Dec. 3, 1963 G. KOPPENWALLNER 3,112,583

CONTROL SYSTEM FOR GRINDING MACHINES

Filed March 22, 1962

FIG. 1

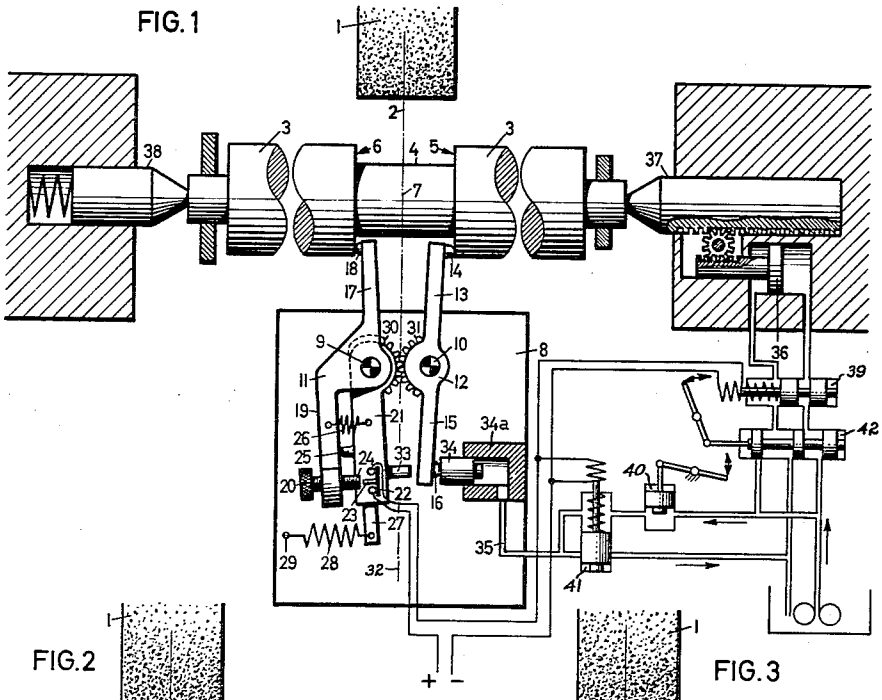


FIG. 2

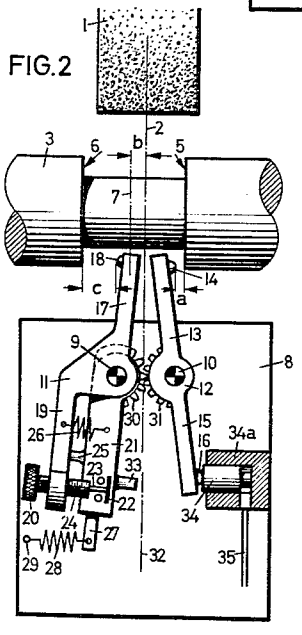
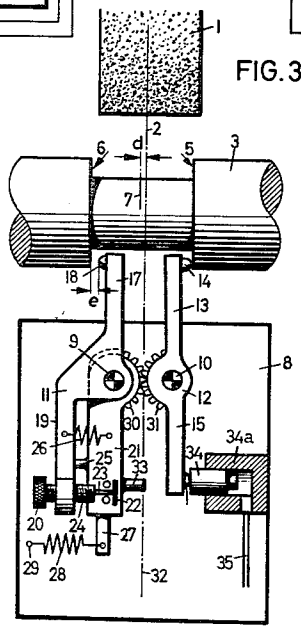


FIG. 3



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United States Patent Office 3,112,583 Patented Dec. 3, 1963

3,112,583

CONTROL SYSTEM FOR GRINDING MACHINES

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Filed Mar. 22, 1962, Ser. No. 181,714
Claims priority, application Germany Mar. 25, 1961
8 Claims. (Cl. 51—165)

The present invention relates to a grinding machine having a control system for adjusting the position of a work piece, more particularly, to a control system for adjusting the groove to be ground in a work piece with respect to the grinding wheel.

Grinding machines have been equipped with control systems to adjust a surface to be ground, such as a shoulder or a flange, with respect to another surface of the work piece such as another flange or the end thereof. Such control systems may include moving the work piece until the reference surface abuts against the fixed stop which is adjusted to the grinding wheel. In another form of a control system the reference surface is scanned by a feeler device when the grinding machine bed is displaced in the longitudinal direction and actuates a control circuit to stop the movement of the bed at a predetermined position of the feeler device.

These control systems, however, are not suitable in the grinding of annular grooves in substantially cylindrical work pieces when two oppositely positioned shoulders of the grooves are to be ground simultaneously at an accurate distance and the thickness of the grinding wheel corresponds to this distance. Under these circumstances it may occur that the material to be ground from the two shoulders of the rough work piece are not equal so that a greater quantity of material must be ground from one shoulder than from the other. It is even possible that the rough dimensions of the work piece are so distorted that when the work piece is adjusted according to known control methods, no material at all is ground from one shoulder with all the grinding occurring on the other shoulder of the groove.

It is therefore the principal object of the present invention to provide a novel and improved control system for grinding machines.

It is a further object of the present invention to provide a control system for accurately positioning an annular groove of a work piece with respect to the grinding wheel so that the grinding wheel grinds equal amounts of material off of the two shoulders of the groove.

The control system of the present invention positions the work piece in such a manner that the center of the groove to be ground corresponds to the center of the grinding wheel. With this positioning the grinding wheel will grind equal amounts of material from the two shoulders of the groove.

This control system has the further advantage that the grinding wheels are equally worn and stressed on both sides so that a longer operating life of the grinding wheel can be obtained than in those cases where the grinding wheel is subjected to unequal stresses on its two sides.

The control system of the present invention essentially comprises a pair of pivotally mounted feed control levers whose lever arms have feeler means thereon for engaging the walls or shoulders of the groove to be ground. A third control lever is pivotally mounted about the same pivot point as one of the feed control levers. This third control lever and one of the feed control levers are provided with meshing segment gears so that these levers are positively connected for simultaneous pivotal movement in opposite directions. The central plane that is between the feed control levers and parallel to their pivotal axes is positioned to correspond with the central plane of

the grinding wheel, perpendicular to the rotary axis thereof.

The third control lever is provided with a microswitch actuated by an adjusting screw mounted on an oppositely extending lever arm of the second feed control lever. An oppositely extending lever arm of the first feed control lever is actuated by a piston and cylinder device of a control system for axially displacing the work piece.

In the operation of this control system the workpiece is clamped between centers in the grinding machine and then roughly adjusted with respect to one of the feed control levers. For every workpiece the same wall or shoulder of the groove to be ground is roughly adjusted with respect to the same feed control lever. As a result of this rough adjustment the central plane of the groove is always positioned in the same direction away from the central plane of the grinding wheel at distances varying according to the dimensions of the rough workpiece.

According to the type of grinding machine the adjusting device can either be fixedly mounted in its operating position or can be pivoted into this operating position. The feed control levers are in the idle position with the feelers of the feed control levers being positioned as close together as possible so that the feelers can be positioned between the walls of the groove without risking premature contact therewith.

The two feed control levers are then pivoted so that the feelers move apart from each other until one of the feelers contacts a predetermined wall of the groove. Upon making this contact the workpiece is moved axially by a control system so that the central planes of the groove and grinding wheel coincide and the other feed control lever contacts its corresponding wall of the groove.

The feed control levers are then returned to their idle position.

Other objects and advantages of the present invention will be apparent upon reference to the accompanying description when taken in conjunction with the following drawings, wherein

FIGURE 1 is a schematic elevational view of the adjusting device of the present invention showing the workpiece in the adjusted position with respect to the grinding wheel;

FIGURE 2 is a view similar to that of FIGURE 1 but showing the position of the workpiece after rough adjustment; and

FIGURE 3 is a view similar to the views of FIGURES 1 and 2 but showing a feeler on one feed control lever in contact with a shoulder of the groove to be ground.

Returning now to the drawings, wherein like reference symbols indicate the same parts throughout the various views, there are shown the essential elements of a grinding machine necessary for the comprehension of the present invention. These elements comprise a grinding wheel 1 having a central plane 2 which is perpendicular to the axis of rotation thereof. The grinding wheel acts upon a workpiece 3 mounted between centers in the conventional manner and with an annular groove 4 therein having walls or shoulders 5 and 6, and a central plane 7.

The control device comprises a housing or casing 8 having bolts 9 and 10 mounted thereon to function as pivot shafts for control levers 11 and 12, respectively.

The first feed control lever 12 comprises a lever arm 13 having a contact or feeler 14 on the outer end thereof. There is an oppositely extending lever arm 15 having a cam 16 on the end thereof.

The second feed control lever 11 comprises a lever arm 17 having a feeler 18 on the end thereof to engage the wall 6 of the groove to be ground. There is also provided an oppositely extending lever arm 19 upon which is mounted a fine adjusting screw 20.

Also mounted on the pivot shaft 9 is a third control

lever 21 upon whose end is mounted a microswitch 22 having an actuating pin 23. The actuating pin is engageable by the inner end 24 of the adjusting screw 20.

The third control lever 21 is also provided with an abutment or stop member 25 which is urged into engagement with the lever arm 19 by a tension spring 26 interconnecting the lever arm 19 and the control lever 21.

The control lever 21 is provided with an extension 27 to which is connected a spring 28 and fixedly connected at 29 on the casing 8.

The third control lever 21 and the first feed control lever 12 are provided with meshing segment gears 30 and 31, respectively, to positively connect these two members. As a result, the third control lever 21 and the first feed control lever 12 will pivot simultaneously but in opposite directions.

The central plane of the control device is indicated at 32 and is parallel to the pivot shafts 9 and 10 and equidistant therefrom.

There is another stop member 33 on the third control lever 21 and engageable with the lever arm 15.

The cam 16 on the lever arm 15 is engageable with the outer end of a control piston 34 slidably mounted in a control cylinder 34*a*. The control cylinder 34*a* is connected through a line 35 with a fluid pressure control system of the grinding machine. This fluid pressure control system also includes a fluid pressure piston indicated generally at 36 for axially displacing a spindle 37 so as to axially displace the work piece 3. The control system is conventional and may comprise a hydraulic fluid, a compressed air, or any other system.

When a fluid pressure medium is admitted to the cylinder 34*a*, the first feed control lever 12 will be pivoted in a clockwise direction. This pivotal movement will cause a simultaneous pivotal movement of the second control lever 11 in the opposite direction due to the positive connection therebetween by the segment gears 30 and 31. This pivoting movement spreads the feelers 14 and 18 apart and this spreading movement is limited by the stop member 33 engaging the lever arm 15.

The other end of the work piece 3 is supported by a resiliently mounted spindle 38 in a known manner.

In the operation of the present control device the work piece 3 is roughly positioned on the grinding machine by conventional structure such as by a feeler control, a stop member or the like. After being so positioned, the central plane 7 of the groove 4 is spaced at a distance *b* from the central plane 32 of the control device which coincides with the central plane 2 of the grinding wheel. Any minor deviations in the dimension of this adjustment are relatively immaterial.

The control or adjustment device mounted in the housing 8 is either fixedly mounted on the grinding machine or so mounted that it can be pivoted to its operating position. The feed control levers 11 and 12 are normally in their idle positions with the feelers 14 and 18 spaced from the respective walls or shoulders 5 and 6. The distance between the shoulder 5 and the feeler 14 is indicated at *a* and is smaller than the distance *b* which is the distance between the central planes of the grooves 4 and of the control device. The distance *b*, in turn, is smaller than the distance *c* between the feeler 19 and the second shoulder 6 ($a<b<c$).

In order to precisely adjust the groove with respect to the grinding wheel, a fluid pressure medium, depending upon the nature of the control system of the grinding machine, is introduced into the cylinder 34*a* and pushes the piston 34 outwardly to pivot the lever arm 15 in a clockwise direction. Because of the positive connection between the third control lever 21 and the first feed control lever 12, these two levers are pivoted outwardly with both feelers 14 and 18 being moved by equal amounts until the feeler 14 engages the shoulder 5. This relationship is indicated in FIGURE 3 and at this time the distance *d* which is the distance between the central plane of the groove and the central plane of the control device, is one half as great as the distance *e* between the feeler 18 and the shoulder 6 ($2d=e$).

The workpiece 3 is then moved axially by the control system of the grinding machine to the right, as viewed in the drawings, so that the groove wall or shoulder 6 approaches the feeler 18. The fluid pressure is still maintained on the piston 34 and accordingly the feeler 14 follows the movement of the workpiece and remains in contact with the shoulder 5.

As soon as the feeler 18 contacts the shoulder 6, the feed control lever arm 17 of the second feed control lever 11 is prevented from further movement. However, the third control lever 21 still follows the diverging movement since it is directly coupled through the segment gears to the feed control lever 12. As a result, there is a relative displacement between the third control lever 21 and the second feed control lever 11. Consequently, the end 24 of the adjusting screw 20 disengages from the actuating pin 23 and the microswitch 22 is actuated. The microswitch then functions to actuate the control system of the grinding machine in such a manner that the supply of fluid pressure medium to the cylinder 34*a* is immediately stopped and the workpiece is clamped in position. The position of the workpiece is now as shown in FIGURE 1 with the central plane of the groove coinciding with the central planes of the grinding wheel 1 and of the control device 8.

After this spreading movement of the feed control levers is stopped, the force on the piston 34 is removed and the feed control levers return to their idle position under the action of the spring 28 attached to the third control lever 21. Because of the gear connection 30 and 31, both control levers are pivoted by equal amounts and because of this connection, the feed control levers are always pivoted through the same angles.

The fine adjusting screw 20 functions primarily to make compensating adjustments for any thermal expansion in the components that may occur during the continuous operation of the grinding machine during the course of the working day. By adjustment of this screw 20, the moment at which the microswitch operates and thus the control system of the machine functions can be varied by very small amounts.

The structure for axially moving the workpiece and the structure for pivoting said feed control levers for completing the final adjustment can be connected to the existing control system on the grinding machine. These control elements can be constructed in accordance with known methods of control techniques and either fluid pressure or some other control system may be employed.

Thus it can be seen that the present invention provides a simple yet effective control system for accurately positioning an angular groove which is to be ground with respect to the grinding wheel of a grinding machine. With such a system the groove can be more accurately ground and the grinding wheel will have a longer life since equal wear will occur on both faces of the grinding wheel.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed as this invention is:

1. A control device for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, and a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opposite direction.

2. A control system for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opposite direction, and means for axially displacing the workpiece having the groove to be ground when the first lever arm of said first feed control lever engages a shoulder of the groove until the second lever arm of the second feed control lever engages the other shoulder of the groove.

3. A control system for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a grinding wheel, a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opposite direction, the central plane of said grinding wheel perpendicular to the rotary axis thereof corresponding to the central plane between said feed control lever pivot axes and parallel to such axes, and means for axially displacing the workpiece having the groove to be ground when said first lever arm of said first feed control lever engages a shoulder of the groove, until the central plane of the groove to be ground corresponds to both of said central planes.

4. A control device for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever, and meshing segment gears on said third control lever and said first feed control lever to positively connect said feed control levers so that said feed control levers pivot concurrently in opposite directions.

5. A control device for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opposite direction, and a tension spring between said third control lever and said second lever arm of said second feed control lever to urge the second and third levers towards each other.

6. A control device for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opposite direction, a tension spring between said third control lever and said second lever arm of said second feed control lever to urge the second and third levers towards each other, a microswitch mounted on said third control lever and having an actuating pin, and a fine adjusting screw on said second lever arm of said second feed control lever and cooperating with said actuating pin to actuate said microswitch.

7. A control system for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever and operatively connected to said first feed control lever for concurrent pivotal movement therewith in an opopsite direction, and means actuating the first lever arm of said first feed control lever for following the axial displacement of the workpiece when said first lever arm of said first feed control lever engages a shoulder of the groove to be ground, until the second lever arm of said second feed control lever engages the other shoulder of the groove.

8. A control system for a grinding machine containing a grinding wheel particularly adapted for adjusting a groove of a workpiece to be ground with respect to the grinding wheel, and comprising a first pivotally mounted feed control lever having a first lever arm for engaging a shoulder of the groove to be ground, a second pivotally mounted feed control lever having a second lever arm for engaging the other shoulder of the groove to be ground, a third control lever pivotally mounted coaxially with said second feed control lever, meshing segment gears on said third control lever and said first feed control lever to positively connect said first and third feed control levers so that said first and third feed control levers pivot concurrently in opposite directions, a fluid pressure control system for causing the first lever arm to follow the axial displacement of the workpiece when said first lever arm of said first feed control lever engages a shoulder of the groove to be ground, until said second lever arm of said second feed control lever engages the other shoulder of the groove, said control system having a control cylinder and a piston therein with said piston actuating said first lever arm of said first feed control lever.

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