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Asano et al. [45] **Nov. 20, 1973**

[54] **AUTOMATIC MEASURING DEVICE**

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[52] **U.S. Cl.** **51/5**, 51/165.75, 51/165.87
[51] **Int. Cl.** **B24b 49/18**
[58] **Field of Search** .... 51/165 R, 165.75, 51/165.87, 165.88, 5

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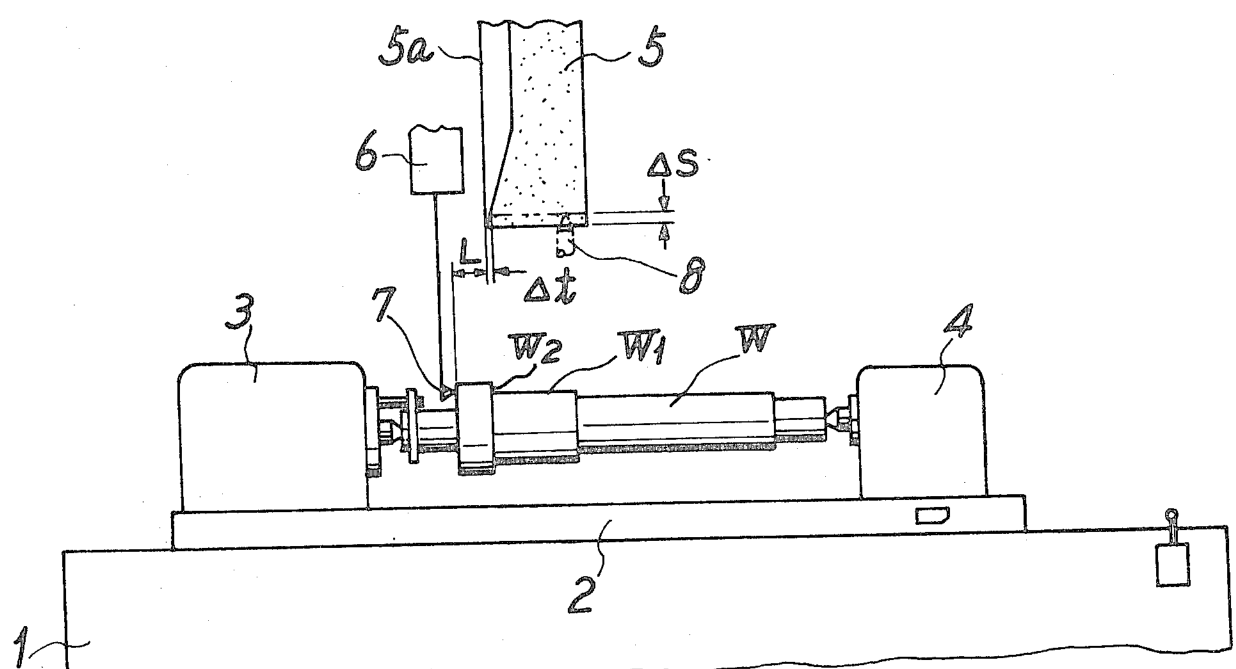
[57] **ABSTRACT**

When a concave-shaped grinding wheel is dressed by a dressing mechanism, the width thereof is reduced by a predetermined amount. To eliminate machining error on a workpiece resulting from the reduction in the width of the grinding wheel, an automatic measuring device according to the present invention is provided for moving a measuring head in an axial direction relative to the workpiece during every dressing operation in conjunction with the dressing mechanism.

12 Claims, 11 Drawing Figures



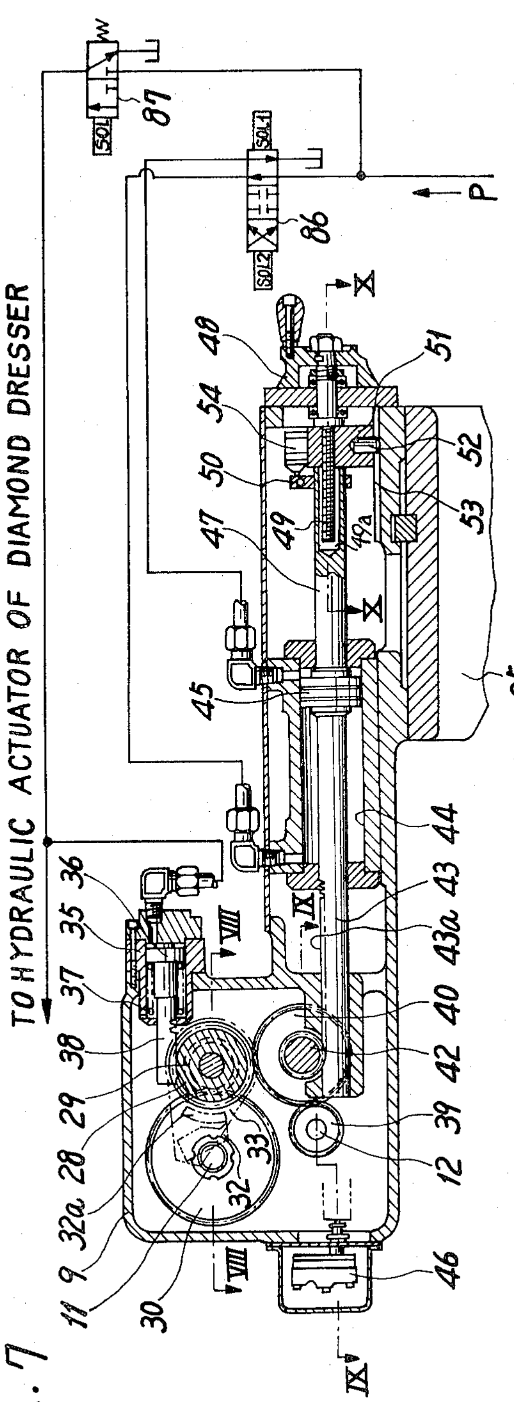


Fig. 7

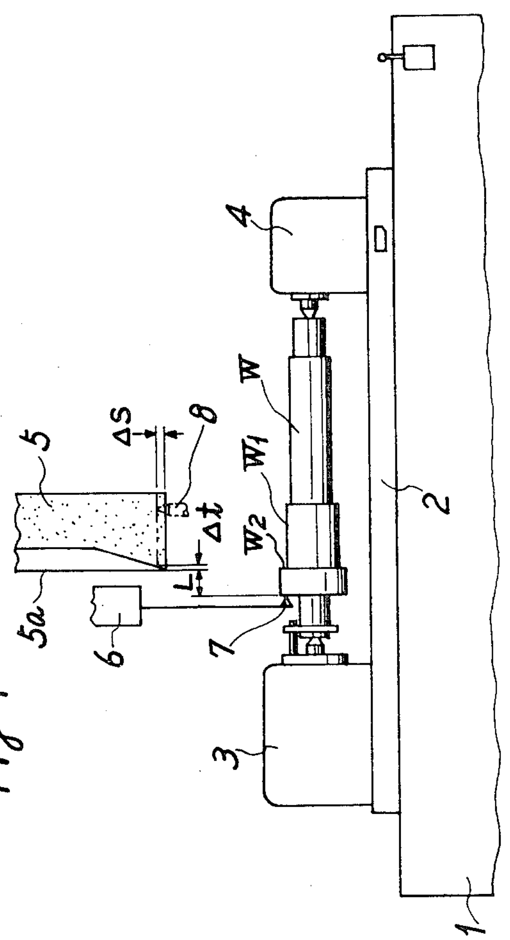


Fig. 1

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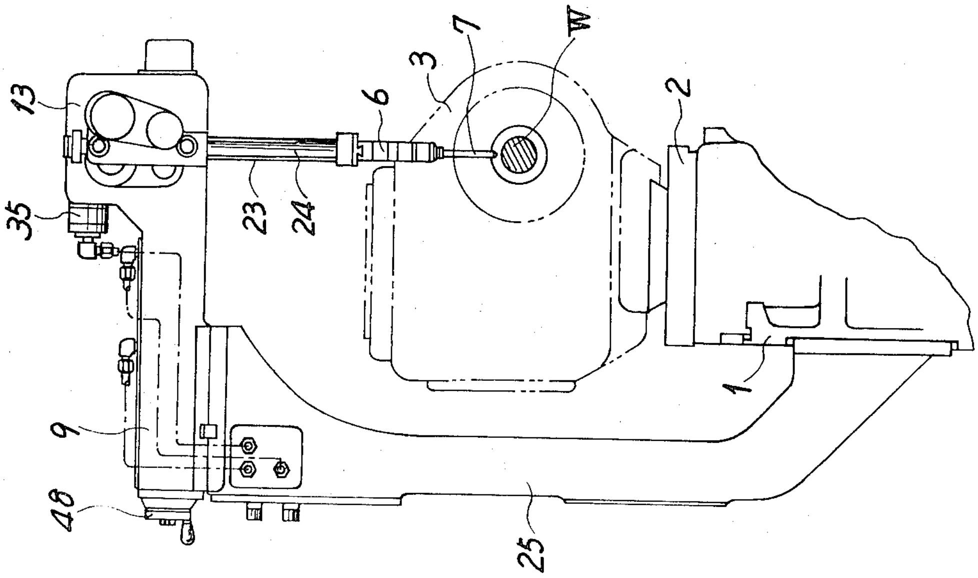
Fig. 3


13
35
9
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W
2
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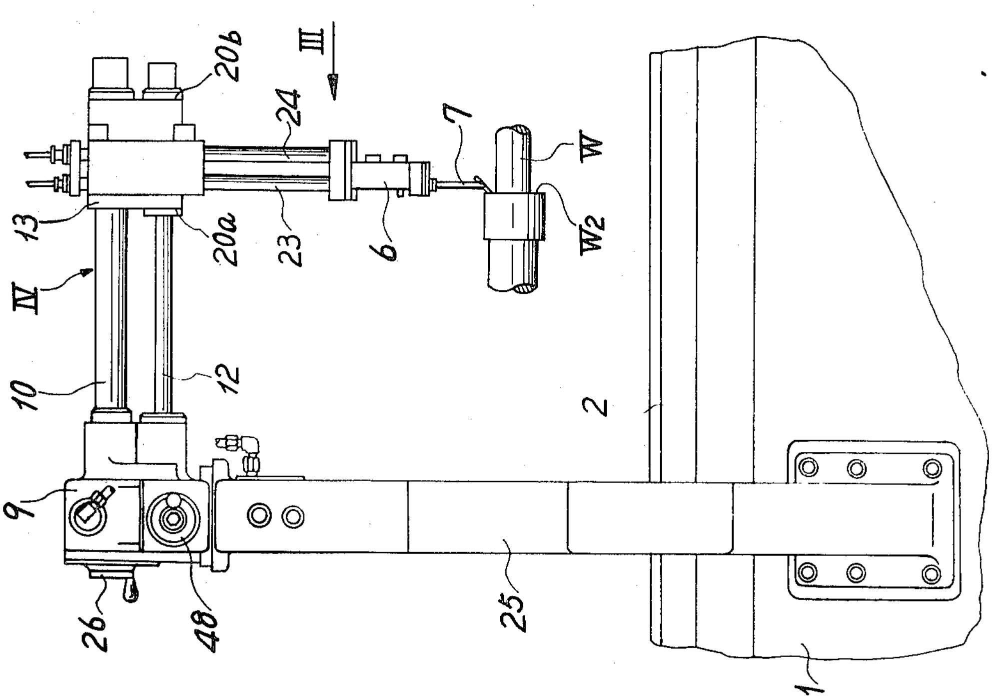
25

Fig. 2


III
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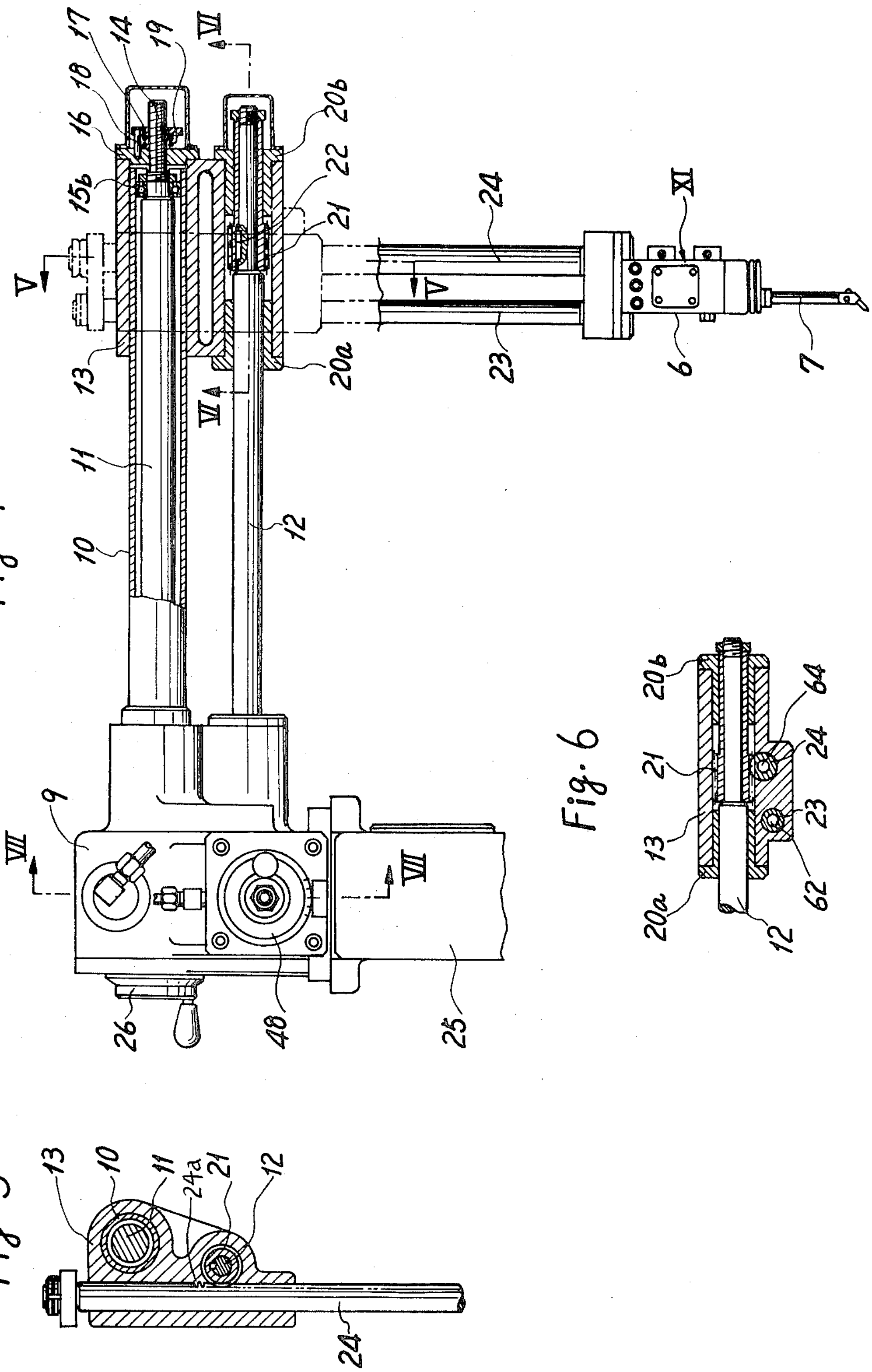


Fig. 4

Fig. 5

Fig. 6

Fig. 11

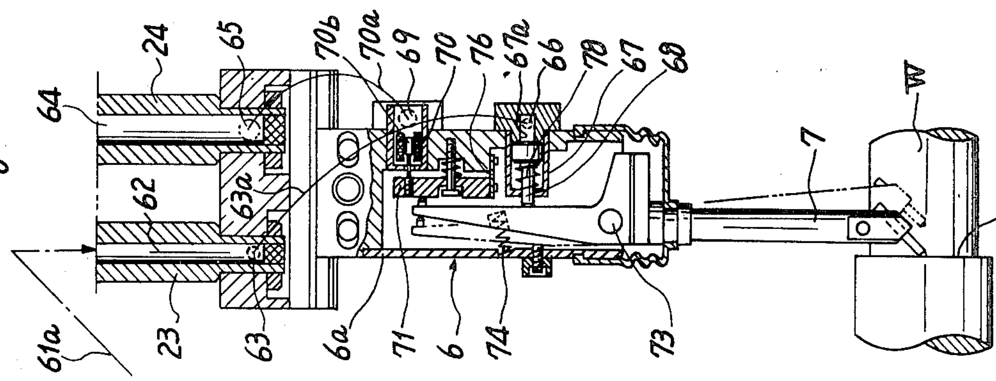


Fig. 9

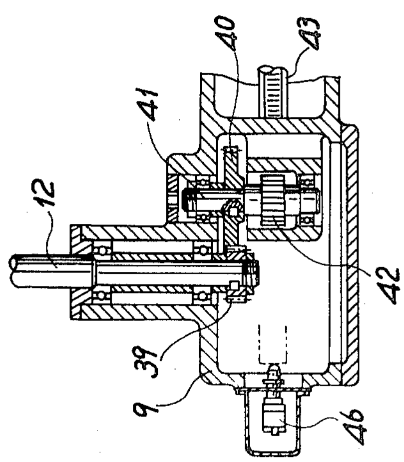


Fig. 10

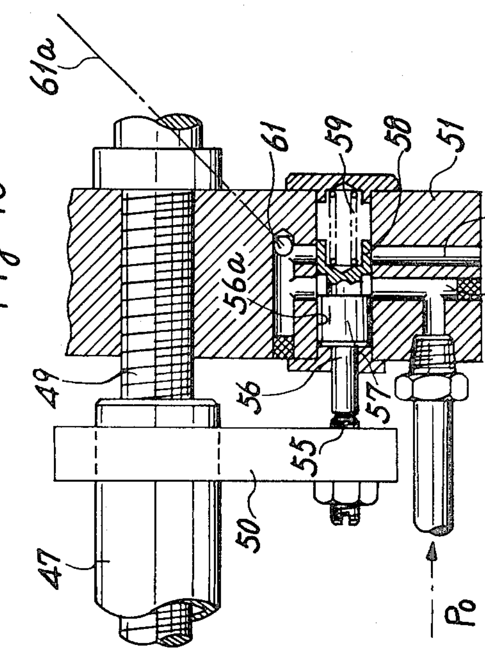
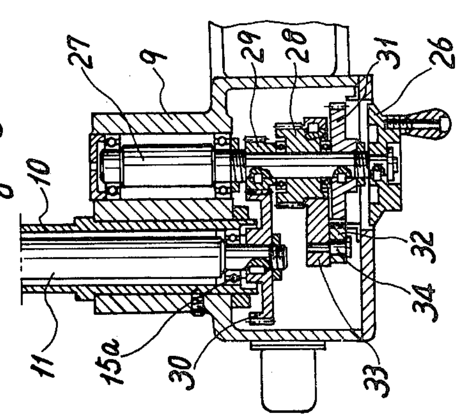


Fig. 8



AUTOMATIC MEASURING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates generally to an automatic measuring device, and more particularly concerns an improved automatic measuring device for compensating the reduction of width of the grinding wheel due to dressing operations performed thereon.

According to the most generally employed method of grinding cylindrical and shoulder portions of a workpiece during a grinding operation, in a first step, a workpiece W is loaded between a head stock 3 and a tail stock 4, which are mounted on a table 2, as shown in FIG. 1. In a second step, a feeler 7 of a measuring head 6 carried on a base 1 is moved toward the workpiece W to engage a reference surface thereof for the purpose of positioning the workpiece W at a desired axial location, and in a third step, a grinding wheel 5 is advanced for grinding a cylindrical portion W1. Thereafter, the table 2 is shifted to the right to thereby cause the wheel 5 to grind the shoulder portion W2 of the workpiece. The grinding wheel 5 for performing the aforementioned grinding operation is usually concaved on one side thereof to prevent an extra rise of temperature on the shoulder portion W2. The grinding wheel, which is concaved at the side thereof, will hereinafter be referred to as a concave grinding wheel.

The concave grinding wheel can prevent an extra rise of temperature at the shoulder portion W2 by the shoulder grinding operation, since only a small side surface 5*a* of the grinding wheel contacts the shoulder portion W2. However, the shoulder grinding operation using a concave grinding wheel gives rise to a problem regarding machining accuracy which must be solved. When a certain number of workpieces have been ground, the grinding wheel 5 must be dressed by a diamond dresser 8. Suppose the periphery of the grinding wheel 5 is dressed by an amount ΔS. The width of the grinding wheel therefore is reduced by an amount Δt. Accordingly, even if the measuring head 6 detects the axial location of the workpiece W correctly, and the table 2 is positioned in accordance with the detection sensed by the measuring head 6, the machining or grinding accuracy at the shoulder portion W2 will be reduced because the distance L between the feeler 7 of the measuring head 6 and the side surface of the grinding wheel 5 is increased since the width of the grinding wheel 5 has been reduced by the amount Δt during each of the dressing operations.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an automatic measuring device which enables a constant distance L to be maintained between a side surface of the grinding wheel and a feeler of a measuring head by compensating for the reduction in the width of the grinding wheel caused by a dressing operation.

Another object of the invention is to provide an automatic measuring device wherein the feeler of a measuring head is shifted from an engaging position to a disengaged position to avoid damage thereto except for those periods during which a measuring operation is taking place.

The foregoing and other objects are attained according to the present invention through the provision of a feeler of a measuring head which is always located at the desired position relative to the grinding wheel to thereby obtain a high degree of machining accuracy. This is accomplished by compensating for the change in distance between the feeler and a reference side surface of the grinding wheel, resulting from a dressing operation on the concave grinding wheel, by moving the measuring head at the same time the dressing operation is taking place. Also, while the measuring head is being moved between an uppermost disposition thereof and a measuring zone, the feeler of the measuring head is shifted to a disengaging position, and only when the measuring head is located in the measuring zone is the feeler shifted to an engaging or measuring position, so that the feeler is effectively prevented from being damaged by colliding with the workpiece during its use.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description when considered in connection with the accompanying drawings, in which like reference numerals designate like or corresponding parts throughout the several views, and wherein:

FIG. 1 is a schematic view showing the general relationship between a workpiece and a grinding wheel;

FIG. 2 is a front elevational view showing a preferred embodiment according to the invention;

FIG. 3 is a side view of the preferred embodiment seen from the direction designated by an arrow III in FIG. 2;

FIG. 4 is a detailed view, partly in section, of the portion indicated by an arrow IV in FIG. 2;

FIG. 5 is a sectional view taken along the line V—V in FIG. 4;

FIG. 6 is a sectional view taken along the line VI—VI in FIG. 4;

FIG. 7 is a sectional view showing a measuring head moving mechanism, taken along the line VII—VII in FIG. 4;

FIG. 8 is a sectional view showing a mechanism for moving a measuring head in a horizontal direction, taken along the line VIII—VIII in FIG. 7;

FIG. 9 is a sectional view showing a mechanism for moving a measuring head in a vertical direction, taken along the line IX—IX in FIG. 7;

FIG. 10 is a detailed sectional view showing a feeler position control mechanism, taken along the line X—X in FIG. 7; and

FIG. 11 is a sectional view showing the detail of a measuring head, indicated by an arrow XI in FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and particularly to FIGS. 2 and 3, a supporting arm 25 is shown being fixedly mounted on a base 1 for carrying a housing 9 from which a guide bar 10 and a feed shaft 12 extend horizontally in parallel relation. A slider housing 13 is slidably mounted on the bar 10 and the shaft 12. A pilot bar 23 and a rack bar 24 having a rack 24*a*, perpendicularly disposed relative to the bar 10 and the shaft 12, are in turn slidably mounted in a substantially vertical direction on the slider housing 13. Positioned at the bottom ends of the pilot bar 23 and the rack bar 24 is a measuring head 6 having a pivotable feeler 7 which may contact a workpiece W to perform a measuring operation thereon. It is to be appreciated that the whole measuring device may be attached to a wheel slide, not shown, carrying a grinding wheel instead of the base 1.

The guide bar 10 is hollowed inside and in the hollow there is coaxially contained a feed shaft 11 which is rotatably supported by antifriction bearings 15*a* and 15*b* adjacent the ends thereof. A threaded portion 14, threadably engaging a feed nut 16 secured to the slider housing 13, is formed at the front end of the feed shaft 11. An assisting nut 17 engaging a pin 18 fixed to the feed nut 16 to prevent relative rotation therebetween, is also threadedly engaged with the threaded portion 14 of the feed shaft 11. A compression spring 19 is interposed between nuts 16 and 17 so that backlash between the feed nut 16 and the threaded portion 14 is eliminated by the biasing force thereof in an axial direction. Accordingly, when the feed shaft 11 is turned, the slider housing 13 is accurately moved back and forth through the agency of the feed nut 16 and the assisting nut 17 axially of the feed shaft 11, or in other words, the feeler 7 of the measuring head 6 is moved toward and away from the shoulder portion W2 of the workpiece W. The feed shaft 12 is rotatably supported by a pair of bushings 20*a* and 20*b* fixedly carried by the slider housing 13 and has a pinion 21 secured thereto by a key 22 at the front end thereof. The pinion 21 further engages the rack 24*a* formed on the rack bar 24, as shown in FIGS. 5 and 6. Therefore, the measuring head 6 may also be moved vertically by the rotation of the feed shaft 12 under the guiding influence of the pilot bar 23.

The details of the feed mechanism for the feed shaft 11 may be described by referring to FIGS. 7 and 8. Thus, in the housing 9, the rear end of the feed shaft 11 has a gear 30 keyed thereto which is further meshingly engaged with another gear 29 fixed to a shaft 27 journaled in the housing 9 in parallel relation with the feed shaft 11. Rotatably mounted on the shaft 27 is a pinion 28 which meshingly engages a rack formed on a piston rod 38 of a piston 36 slidably disposed in an actuator 35 formed in the housing 9. A compression spring 37 is interposed in the actuator 35 for returning the piston 36 to its original position following actuation. A rocking piece 33 is secured to the pinion 28 so that the pinion 28 and the rocking piece 33 are integrally movable. A ratchet pawl 32 is pivotably mounted on the rocking piece 33 by a pin 34 and is engageable with a ratchet wheel 31 keyed to the shaft 27. Accordingly, the ratchet wheel 31 may be intermittently turned in only one direction by the reciprocating movement of the piston 36 through the pinion 28, rocking piece 33 and ratchet pawl 32. The amount of rotation of the ratchet wheel 31 may be controlled by an arc-shaped plate 32*a* which is adjustably secured to the housing 9 between the pawl 32 and the ratchet wheel 31, since, by leftward movement of the piston 36, as seen in FIG. 7, the rocking piece 33 is turned in a counterclockwise direction so that the ratchet pawl 32 slides over the arc-shaped plate 32*a* during a calibrated amount of such movement of the rocking piece 33, and thereafter becomes engaged with the ratchet wheel 31. Subsequently, further rotation imparted to the ratchet wheel 31 is transferred to the feed shaft 11 through the shaft 27 and gears 29 and 30 so that the slider housing 13 is moved in a horizontal direction.

A manual handle 26 is fixed at one end of the shaft 27 so that the slider housing 13 may also be moved manually, if desired. It is to be appreciated that the slider housing 13 can be freely movable by manual operation, since when the shaft 27 is manually rotated, the ratchet pawl 32 is located on the arc-shaped plate 32*a* and no engagement between the ratchet wheel 31 and the pawl 32 exists.

The operation of the actuator 35 is performed at the same time that a dressing actuator, not shown, for moving a diamond dresser 8 is operated, or in other words, a pressurized fluid being supplied from a pump is directed to both the actuator 35 and the dressing actuator for moving the diamond dresser 8 simultaneously. When such a dressing operation is performed on the concave grinding wheel 5, the width thereof is reduced by an amount Δt through the diametric reduction thereof, whereby the distance L between the feeler 7 and the corresponding side surface of the grinding wheel 5 is increased by the same amount Δt.

However, the distance L may be kept constant with the apparatus herein described since the feed shaft 11 is rotated to thereby move the slider housing 13 in conjunction with the dressing operation being performed on the grinding wheel. The distance through which the slider housing 13 is moved is, as mentioned above, controlled by the arc-shaped plate 32*a* in the ratchet mechanism.

Referring now to FIGS. 5, 6, 7 and 9, the details of the mechanism for moving the measuring head 6 in a vertical direction is described hereinunder. In FIG. 7, disposed in the housing 9 is a hydraulic actuator 44 which contains a slidable piston 45 having an extended rod 43 formed with a rack 43*a*. The rack 43*a* is meshingly engaged with a pinion member 42 carried by a shaft 41 which is rotatably mounted in the housing 9 in parallel relation with the feeding shaft 12. A gear 40 keyed to the shaft 41 meshingly engages a gear member 39 secured to the feed shaft 12 at one end thereof so that when the piston 45 in the hydraulic actuator 44 is advanced or moved to the right, as seen in FIG. 7, the rightward movement of the piston rod 43 is converted into rotational movement of the feed shaft 12 through pinion 42, shaft 41, gears 40 and 39, and thus the rack bar 24 is moved vertically downward through the engagement between the rack 24*a* and the pinion 21 keyed to the other end of the feed shaft 12. As understood from the above description, the measuring head 6 may be moved up or down, being guided by the pilot bar 23, by rotating the feed shaft 12 in a clockwise or a counterclockwise direction through operation of the hydraulic actuator 44. A limit switch 46, fixed at the rear end of the housing 9, is provided to confirm the fact that, upon actuation thereof by the piston rod 43, the measuring device 6 has been moved to its uppermost position.

An ordinary change-over valve 86 is provided to control pressurized fluid being supplied to the hydraulic actuator 44 so that the piston 45 therein may be moved back and forth under a controlled situation.

There is provided a stroke control device for the hydraulic actuator 44 at the opposite side of the piston rod 43. Another piston rod 47 having a hollow 49*a* in one end thereof and an engaging piece 50 fixedly mounted thereon at the front portion thereof extends from the end of the piston 45 opposite the piston rod 43. A screw shaft 49 rotatably supported at the front end of the housing 9 but precluded from axial movement is provided at one end with a handle 48 disposed outside the housing and at its other end extends into the hollow portion 49*a* of the piston rod 47. A stop block 51 is threadedly engaged with the screw shaft 49 outside the hollow 49*a* and has a limit switch 54 thereon for confirming the fact that the piston 45 has been moved to its right stroke end, or in other words, that the measuring head 6 has been advanced to its lowermost position or to the measuring zone. A pin 52 is press fitted to the stop block 51 and engages a guide groove 53 formed in the housing 9 in parallel relationship with the axis of the piston rod 47 so that the stop block 51 may not be turned and thereby be inadvertently moved in an axial direction of the piston rod 47. Accordingly, the right stroke end of the piston 45 may be controlled only by moving the stop block 51 through the handle 48, the extent of rightward movement of the piston 45 being regulated by the engagement of the stop block 51 and the piston rod 47. Thus, when the right end of the piston rod 47 is engaged with the stop block 51, the limit switch 54 is actuated by the engaging piece 50 to confirm the fact that the measuring head 6 has traveled to the measuring zone. As may be understood from the above description, when the measuring operation is not required, the feeler 7 of the measuring head 6 may be located at its uppermost position from the workpiece W, and when the measuring operation is required, the measuring head 6 is positioned in the measuring zone, whereby damage of the feeler 7 due to movement of the workpiece W or the measuring head 6 is effectively avoided.

Referring now to FIG. 11 for a description of the details of the measuring head 6, the feeler 7 is shown being pivotably mounted on a housing 6*a* of the measuring head 6 about a pin 73. To impart a calibrated pressure from the lower tip of the feeler 7 against the workpiece W, a compressed coil spring 74 is interposed between the housing 6a and the upper portion of the feeler 7. The upper end of the feeler 7 is engaged with a lever 71 attached to the housing 6a of the measuring head 6 by means of a leaf spring 76 so that the lever 71 may be turned in accordance with the pivotal movement of the feeler 7. An iron core 70*b* of a differential transformer 70 mounted in the housing 6a is secured to the free end of lever 71 for detecting the movement of a feeler 7. The differential transformer 70 converts the movement of the iron core 70*b* into an electric signal which is supplied to a main control system, not shown, of the grinding machine by a wire running through opening 69, flexible tube 70*a*, opening 65 and inner bore 64 perforated in the rack bar 24. The feeler 7 may be turned into a position, shown by the phantom line in FIG. 11, by a piston rod 68 of a hydraulic actuator 67 for disengaging the feeler 7 from the workpiece W. The piston rod 68 of the hydraulic actuator 67 is normally urged into a retracted position by a compression spring 78 contained therein and is advanced against the force of the compression spring 78 to push the feeler 7 out of engagement with the workpiece when a pressurized fluid is supplied to a chamber 67*a* of the hydraulic actuator 67. Accordingly, when the piston rod 68 is located in its retracted position, the feeler 7 is brought to the measuring position by means of the compressed spring 74, and when the piston rod 68 is advanced by the pressurized fluid supplied to the chamber 67*a*, the feeler 7 is turned out of the measuring position.

With reference now to FIG. 10, a detailed description of a feeler position control mechanism for controlling the actuator 67 will now be provided. A spool valve 56 having land portions 57 and 58 disposed in spaced relation thereon is slidably mounted in a bore 56*a* formed in the stop block 51 and connected to supply and drain conduits 60*a* and 60*b*. A compression spring 59 interposed between the spool valve 56 and a cover plate for the bore 56*a* normally urges the spool valve 56 toward the left as seen in FIG. 10, whereby supply conduit 60*a* is opened and the drain conduit 60*b* is closed by the land 58. Adjustably mounted on the engaging piece 50 of the piston rod 47 is a screw 55 which upon movement of the piston rod 47 to its right stroke end, engages the spool valve 56 and pushes the same to the right. Therefore, the land 57 closes the supply circuit 60*a* and the land 58 opens the drain conduit 60*b*.

An opening 61 connects the conduits 60*a* and 60*b* with an inner bore 62 formed in the pilot bar 23 through a flexible tube 61*a*. A connecting opening 63, provided at the bottom end of the inner bore 62, is led by a flexible tube 63*a* to the chamber 67*a* of the hydraulic chamber 67. Until the piston 45 of the hydraulic actuator 44 has arrived at its right stroke end, or in other words, when the measuring head 6 has been brought into the measuring zone, the spool valve 56 is maintained in the left position, as seen in FIG. 10, by means of the compression spring 59, and thus, the pressurized fluid is supplied to the chamber 67*a* through opening 61, flexible tube 61*a*, inner bore 62, opening 63, flexible tube 63*a* and opening 66. Accordingly, the piston 68 is advanced against the force of the spring 78 so as to turn the feeler 6 into its position of disengagement. When the piston 45 is moved to its right stroke end, the screw 55 on the engaging piece 50 pushes the spool valve 56 to the right, whereby the supply conduit 60*a* is closed by the land 57 and the drain conduit 60*b* is opened to the atmosphere resulting in the pressure in the chamber 67*a* being reduced to that of the atmosphere and the piston rod 68 being retracted into the actuator 67 by operation of the biasing force of compression spring 78. Subsequently, the feeler 7 is turned in a clockwise direction by the compression spring 74 into its engaging or measuring position.

The complete operation of the automatic measuring device of this invention will now be described. The position in a horizontal direction of the slider housing 13 and the position in the measuring zone of the measuring head 6 are respectively adjusted initially so as to produce a preselected measuring signal by rotating the feed shaft 11 with the manual handle 26 and by shifting the stop block 51 through manual operation of the handle 48 so that the measuring head 6 is located at the most suitable position with respect to the workpiece W supported by the headstock 3 and the tailstock 4.

When the grinding operation is started, the solenoid SOL 1 of the change-over valve 86 is energized so that the measuring head 6 may be descended into the measuring zone. When the measuring head 6 is positioned in the measuring zone, the feeler 7 is turned to the measuring position by means of the compression spring 74. Simultaneously, the limit switch 54 is actuated by the engaging piece 50 to confirm the fact that the piston 45 of the hydraulic actuator 44 has arrived at its proposed stroke end, thus producing a signal which initiates movement of the table 2 in an axial direction of the workpiece W. Therefore, the shoulder portion W2 of the workpiece W is engaged by the feeler 7 and the measuring head 6 produces a measuring signal when the workpiece W and the measuring head 6 come into a predetermined relationship relative to the distance therebetween. By the measuring signal, the table 2 is stopped and another solenoid, namely solenoid SOL 2 of the change-over valve 86, is energized so as to move the piston 45 in the opposite direction, whereby the measuring head 6 is retracted into its uppermost position. When the piston 45 begins to retract, the engaging piece 50 on the piston rod 47 is disengaged from the spool valve 56 resulting in the land portion 57 of the spool valve 56 opening the supply conduit 60*a* and the land portion 58 thereof closing the drain conduit 60*b*. Subsequently, the pressurized fluid is supplied to the chamber 67*a* of the hydraulic actuator 67, whereby the feeler 7 is turned by the piston rod 68 so as to be disengaged from the workpiece W. When the measuring head 6 is retracted to its uppermost position, the limit switch 46 is actuated by the piston rod 43 to produce another electrical signal which initiates the advancing movement of the grinding wheel 5 toward the workpiece W to perform a grinding operation on the cylindrical portion W1 and the shoulder portion W2 of the workpiece W. When a predetermined number of grinding operation cycles has been completed, a dressing signal is produced, by which a change-over valve 87 is energized to direct the pressurized fluid for advancing the diamond dresser 8 toward the concave grinding wheel 5. In case the periphery of the grinding wheel 5 is dressed by an amount ΔS, the width thereof is, as mentioned above, reduced by the amount Δt, and as a result, the distance L between the feeler 7 and the side surface of the grinding wheel 5 is increased by the same amount. However, when the change-over valve 87 is energized by the dressing signal to advance the diamond dresser 8, the ratchet wheel actuator 35 is also supplied with the same pressurized fluid to move the slider housing 13 and thereby to eliminate the normally produced differential Δt through the operation of the ratchet mechanism and its associated gear train. As understood from the above description, the distance L is automatically and accurately compensated for any such variation being introduced, and accordingly is always kept constant.

While the invention has been described by means of a specific embodiment, it should be understood that the novel characteristics thereof may be incorporated in other structural forms. It is to be understood, therefore, that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An automatic measuring device for use in a grinding machine having a bed, workpiece supporting means slidably mounted on said bed in a longitudinal direction thereof and serving to rotatably support a workpiece, a wheelslide mounted on said bed being movable toward and away from said workpiece, said wheel-slide rotatably supporting a grinding wheel for grinding said workpiece, and dressing means for performing a dressing operation on said grinding wheel resulting in a reduction of width of said grinding wheel by a predetermined dimension in each dressing operation thereby, comprising:

a housing;

guide means mounted on said housing;

supporting means movably guided by said guide means in a direction parallel to the axis of said grinding wheel;

measuring means supported by said supporting means and being movable toward and away from said workpiece, said measuring means having feeler means for contacting a shoulder portion of said workpiece;

first feed means for moving said measuring means toward and away from a measuring zone; and

second feel means for moving said measuring means together with said supporting means in an axial direction of the grinding wheel relative thereto by said predetermined dimension in response to a dressing operation on said grinding wheel so as to compensate for said reduction of width of said grinding wheel and to constantly maintain a predetermined relative position between a grinding end surface of the grinding wheel and said measuring means.

2. An automatic measuring device according to claim 1, wherein said second feed means comprises:

a feed shaft operably connected to said measuring means for axially moving the same;

power means for rotating said feed shaft; and

ratchet means connected between said feed shaft and said power means for controlling the amount of rotation of said feed shaft.

3. An automatic measuring device according to claim 1, wherein said measuring means comprises:

a feeler pivotably mounted on a housing of said measuring means;

spring means for urging said feeler in one direction;

power means for urging said feeler in another direction against the biasing force of said spring means; and

detecting means for detecting pivotal movement of said feeler.

4. An automatic measuring device according to claim 1, wherein said first feed means comprises a reciprocating actuator for moving said measuring means toward and away from said measuring zone, said reciprocating actuator having at least one rod extending therefrom.

5. An automatic measuring device according to claim 3, which further comprises switching means responsive to movement of said first feed means for controlling the pivotal movement of said feeler means to thereby engage or disengage the same from said workpiece.

6. An automatic measuring device according to claim 3, wherein said detecting means is a differential transformer for converting the pivotal movement of said feeler into an electrical signal.

7. An automatic measuring device according to claim 3, which further comprises switching means responsive to a movement of said first feed means for deenergizing said power means when said measuring means is brought to the measuring zone, whereby said feeler is shifted to an engaging position by means of said spring means.

8. An automatic measuring means according to claim 4, which further comprises stop means for regulating said reciprocating actuator.

9. An automatic measuring device according to claim 5, wherein said power means is a hydraulic actuator; and

said switching means comprises valve means for controlling the supply of pressurized fluid to said power means and spring means for urging said valve means in one direction.

10. An automatic measuring device according to claim **8**, wherein said stop means comprises:

a screw shaft rotatably mounted on said housing;

a stop block threadedly engaged with said screw shaft and adapted to engage said rod extending from said reciprocating actuator to regulate the movement of said reciprocating actuator.

11. An automatic measuring device according to claim **10**, which further comprises valve means slidably mounted in said stop block for controlling the supply of pressurized fluid to said power means being movable in one direction by said extended rod, and spring means for urging said valve means in another direction.

12. An automatic measuring device for a grinding machine having a concave grinding wheel comprising:

a housing;

guide means fixably mounted on said housing;

supporting means slidably carried by said guide means;

measuring means movably mounted on said supporting means for measuring a position of a workpiece;

first feed means for moving said measuring means toward a measuring zone when a grinding operation is to be performed and away from a measuring zone when a dressing operation is to be performed on said workpiece;

second feed means for moving said supporting means in an axial direction of said workpiece through a calibrated distance corresponding to the reduction in the width of the grinding wheel surface while a dressing operation is being performed on the grinding wheel; and

dressing means for dressing said grinding wheel, said dressing means and said second feed means being connected to a common switching means for being cooperatively controlled.

* * * * *