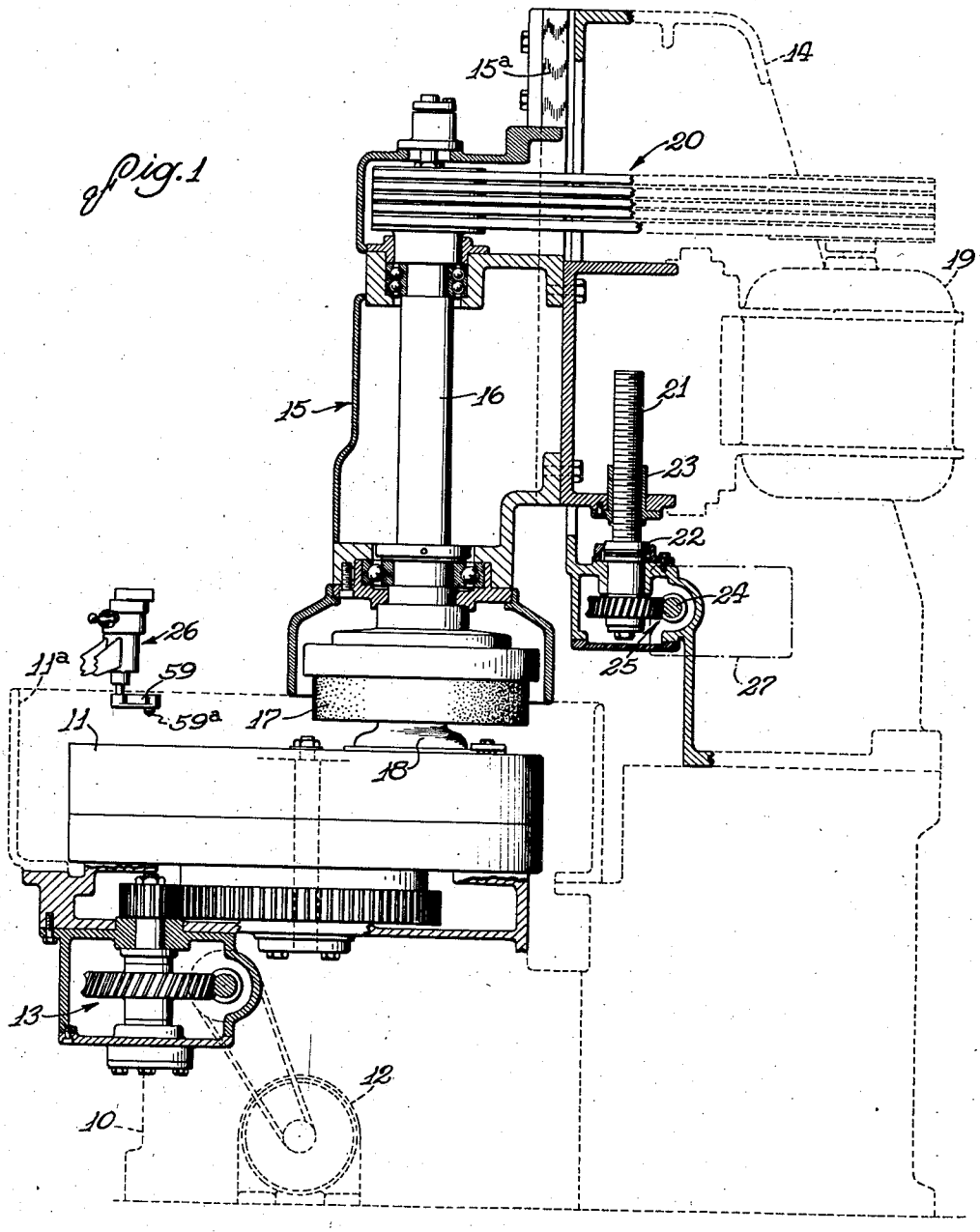
Feb. 28, 1939. D. R. HALL 2,148,744

GRINDING MACHINE

Filed May 28, 1936 3 Sheets-Sheet 1

Fig. 1



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GRINDING MACHINE

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Fig. 2

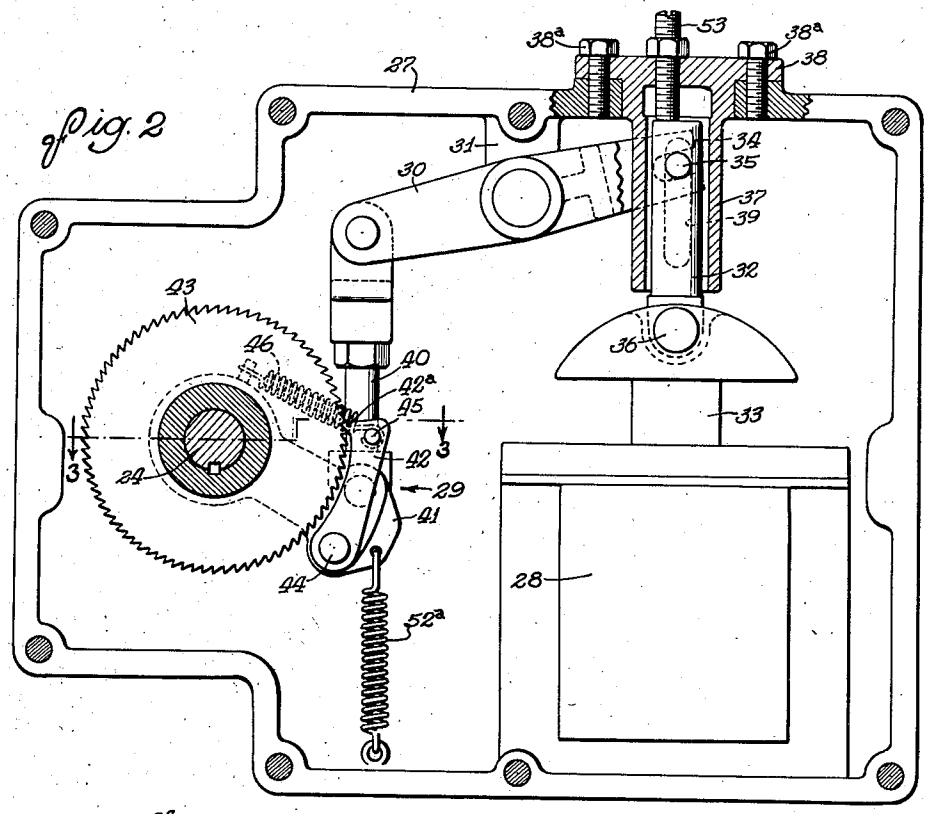

Fig. 3

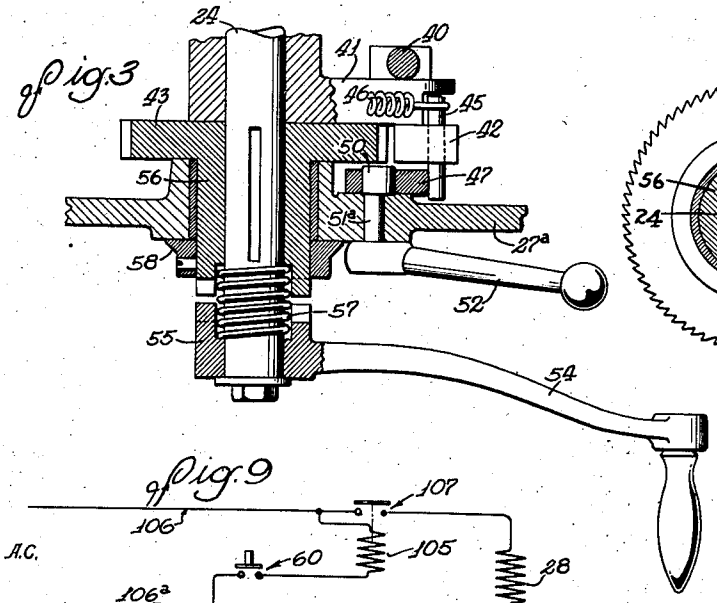

Fig. 4

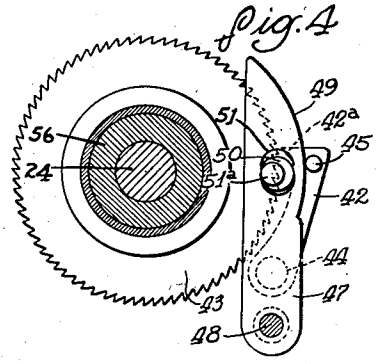

Fig. 9

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GRINDING MACHINE

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Fig. 5

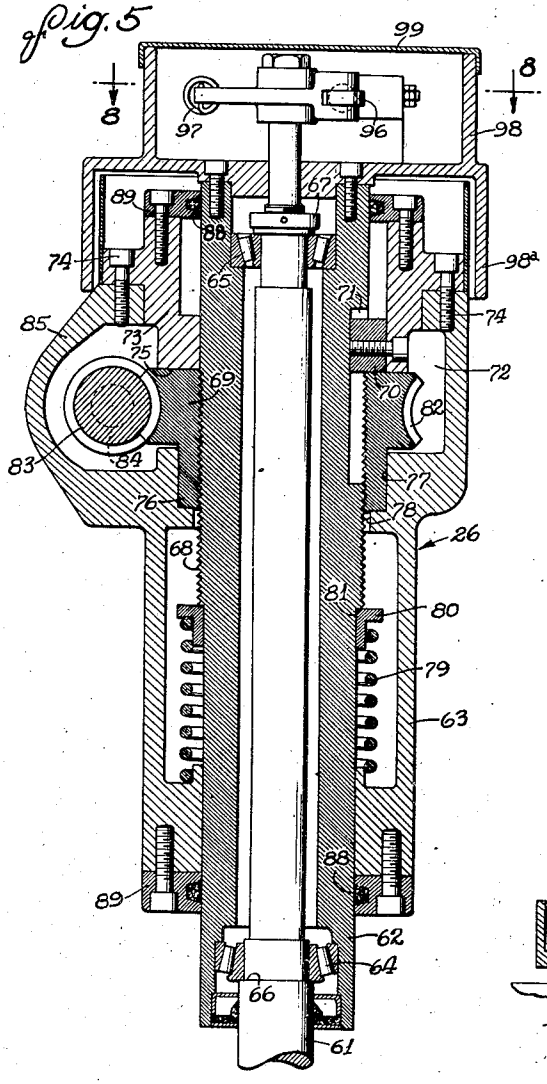


Fig. 7

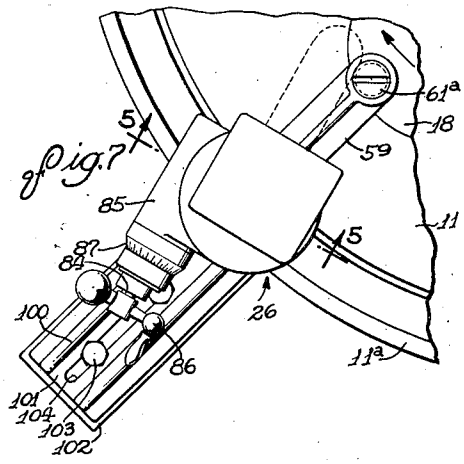


Fig. 6

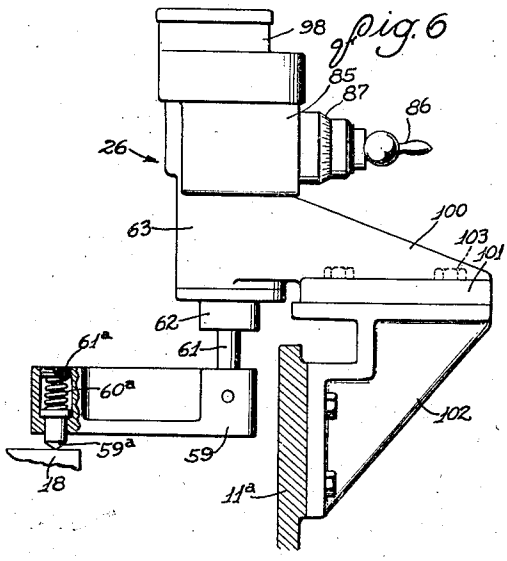
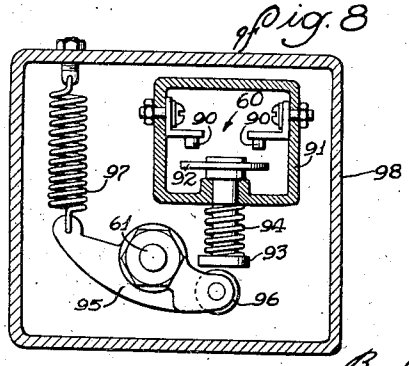


Fig. 8



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Patented Feb. 28, 1939 2,148,744

UNITED STATES PATENT OFFICE

2,148,744

GRINDING MACHINE

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Application May 28, 1936, Serial No. 82,242

9 Claims. (Cl. 51—165)

This invention relates to surface grinding machines and more particularly to a machine of this character having means for adjusting the relative positions of the grinding element and the work to compensate for the wear of the element.

The invention is particularly applicable although not limited to surface grinding machines of the vertical type in which a succession of work pieces are carried to and from the grinding element by a movable work support. In operation, the machine is initially set to grind the work to a predetermined dimension. However, due to natural wear of the element in continued use, the relative positions of the element and the work must be adjusted from time to time to enable the machine to grind succeeding work pieces to the predetermined dimension. It is the primary object of the present invention to provide an improved method and apparatus for effecting such adjustment automatically and thus enable the machine to produce uniform work without constant supervision by the attendant.

Another object of the invention is to provide automatic feed mechanism of an improved character for effecting a relative approach of the grinding element and work which mechanism can be installed readily in existing grinding machines.

Another object is to provide an improved work measuring or calipering device particularly suitable for use with surface grinding machines and adapted to cooperate with the feed mechanism of such machines to control the relative positioning of the grinding element with respect to the work.

A further object is to provide an improved calipering device which is extremely accurate in operation and yet of simple and rugged construction.

Still another object is to provide an improved calipering device including a contact member for gauging the surface of the work which member is moved a substantial distance from its normal position by reason of the presence of even an exceedingly small amount of excess stock on the ground surface of the work.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical sectional view of a grinding machine embodying the features of the invention.

Fig. 2 is an elevational view of the automatic feed mechanism.

Fig. 3 is a fragmentary view, partly in section taken substantially along the line 3—3 of Fig. 2.

Fig. 4 is a detailed view of a part of the feed mechanism.

Fig. 5 is a vertical sectional view of the calipering device taken along the line 5—5 of Fig. 7.

Fig. 6 is an elevational view of the calipering device.

Fig. 7 is a fragmentary plan view of the grinding machine showing the manner in which the calipering device is associated therewith.

Fig. 8 is a plan view of the switch mechanism taken along the line 8—8 of Fig. 5.

Fig. 9 is a schematic diagram showing the electrical control circuits associated with the feed mechanism and calipering device.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

By way of illustration I have shown and will hereinafter describe the invention as applied to a conventional surface grinding machine of the vertical spindle type in which the grinding head is movable toward and from the work support, but it will be appreciated that the invention may be readily applied to other types of grinding machines.

Referring to Fig. 1 of the drawings, the machine comprises generally a base 10 carrying at its front end a rotatably supported horizontal table or work support 11 partially enclosed by a frame or guard 11a. The work support 11 is adapted to be rotated by a motor 12 through the medium of a speed reducing gear train 13 to carry the work to and from the grinding element of the machine.

At the rear end of the base 10 is an upright column 14 on which a reciprocable grinding head 15 is supported on vertical ways 15a for movement toward and from the work support. A vertically disposed spindle 16 journaled in the head carries a suitable grinding element 17 at its lower end, the arrangement being such that work pieces 18 are traversed past the grinding element in the rotation of the work support 11. A motor 19 mounted on the head 15 and drivingly connected with the spindle 16 by a belt 20 rotates the spindle and grinding element 17.

For raising and lowering the head 15 to adjust the position of the grinding element 17 with respect to the work, a vertically disposed feed screw

21 journaled in a thrust bearing 22 carried by the column 14 and coacting with a nut 23 secured to the head 15 is provided. Operation of the feed screw 21 is effected either manually, or automatically by means of the feed mechanism shown in Figs. 2 and 3, through the medium of a cross shaft 24 having a worm and gear connection 25 with the feed screw.

After the grinding operation, the work is carried into operative relation with a calipering device, generally designated 26, which automatically checks or calipers the ground surface thereof and initiates the operation of the automatic feed mechanism when such action is required.

Having in mind the general organization and arrangement of the machine as above set forth, the construction and operation of the mechanisms with which the invention is particularly concerned will now be described in detail. Referring first to the automatic feed mechanism, it will be observed that this mechanism, as shown in Figs. 2, 3 and 4, is operatively associated with the cross shaft 24 by which the feed screw 21 is rotated to raise or lower the grinding head. Preferably, the mechanism is enclosed in a suitable casing 27 supported on the frame of the machine adjacent the lower end of the feed screw, with the cross shaft 24 extending therethrough. As herein shown, the automatic feed mechanism is arranged to rotate the shaft 24 in intermittent steps, the direction of rotation being such that the feed screw operates to move the head and grinding element 17 toward the work.

Automatic rotation of the shaft 24 is effected by a solenoid 28 through the medium of a pawl and ratchet mechanism generally designated 29 (Fig. 2), operatively associated with the shaft. The solenoid is arranged to operate the mechanism 29 by means of a mechanical linkage including a lever 30 pivotally supported intermediate its ends on a bracket 31 formed integral or suitably secured to the casing 27. One end of the lever 30 is operatively connected by a stem 32 with a headed member 33 constituting the armature of the solenoid 28. To this end, the lever 30 is bifurcated and the two legs thus formed are slotted as at 34 to receive a pin 35 fitted in the upper end of the stem 32. The stem is connected at its lower end to the armature 33 by means of a pivot pin 36, and the other end is enclosed in a tubular guideway 37 formed integrally with a plate 38 removably secured to the casing 27 as by bolts 38a. Vertically disposed slots 39 formed in opposite sides of the guideway guide the pin and link in their movement incident to the operation of the solenoid and prevent the pin from leaving the slots 34 in the legs of the lever 30 which straddle the guideway.

The other end of the lever 30 is connected by an adjustable link 40 with the free end of a pawl supporting arm 41 loosely mounted on the shaft 24. Arm 41 carries a pawl 42 having an angular projection or tooth 42a formed at one end for engagement with the teeth of a ratchet wheel 43 keyed to the shaft 24. The pawl is pivoted at the other end on the arm 41 as indicated at 44. The end of the pawl adjacent the projection 42a carries a transversely disposed pin 45 projecting on opposite sides which provides an anchorage for a spring 46 tending to draw the pawl into operative engagement with the teeth of the ratchet wheel 43. The pin 45 also constitutes a part of the manually operable means for disengaging the pawl from the ratchet wheel.

The pawl disengaging mechanism, as shown in Figs. 3 and 4, includes a cam plate 47 pivotally mounted on the cover plate 27a of the casing at 48 and having an arcuate cam surface 49 adapted to be moved into and out of the path of the pin 45. With the cam plate in the position shown in Fig. 4, the pin 45 rides on the cam surface 49 and the pawl 42 is held out of engagement with the teeth of the ratchet wheel. Movement of the cam plate is effected by rotation of an eccentric 50 operating in a slot 51 in the cam plate. The eccentric 50 is formed on one end of a shaft 51a journaled in the cover plate 27a. A manually operable lever 52 fast on the projecting end of the shaft 51a provides a convenient means for rotating the eccentric to engage or disengage the pawl.

The pawl mechanism 29 is normally held in a lowered position by the action of a tension spring 52a having one end connected to the free end of the arm 41 and the other end suitably anchored to one wall of the casing 27 as shown in Fig. 2 of the drawings. With the mechanism in this position, the armature 33 is withdrawn from the solenoid as shown. Upon energization of the solenoid, the armature is drawn downwardly and, through the medium of the connecting linkage, moves the pawl mechanism through an arc adjacent the teeth of the ratchet wheel 43.

When the solenoid is deenergized, spring 52a acts to return the pawl mechanism to normal position so that the projection may engage the next adjacent tooth of the ratchet wheel. To insure proper engagement of the projection 42a of the pawl with the teeth of the ratchet wheel and to determine the length of the armature stroke and thus the extent of movement of the pawl, adjustable means for limiting the return movement of the mechanism is provided. In the present instance, this means comprises an adjusting screw 53 threaded into the plate 38 so as to coact with the upper end of the stem 32 in the return movement of the pawl mechanism.

As herein shown, the automatic feed mechanism is operative to move the grinding element toward the work in relatively small steps. For retracting the element from the work and for initially positioning it with respect thereto, manually operable means for rotating the cross shaft 24 is provided. This means includes a hand crank 54 loosely mounted on the shaft 24. The hub 55 of the crank is formed with a positive clutch element adapted, on axial movement of the crank to engage with a complementary clutch element formed on the sleeve 56 of the ratchet wheel 43. A compression spring 57 normally holds the clutch elements apart. A graduated dial plate 58 fast in the sleeve 56 enables the attendant to readily determine the extent to which the grinding element is moved.

Control of the automatic feed mechanism is effected, in the present instance, by means of the calipering device 26 which initiates the operation of the mechanism when readjustment of the relative positions of the work and grinding element is required. Such readjustment is necessitated from time-to-time by the wearing away of the grinding surface of the element in continued operation, and is indicated by the excess stock left on the work after the grinding operation.

The calipering device is arranged to detect the presence of excess stock on the work pieces as they are carried from the grinding element in the movement of the work support. To this end, it includes a movable contact arm 59 (Figs. 1, 6 and

7) adapted to be disposed closely adjacent the path along which the work pieces are carried. As herein shown, the contact arm 59 is arranged for pivotal movement about a vertical axis, that is, for movement in a plane substantially parallel to the ground surface of the work. The arm is so positioned that there is sufficient clearance for work pieces ground to the predetermined dimension to pass by without operatively engaging it. On the other hand, when a work piece has even a slight excess of stock on the ground surface the edge thereof will engage with the arm and move it laterally from its normal position as the work piece is moved along by the work support. Thus, an extremely small excess of stock is enabled to produce a relatively large movement of the contact arm which materially increases the sensitivity of the device and enables it to function efficiently and accurately.

The movement of the contact arm is utilized, in the present instance, to actuate a switch 60 which completes an operating circuit for the automatic feed mechanism solenoid 28, and thereby adjusts the position of the grinding element with respect to the work. Thus, the calipering device gauges one work piece of a series to automatically adjust the machine for grinding succeeding pieces to a predetermined dimension. It will be apparent that the movement of the contact arm may be used to actuate devices other than the switch shown by way of illustration, and that the switch 60, likewise, may be arranged to control other mechanisms.

In the preferred form shown in Figs. 5 to 8 of the drawings, the calipering device 26 includes a vertical shaft or spindle 61 on the lower end of which the contact arm 59 is secured. The spindle 61 is rotatably mounted in a tubular member or quill 62 enclosed within a hollow casing 63 as shown in Fig. 5 with the arm 59 projecting radially therefrom adjacent the path along which the work is carried by the work support. Engagement between the free end of the arm and an oversize work piece operates to rotate the spindle and actuate the switch 60. To guard against any possibility of injury to the device due to too great a deflection of the contact arm, actual engagement with the work is effected by a yieldable pin 59a carried in an aperture in the free end of the contact arm. The pin is urged downwardly by a spring 60a interposed between the head of the pin and a screw plug 61a closing the aperture. When excessive pressure is applied, the pin yields and permits the arm to return to normal position without injury to the device.

The spindle is journaled in radial thrust bearings 64 and 65 disposed in opposed relation at opposite ends of the quill 62. The bearings are preferably of the tapered roller type, and the inner race ring of the bearing 64 is seated against a shoulder 66 formed by the enlarged lower end portion of the spindle. The inner race ring of the bearing 65 is held in place by means of a nut 67 threaded on the spindle adjacent its upper end. Thus, by tightening up the nut 67, all play in the spindle is eliminated and axial movement of the spindle relative to the quill is effectually prevented so that the position of the control arm relative to the ground surface of the work can be adjusted and maintained with great accuracy.

Vertical adjustment of the spindle 61 to position the contact arm 59 relative to the surface of the work is effected by moving the quill 62 axially relative to the casing 63. To this end, an intermediate portion of the quill is threaded as at 68 for engagement with the internal threads of a nut 69 rotatably supported within the body of the casing. Preferably, the threads 68 are of fine pitch so that the position of the quill may be accurately adjusted within narrow limits. A key 70 secured to the wall of the casing and riding in a vertically disposed slot 71 formed in the quill prevents the quill from rotating with the nut.

To provide space for the nut 69, the upper end of the casing 63 is enlarged to form an annular chamber 72. The top of the chamber is closed by a cover or cap 73 removably secured to the casing as by machine screws 74. As shown, the cap 73 is formed with a depending flange which provides a bearing surface 75 for the top of the nut. The nut is formed with a cylindrical lower end portion 76 journaled in a bearing 77 formed in the casing. An internal annular flange 78 on the casing wall underlies and engages the end of the nut at the base of the bearing 77. Thus, while the nut is freely rotatable, it is held against axial movement relative to the casing by the cap 73 and flange 78 and against lateral movement by the bearing surface 77. The position of the spindle 61 and contact arm 59 can therefore be adjusted within very close limits thus enabling the device to function accurately in detecting extremely small variations in the dimensions of the work.

As a further means of facilitating accurate positioning of the device, means for taking up any play between the threads of the quill 62 and nut 69 is provided. In the present instance this means includes a compression spring 79 disposed within the hollow body of the casing 63. One end of the spring bears against the bottom wall of the casing and the other end against a collar 80 loosely carried by the quill 62. The collar abuts against a shoulder 81 formed at the end of the threaded section of the quill thus transferring the upward thrust of the spring to the quill and serving to maintain the quill threads 68 in tight engagement with the threads of the nut 69 in all positions of the quill.

Manually operable means is provided for rotating the nut 69 in either direction to raise or lower the spindle 61 and its associated contact arm 59. For this purpose, the nut is formed rigid with a worm gear 82 which meshes with a worm 83 fast on a shaft 84 disposed at one side of the nut 69 and extending transversely of the axis of the nut. The worm is enclosed in an extension of the chamber 72 defined by a housing 85 formed integrally with the casing 63 as shown in Figs. 5, 6 and 7. The shaft 84 is journaled in suitable bearings in the housing 85 with one end projecting therefrom. A hand lever 86 fast on the projecting end of the shaft provides a convenient means of rotating the same while a graduated dial plate 87, also fast on the shaft, indicates the amount of rotation.

The interior of the casing 63, including the chamber 72 may be filled with oil or grease to provide suitable lubrication for the various moving parts. Leakage of the lubricant around the quill is prevented by packing rings 88 provided at the upper and lower ends of the casing. To permit changing the packing rings without necessitating the removal of the quill from the casing, the rings are held in annular end members 89 removably secured to the bottom of casing 63 and the top of the cap 73, respectively.

Having in mind the construction and mounting of the spindle 61 and associated parts, the construction and operation of the switch 60 will now

be described. Referring particularly to Fig. 8, the switch 60 includes a pair of spaced contacts 90 stationarily mounted on a frame 91 and a movable contact blade 92 adapted to electrically connect the stationary contacts. The contact blade is carried by a plunger 93 slidably supported in the frame 91 for movement toward and from the contacts 90. A spring 94 coacts with the plunger to hold the switch blade out of engagement with the contacts and thus normally maintain the switch in open position.

Closing of the switch is effected by a switch actuating lever 95 fast on the upper end of the spindle 61. One end of the lever carries a roller 96 adapted to engage the end of the plunger 93 incident to the rotation of the spindle in a counterclockwise direction. A tension spring 97 secured to the other end of the lever operates to hold the spindle 61 in a normal position in which the roller 96 is out of engagement with the plunger 93.

The switch 60 and its actuating mechanism is enclosed in a housing 98 secured to the upper end of the quill 62 and movable therewith relative to the casing. The housing is formed with a guard 98a in the form of a depending flange which overhangs the upper end of the casing. A removable cover 99 on the switch housing protects the switch contacts from dust and dirt.

The calipering unit 26 is designed to be mounted at one side of the work support so that the contact arm 59 projects substantially radially of the support with its free end adjacent the path along which the work pieces are carried after the grinding operation. To this end, the casing is provided with an extension comprising a pair of rearwardly projecting legs 100 joined by a web 101 adapted to be supported on a bracket 102 carried by the guard 11a which surrounds the work support. The extension is secured to the bracket 102 by means of bolts 103 which extend through a suitable slot 104 in the web and thread into the bracket. The slot permits adjustment of the calipering device radially of the work support so that the contact arm 59 may be suitably positioned for cooperation with various types of work pieces.

For controlling the automatic feed mechanism, the switch 60 may be interposed directly in the circuit of the feed mechanism solenoid 28 or may be arranged to control the solenoid circuit through the medium of an auxiliary solenoid and switch as shown diagrammatically in Fig. 9. Referring to the drawings, it will be observed that the switch 60 is connected in series with a solenoid 105 across the conductors 106 and 106a of the power line. Solenoid 105, when energized, actuates a switch 107 to complete the operating circuit for the solenoid 28. With this arrangement, current through the switch 60 may be kept at a low value thus permitting the use of a small and relatively sensitive switch in the calipering device.

In the operation of a grinding machine embodying the features of the invention, the work 18 is set up on the work table 11 in the usual manner. The grinding head 15 is adjusted manually by means of the hand crank 54 so that the grinding element 17 removes the desired amount of stock from the work. After this adjustment is made, the hand crank is disengaged from the feed shaft 24 and the ratchet mechanism 29 of the automatic feed mechanism is engaged by releasing the cam plate 49.

The calipering device 26 is adjusted radially of the work support so that the ground surface of the work will pass under the free end of the contact arm 59 as the work is carried away from the grinding element. The position of the contact arm is likewise adjusted vertically so that the end of the contact pin 59a is just slightly above the surface of a properly ground work piece.

As the grinding element 17 wears away in the continued operation of the machine, less stock is removed from the succeeding work pieces. When the excess material left in the work pieces reaches a predetermined point sufficient to effect engagement with the contact pin 59a, the contact arm 59 is deflected thus rotating the spindle 61 and closing the switch 60. Closure of the switch 60 completes a circuit for energizing the solenoid 105 and the latter, by closing switch 107, completes the operating circuit for the automatic feed solenoid 28. Solenoid 28, in turn, actuates the pawl mechanism 29 to impart a rotative step to the cross shaft 24 and feed screw 21 and thus move the grinding head 15 and element 17 toward the work. This operating cycle is repeated from time-to-time as determined by the condition of the work after the grinding operation.

It will be apparent from the foregoing that I have provided an improved means for automatically adjusting a grinding machine to enable the machine to grind successive work pieces to predetermined dimensions within narrow limits. The adjusting means is of simple and sturdy construction and may be installed readily in existing machines without in any way interfering with the normal operation thereof. It includes an efficient and reliable feed mechanism for effecting a relative approach of the grinding element and work, together with a calipering device for automatically initiating the operation of the mechanism to compensate for the wear of the grinding element in continued operation. The calipering device while of rugged construction, is extremely accurate in operation and is capable of detecting minute variations in the finished dimensions of the work. Moreover, it may be quickly and accurately adjusted for operation with every kind and size of work piece within the capacity of the machine.

I claim as my invention:

1. A calipering device for use with a surface grinding machine having a movable work support for carrying the work into and out of operative relation with the grinding element of the machine, said device comprising, in combination, a hollow casing adapted to be supported adjacent the work support, a tubular member supported in said casing for axial movement toward and from the work support, a spindle journaled in said member and movable therewith, said spindle having a contact arm adapted to project over the work pieces being carried away from the grinding element, means for moving said tubular member relative to said casing to position said arm so that an oversize work piece will engage with and deflect the arm and thereby rotate said spindle, and switch means actuated incident to the rotation of said spindle.

2. A calipering device for use with a grinding machine having a rotatable grinding element and means for carrying a series of work pieces into and out of operative relation to said element, said device comprising, in combination, a contact arm supported for pivotal movement about an axis substantially perpendicular to the path along which the work pieces are moved after the grind-

ing operation, a contact member yieldably supported on the free end of said arm adapted to be positioned closely adjacent said path with sufficient clearance only for the passage of work pieces ground to a predetermined dimension, work pieces exceeding said predetermined dimension engaging said member and deflecting said arm by rocking it about its pivot in the direction of movement of the work whereby a slight excess of stock on the ground surface of the work is enabled to effect a relatively large movement of the contact arm, said member yielding when the arm reaches its limit of movement to prevent damage to the device, and control means operated in response to the movement of said arm.

3. A calipering device for use with a grinding machine having a movable support for carrying work pieces to and from the grinding element of the machine, said device comprising, in combination, a casing adapted to be stationarily mounted adjacent said support, a spindle journaled in said casing for rotation about an axis substantially perpendicular to said support, an arm projecting radially from said spindle, means for shifting said spindle axially relative to said casing to position said arm closely adjacent the path along which the work is carried in the movement of said support, said arm being engageable by an oversize work piece in its movement along said path and operative upon such engagement to rotate said spindle about its axis, a switch mechanism supported on said casing, and a switch actuating member carried by said spindle and operative in the rotation of said spindle to actuate said switch.

4. A calipering device for use with a grinding machine having a movable support for carrying work pieces to and from the grinding element of the machine, said device comprising, in combination, a casing adapted to be stationarily mounted adjacent said support, a spindle journaled in said casing for rotation about an axis substantially perpendicular to said support, an arm projecting radially from said spindle, means for shifting said spindle axially relative to said casing and for shifting the casing laterally relative to said support to position said arm closely adjacent the ground surface of a work piece carried on said support, the position of said arm being such that a work piece having an excess of stock on the ground surface is effective to engage the arm and rotate said spindle incident to the movement of the work by said support, a normally open switch mounted on said support, and means actuated by said spindle in its rotation for closing said switch.

5. A calipering device for use with a grinding machine having a movable table for carrying work pieces to and from the grinding element of the machine, said device comprising, in combination, a casing adapted to be stationarily mounted adjacent said table, a tubular member slidably supported in said casing for movement toward and from said table, a spindle journaled in said tubular member and movable therewith, an arm projecting radially from said spindle and operative upon radial deflection to rotate the same, and means for shifting said tubular member relative to said casing thereby positioning said arm to provide clearance only for the passage of a work piece ground to a predetermined dimension comprising, a nut rotatably supported in said casing and having a threaded connection with said tubular member, and manually operable means for rotating said nut.

6. A calipering device for use with a grinding machine having a movable table for carrying work pieces to and from the grinding element of the machine, said device comprising, in combination, a spindle supported for rotation about an axis substantially perpendicular to said table, an arm projecting from said spindle over said table and substantially parallel therewith, said arm being engageable by an oversize work piece carried by the table and operative upon such engagement to rotate said spindle, and means adjustably supporting said spindle comprising a casing stationarily mounted adjacent said table, a tubular member slidably supported in said casing and having spaced bearings for the spindle, a nut rotatably supported in said casing and having a threaded connection with said member, means for rotating said nut to shift said member and said spindle axially relative to the casing, and resilient means coacting with said casing and said member to take up the play in the threads of the member and said nut and thereby maintain accurate adjustment of said spindle.

7. In a grinding machine, in combination, a rotary grinding element, a movable work support for carrying a series of work pieces across the face of said element, a feed screw for moving said element toward and from the work support, and means for rotating said feed screw under control of said work pieces comprising, a calipering device including a pivotally supported contact arm having one end disposed closely adjacent the path along which the work pieces are carried after being operated on by the grinding element, said arm being positioned so as to be engaged by an oversize work piece whereby the arm is rocked about its pivot, and means operated once in each of such movements of said arm for imparting a single rotative step to said feed screw to advance the grinding element toward the work support.

8. A calipering device for use with a grinding machine having a work support arranged to carry a series of work pieces into and out of operative relation with a grinding element and means for adjusting the relative spacing of the element from the support, said device comprising, in combination, an arm supported for pivotal movement in a plane substantially parallel to the finished surface of a work piece leaving the grinding element, a contact member projecting from said arm closely adjacent the path along which the work pieces are carried after leaving the grinding element, said member having a contact point positioned for engagement by an oversize work piece whereby to rock said arm about its pivot, means supporting said member for yielding movement to allow the oversize work piece to pass when the arm is rocked to its limit position, and control means actuated in response to the rocking of said arm for operating the adjusting means of the machine.

9. In a grinding machine, in combination, a grinding element, a movable work support for carrying a series of work pieces into and out of operative relation with said element, adjusting means for effecting relative movement of the element and work support toward and from each other to adjust the machine for grinding each of the work pieces to a predetermined dimension, a solenoid operable when energized to actuate said adjusting means and thereby decrease the spacing of the element and the work support.

a calipering device for controlling the energization of said solenoid to automatically compensate for the wear of the element including a contact arm pivotally supported at one end and having its other end disposed closely adjacent the path along which the work pieces are carried away from the grinding element, a contact member yieldably supported on said arm for engagement by an oversize work piece whereby to rock said arm about its pivot, said contact member yielding to allow the work piece to pass when the arm is rocked to its limit position, and a switch actuated in response to the rocking of said arm operative to energize said solenoid.

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