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FEED DEVICE FOR THREAD GRINDING MACHINES

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Fig. 2

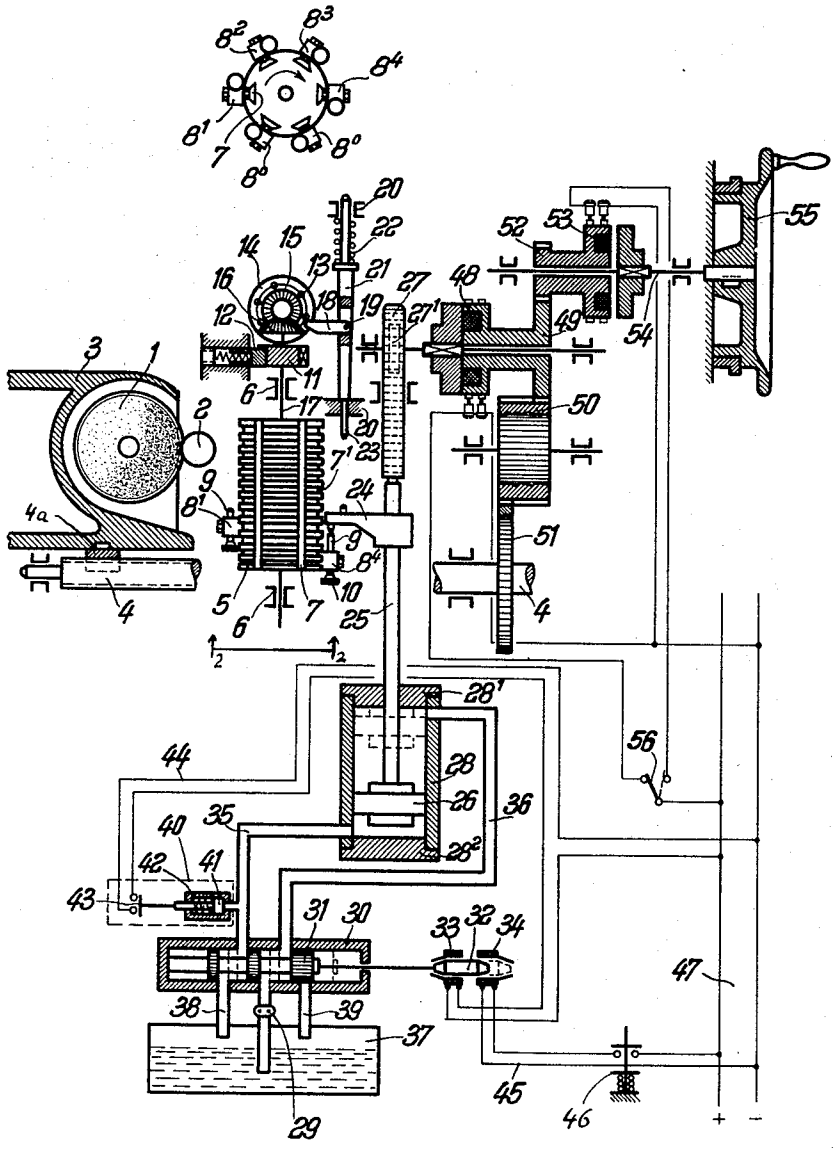


Fig. 1

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FEED DEVICE FOR THREAD GRINDING MACHINES

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This invention relates in general to feed devices for thread grinding machines, and particularly to a new and useful automatic feeding device for thread grinding machines, or the like, in which the advance of the grinding mechanism is automatically controlled to a predetermined adjustable amount which may be varied for each of a plurality of successive grinding feed passes.

Previously, with machines of this general nature, automatic devices for limiting the grinding feed and hence the depth of grinding cut consisted of such mechanism as a pawl which rotated a ratchet over an adjustable number of peaks. Such devices were capable of effecting the same depth of cut for each feed or pass of the grinding wheel. It was not possible with these mechanisms, to vary the extent of grinding wheel feed from one pass to the other.

In accordance with one aspect of the invention, an apparatus is provided to effect a variation in the extent of grinding wheel feed for each successive pass. With such a machine, it is possible to preselect the depth of grinding for each successive pass as desired. The mechanism finds particular application in thread grinding where it is particularly advantageous to make the first few grinding passes deep grinding cuts, and to make successive passes at gradually decreasing depth until the final precise size is reached.

Accordingly, it is an object of the present invention to provide an automatic grinding wheel feeding device for thread grinding machines, or the like, in which grinding feed is automatic and adjustable for each successive grinding pass.

A further object of the invention is to provide an apparatus for automatic grinding wheel feeding, which includes control mechanism engageable with a stop to limit the extent of grinding wheel feed during each grinding pass, and which mechanism is effective to position a new stop in alignment for contact to limit the extent of grinding wheel feed during the succeeding grinding wheel feed pass.

A further object of the invention is to provide a grinding wheel feeding device which is simple in design, rugged in construction, and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawings:

Fig. 1 is an overall schematic view of a thread grinding wheel feeding device constructed in accordance with the invention; and

Fig. 2 is a front elevation of the feed drum indicated in Fig. 1 and taken along the line 2—2 of Fig. 1.

Referring to the drawings in particular, the invention as embodied therein includes a thread grinding wheel 1

which is constantly rotated by mechanism (not shown) to grind the surface of a slowly rotated work piece 2. The work piece 2 is supported on a carriage or table (not shown) to advance and retract the work piece axially of the grinding wheel 1. The grinding wheel 1 is supported in a movable feed member or head stock 3.

A feed control screw spindle 4 is mounted in suitable bearings for rotation thereon and is provided with suitable mechanism such as a sliding nut 4*a* which rides in a spiral groove thereon. The nut 4*a* is secured to the head stock 3 and movement of the head stock toward and away from the work piece 2 is controlled by the rotation of the feed control screw spindle 4. Rotation of the feed control spindle 4 is effective to control the depth of the grinding cut upon rotation of the spindle in one direction, and rotation of the spindle in the opposite direction, is effective to return the grinding wheel 1 to its starting position after each grinding cycle.

In accordance with the invention the amount of rotation of the feed control spindle 4, and the extent of the advance of the grinding wheel 1 during a cycle, is determined by a feed drum 5. The feed drum 5 is journalled in bearings 6, 6 and is provided with a plurality of substantially dovetailed cross-sectional grooves 7 which are uniformly spaced around the circumference and extending the full length of the drum 5. In this embodiment, six grooves are provided to accommodate control stop blocks 8 in each one thereof. A number greater, or less, than six could be advantageously provided, as determined by the number of successive grinding wheel feed passes which must be controlled as to the extent of feeding and the depth of grinding cut.

Some of the control stop blocks 8 are provided with feed stops 9 as the blocks 8_1, 8_2, 8_3 and 8_4, while two of the blocks are set for idling and do not carry any stops as at 8_0, 8_0. In Fig. 1 of the drawings only two of the control stop blocks 8 are indicated for clarity of illustration purposes. In this figure, blocks 8_2 and 8_3 should also normally appear in the grooves 7. In this embodiment correct grinding of the work piece 2 requires four separate feed passes of the grinding wheel 1, and each of the passes are set to effect a different grinding depth. The arrangement permits the grinding wheel to idle or to remain out of contact with the work piece during two cycles of operation of the control mechanism to afford time for the positioning of the next work piece.

The feed drum 5 is also provided with a plurality of annular grooves 7_1 to permit adjustment of the location of each of the control stop blocks 8. The annular grooves 7_1 intersect the longitudinal grooves 7 and the blocks 8 are shaped so that they can be set into the annular grooves and then clamped tight in the longitudinal grooves. The feed stops 9 are threaded and can be screwed into the control stop blocks 8 to afford a fine adjustment of the stop location. The length of the threaded portion of the stop 9 is such that adjustment can be made to cover the range between two positions of the coarse adjustment of the blocks in the annular grooves and longitudinal grooves.

The feed drum 5 is re-positioned once during each cycle of the control mechanism to present a different control stop block in an operating position for the next control cycle. The feed drum 5 is indexed into a precise position during each control cycle, by movement of a ratchet wheel 14 having six upstanding pins 13 annularly spaced on a concentric circle thereon and which drives the feed drum 5 through the medium of bevel gears 15 and 16. The bevel gear 16 is affixed to a shaft 17 which is connected to the feed drum 5. The ratchet wheel 14 is rotated through engagement by a pawl 18 with the pins 13. The pawl 18 is pivotally attached as at 19 to a push rod 21 which is axially guided for reciprocable movement

in bearings 20. The push rod is biased downwardly by a compression spring 22 which is positioned between an abutment on the push rod 21 and the bearings 20.

The feed drum 5 is indexed, that is, rotated step by step, by the reciprocation of the pawl 18 as it engages the members 13 and advances the reel 14. It is essential that the drum 5 be held fast in each position. For this purpose, a detention disc 11 is provided which cooperates with a spring biased bolt 12 which is urged by the spring into one of a plurality of recesses defined in the disc 11. The flanks of the bolt 12 are beveled and so are the flanks of the recesses in the detention disc and the bolt is urged out of the recess as the drum 5 is indexed to a new position. The rotational force exerted on the drum 5 causes movement of the bolt against the spring biasing force out of the recess in the detention disc during each indexing movement.

When a control stop 8 with its feed stop 9 is in an operating position the stop 9 faces the lower end 23 of the push rod 21, the lower end 23 being spaced a distance from the top of the stop 9. Reciprocably movable in this space is a double acting trip-dog 24, which is fixedly mounted on a control element or control rod 25. The control rod 25 is connected at one end to a piston 26 and at its other end to a rack 27.

The piston 26 is reciprocable in a cylinder 28 having a cover 28_1 and a bottom 28_2. The piston is acted upon by a hydraulic fluid supplied by a pump 29 and controlled by a slide valve 30. The extent of travel of the piston 26 is determined by the point at which the stop 9 contacts the trip-dog 24 in the lowermost position, and by the point at which the piston contacts the cover 28_1 in the uppermost position. In the embodiment shown, the cover 28_1 limits the upper movement of the piston 26, however, any other stationary stop positioned either in the cylinder 28 or outside of it would be suitable.

The slide valve 30 includes a horizontally reciprocable piston 31 connected at its one end to a solenoid 32. The solenoid 32 is movable within and between two electromagnetic coils 33 and 34. Conduits 35 and 36 lead from spaced central locations connecting the valve 30 to the cylinder 28, serving alternately as a feed line and as a return line. The lines continue from the slide valve 30 to a sump 37 through conduits 38 and 39.

A pressure sensitive switch 40 is arranged in the conduit 35 and is provided with a spring biased piston 41 in a cylinder 42, which is connected to the conduit 35. The other end of the piston 41 is connected to a contact 43 and movement of the piston 41 under increased pressure causes the contact to complete an electrical circuit 44. The circuit 44 is connected to the coil 33 of the solenoid 32. The other coil 34 of the solenoid 32 is arranged in an electrical circuit 45. The circuit 45 comprises a switch 46, such as a pulse switch, or a relay contact, which is actuated either by the automatic control mechanism of the grinding machine, or limit switches (not shown), connected with suitable elements of the machine (for example, at each end of the carriage carrying the work piece), or by a hand adjustment to be described more fully hereinafter. The main supply circuit of direct current is generally indicated at 47.

The rack 27 of control rod 25 cooperates with a pinion 27_1 to rotate an electromagnetic clutch 48 affixed to the same shaft as the pinion 27_1. A gear 49 operatively connected to one of the mating portions of the electromagnetic clutch 48 is rotated thereby when the clutch is electrically energized and rotated by movement of the rack 27. The gear 49 meshes with a gear 50 which in turn drives a gear 51 affixed to the spindle 4 to rotate the latter. The gear 49 is also arranged to mesh with a small gear 52. An electromagnetic clutch 53, adapted to couple with a clutch engaging portion on a shaft 54, may be rotated when the clutch is actuated electrically, by revolving a hand wheel 55. The two electromagnetic clutches 48 and 53 are alternately energized by a two-

way switch 56. When the switch 56 is in the solid line position indicated in Fig. 1, the electromagnetic clutch 48 is energized for automatic feed. When the position of the switch 56 is in the dotted line position the clutch 53 will be energized to draw the clutch mating portion on the shaft 54 thereto, so that control is effected by manual operation of the hand wheel 55.

The operation of the thread grinding machine is as follows:

The grinding of the work piece 2 is accomplished when the spindle is rotated to advance the grinding wheel 1 into an operative grinding position therewith. After a traverse of the work piece 2, the switch 46 is actuated, either by the automatic controls of the grinding machine, or directly by the movement of a sliding table (not shown) which supports the work. When the switch 46 is energized the coil 34 of the solenoid 32 is energized thereby and the piston 31 of the slide valve 30 is moved into the position indicated by the dash lines. The pump 29 directs fluid from the reservoir 38 through the conduit 35 and into the cylinder space below the piston 26. The piston 26 is moved upwardly until it reaches the position indicated by the dash lines adjacent the cover 28_1.

The control rod 25 which is moved upwardly with the rack 27 causes rotation of the screw spindle 4 through the gear train 49, 50 and 51. The rotation of the screw spindle causes movement of the nut 4*a* in a direction away from the work piece to withdraw the head stock 3 from engagement therewith.

Prior to the piston reaching its upper terminal position against the cover 28_1, the dog 24, which is affixed to the control rod 25, will engage the push rod extension 23 of the push rod 21 to cause the pawl 18 to engage an upstanding pin 13 of the ratchet wheel 14 to rotate the ratchet wheel. The rotation of the ratchet wheel 14 causes rotation of the feed drum 5 to bring the next stop 9 of a feed block 8 into an operative position. When the piston 26 reaches the upper-most position indicated by the dash lines, the pressure behind the piston increases, to cause the pressure switch 40 to energize the electrical circuit 44, and cause the coil 33 of the solenoid 32 to move the solenoid 32 to the full line position and return the piston 31 to the full line position indicated in Fig. 1. In this position, the piston 31 directs fluid from the pump 29 through conduit 36 and into the cylinder 28 in the space above the piston 26. The piston is returned by the force of the fluid to its lowermost terminal position indicated by the solid lines. The lowermost position is determined by the feed stop 9 which limits the lower travel of the dog 24 affixed to the control rod 25.

The downward movement of the piston 26 causes the feed spindle 4 to rotate and move the nut 4*a* and the grinding wheel 1 toward the work piece 2. The extent of this movement, and hence the depth of cut made during this grinding wheel pass, is adjusted and set by means of the stop 9. After a traverse of the work piece is completed, the contact 46 is actuated as previously and the cycle is repeated.

After the last traverse of the work piece 2, the switch is actuated by the automatic control to maintain the grinding wheel away from the work piece in an idle position corresponding to the idle settings 8_0, 8_0. For the idling position, the stops 9 are set to hold the grinding wheel well clear of the work piece 2.

Thus the invention provides a simple mechanism for controlling the depth of cut of a grinding wheel during each pass in a multi-pass grinding operation. The mechanism provides for simple depth cutting control to effect a great many variations of cut for a plurality of individual grinding cycles. The mechanism provides simple hand operation and control if desired, as well as complete automatic grinding and controlled grinding depth stages.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles it will be understood that the

invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A feed device for a thread grinding machine including means for supporting a work piece, a grinding means mounted for movement toward and away from and laterally in respect to said work piece supporting means, means for moving said grinding means to and fro laterally, means for advancing said grinding means toward said work piece supporting means whereby to grind a work piece supported thereon during each lateral feeding movement of said grinding means in one direction and away from said work piece supporting means during lateral movement of said grinding means in the opposite direction, means for controlling said advancing means, and means responsive to said controlling means during each grinding cycle to alter said controlling means and effect change in the extent of movement of said advancing means toward said work piece supporting means during the next grinding cycle.

2. A feed device according to claim 1 including a plurality of stops movable into and out of an operative position, a fixed stop, and said controlling means movable between said fixed stop and an operative one of said movable stops during each grinding cycle to actuate said advancing means and simultaneously advance one of said movable stops into an operative position for the next grinding cycle.

3. A feed device according to claim 2 including a feed drum connected to said control means, said movable stops being positioned in circumferential and longitudinal offset positions on said feed drum, and said drum is rotated by said control means to move a stop into an effective operating position for the next grinding cycle.

4. A feeding device according to claim 3 wherein said control means includes a control rod, a member affixed to said control rod and extending outwardly therefrom, said member being effective to engage an operative one of said movable stops to limit the movement of said control rod and said grinding wheel advancing means.

5. A feeding device according to claim 4 including a piston at one end of said control rod, a cylinder in which said piston is movable, means to move said piston to its uppermost position against said fixed stop, and means thereafter effective to move said piston downwardly.

6. A feeding device according to claim 5 wherein said means for moving said piston downwardly includes means for building up pressure in said cylinder beneath said piston, and means responsive to said pressure increase beneath said piston to cause said pressure means to be directed against the top of said piston and reduced below said piston.

7. A grinding wheel feeding device for thread grinding machines comprising means for supporting a work piece, a constantly rotating grinding wheel, means for advancing said grinding wheel toward said work piece supporting means and into operative association with a work piece supported thereby, a feed drum, a plurality of adjustable stops positioned in spaced relationship on said feed drum, means for indexing said feed drum to present a different stop in an operative position during each grinding cycle, a fixed stop, and control means movable between said fixed stop and an operative one of said adjustable stops and effective to actuate said indexing means and said advancing means, the latter being actuated in proportion to the movement of said control means between said stops.

8. A feeding device according to claim 7 wherein said indexing means includes a downwardly biased push rod, a ratchet wheel connected to said feed drum, a pawl on said rod engaging said ratchet wheel, and said control means includes an element engageable with said push rod during each grinding cycle to move said rod against said biasing means to move said feed drum.

9. A feeding device for thread grinding machines comprising a work piece supporting means, a constantly rotating grinding wheel, means for advancing said grinding wheel toward said work piece supporting means and into operative association with a work piece supported thereby during each grinding cycle, a feed drum, a plurality of adjustable stops positioned in spaced relationship on said feed drum, means for indexing said feed drum to present a different stop in an operative position during each grinding cycle, a fixed stop, a control rod, a member on said control rod extending outwardly therefrom and movable between the operative one of said adjustable stops and said fixed stop, said member being engageable with said indexing means to actuate the latter during each grinding cycle, means on said control rod connected to said grinding wheel advancing means to rotate the latter and effect movement of said grinding wheel in proportion to movement of said control rod, a piston on the opposite end of said control rod, fluid pressure means, means to direct said fluid pressure against the bottom of said piston to move said control rod upwardly and move said grinding wheel in a direction away from said work piece, and means for directing said pressure means against the top of said piston to move said control rod downwardly to advance said grinding wheel into said work piece in accordance with the movement of said control rod as limited by the element thereon contacting said operative one of said adjustable stops.

10. A feeding device according to claim 9 wherein said means for advancing said grinding wheel includes a screw type spindle, a nut secured to said grinding wheel and rideable in a groove of said spindle whereby rotation of said spindle causes movement of said grinding wheel axially along the length of said spindle.

11. A feeding device according to claim 9 including means to direct pressure to said cylinder above said piston when the pressure at the bottom of said piston reaches a predetermined amount.

12. A feeding device according to claim 9 including pressure operable means to direct fluid pressure to the top of said piston.

13. A feeding device according to claim 9 wherein at least one of said adjustable stops provides for a cycle of operation in which the grinding wheel is maintained out of contact with said work piece.

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