This invention relates generally to testing machines, and particularly to an improved apparatus for testing and classifying abrasive specimens as to their relative hardness.

The bonded abrasive specimens which the machine of the present invention is designed to test find use in various metal finishing processes, such as, for example, honing and grinding, and are fabricated generally from abrasive grit particles carried within a suitable matrix material. These specimens of articles are generally molded into a variety of shapes, such as sticks or wheels, depending on particular needs and desires and are mounted in a suitable holder to form an abrasive tool. Since abrasive tools having different hardnesses find different uses in industry, it is customary, after fabricating these abrasive articles to segregate and classify them as to relative hardness.

As used herein, hardness refers to the adhesive strength between the abrasive grit and bond particles in a particular specimen provided for by the adhesive substance and which is also a function of the particle grain size and type and the specimen porosity. Stated in another way, this property is used to indicate how readily the bonded abrasive grit and bond particles in the specimens making up a tool will break away during use.

In finishing different materials, the requirements for a particular abrasive tool relating to the ability of the component particles thereof to break away will vary widely. Thus, the knowledge of this property serves as a guide in determining the particular abrasive tool to use for a given job. Various devices adapted to test and classify abrasive specimens of this type have been proposed in the past and have met with varying degrees of success, and it is this type of device to which the present invention relates.

Briefly, the device of the present invention includes a fixture adapted to grip the abrasive specimen and move it along a suitable support. A grading device having a relatively hard surface is positioned to interferingly engage a particular surface of the abrasive article after it has been smoothed or dressed and is adapted to break away the grit and filler particles from their bond in the specimen. A suitable gauge and/or recording device is provided from which the deflection of the grading device is read and/or recorded as it contacts the abrasive article and it is the extent of this deflection which is used to rate the stone hardness. Thus, by similarly processing a series of abrasive articles, the relative hardness of each can be accurately determined.

One of the problems which arises in this type of testing apparatus lies in maintaining constant the extent of interference between the grading tool and the abrasive specimen. This is necessary in order to provide an accurate relative hardness reading for succeeding abrasive specimens since the grading tool deflection increases proportionally with the extent of interference. Further, this problem is compounded by the fact that these molded abrasive specimens generally have highly irregular surfaces. Thus, even though the grading tool and the abrasive specimen are moved relative to each other in a straight line, the depth of penetration into the abrasive specimen by the grading tool may vary over a wide range because of this surface irregularity thereby rendering the grade or hardness reading relatively inaccurate and of no use.

The device of the present invention overcomes this problem by providing a relatively hard dressing tool positioned adjacent the grading device and which is operative to smooth or dress a surface of the abrasive specimen to be graded. The working surfaces of the dressing tool and the grading device are accurately adjustable relative to each other to maintain the extent of interference between the grading device and the dressed specimen surface constant. Thereafter, relative straight-line movement between the abrasive specimen and the grading tool produces a controlled constant depth penetration and an accurate measurement of the specimen hardness.

The device of the present invention provides an improved apparatus adapted to accurately test and grade a bonded abrasive specimen.

It is a further object of the present invention to provide an improved apparatus of the above character adapted to accurately smooth or dress a surface of the abrasive specimen before testing.

It is a further object of the present invention to provide an improved testing and grading apparatus of the above character adapted for use with a variety of abrasive specimens.

It is a further object of the present invention to provide an improved apparatus of the above character having means for indicating and recording the relative abrasive specimen hardness.

It is still a further object of the present invention to provide an improved apparatus of the above character which is relatively inexpensive to manufacture, rugged in construction and reliable in use.

Further objects and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the drawings in which:

FIGURE 1 is a perspective view of a testing and grading machine constructed according to the principles of the present invention;

FIG. 2 is an enlarged front elevation view of a portion of the structure of FIG. 1;

FIG. 3 is a view of the structure of FIG. 2 taken in the direction of the arrow 3;

FIG. 4 is a plan view of the structure of FIG. 2;

FIG. 5 is an enlarged fragmentary sectional view of the structure of FIG. 2 taken along the line 5-5 thereof;

FIG. 6 is an enlarged fragmentary view of a preferred form of testing device; and

FIG. 7 is a view similar to FIG. 6 illustrating a modified form of testing device.

Referring now more specifically to the drawings and especially FIGS. 1-4, the testing and grading machine of the present invention is seen to include a frame 11 having a base 13 rigidly mounted thereon adapted to support the machine assembly. A carriage and vise assembly generally indicated at 15 and 61, respectively, are mounted for movement longitudinally along the base 13 and carry the abrasive specimen being tested therewith. An abrasive dressing tool assembly and grading assembly 99 and 101, respectively, fixed to the base 13 are positioned to dress and grade the abrasive specimen in a manner to be described.

The drive for the carriage 15 includes an interconnected reversible variable speed electric motor 17 and planetary speed reducer 19 fixed atop the base 13 as by screws 21. The speed reducer 19 is provided with an output shaft 23 drivingly connected to a feed screw 25 by a coupling 27. A thrust bearing assembly 29 is retained within a guide bracket 31 suitably fixed to the base 13 as by screws 32.
and is received in a reduced diameter portion 34 formed on the feed screw 25. Thus, the feed screw 25 is restrained against axial movement relative to the bracket 31 while being movable relative thereto.

The feed screw 25 extends beyond the guide bracket 31 and through a traveling carriage 33 movably supported atop the base 13. A traveling unit 35 is fixed to the carriage 33 by screws 37 and threadedly receives the feed screw 25. Additionally, a pair of generally elongated bars 39 extend parallel to and on either side of the feed screw 25 and have their ends snugly received within the guide bracket 31 and another guide bracket 41 also suitably fixed to the base 13 as by screws 42. A pair of elongated blocks 43 are fixed to the guide brackets 31 and 41 by screws 45 and to the base 13 by clamps 47. See FIG. 3. These blocks 43 are provided with an upper surface complementary to and adapted to support a respective one of the bars 39 intermediate their ends. A pair of sleeves 49 extends through suitable longitudinal openings formed in the carriage 33 and are slidably supported upon a respective one of the bars 39. Conventional means such as screws 51 are employed laterally to a point within the carriage 33 to engage the sleeves 49 and fix them within the carriage and snugly but slidably upon the bars 39. The sleeves 49 are broken away as at 53 and the carriage 33 at 55 to avoid interference with the blocks 43 as the carriage 33 traverses the base 13. A pair of protective boots 57 may be secured to the bracket 31 and carriage 33, and the bracket 41 and carriage 33, respectively, by straps 59 to shield the feed screw and guide assembly from shavings, dirt and other foreign matter. Thus, as the feed screw 25 rotates by rotation of the drive motor 17 and shaft 23, the carriage 33 traverses the base 13 sliding along the bars 39, the direction of carriage movement being dependent upon the direction of rotation of the feed screw.

The extent of movement of the carriage 33 along the base 13 is determined by a pair of limit switches 52 and 54 electrically connected to the motor 17. See FIG. 4. Each of the limit switches 54 is provided with a control arm 56 engageable by an actuator plate 58 fixed to the carriage 33 by a screw 60. Initially, the carriage 33 is positioned as shown in FIG. 4 with the actuator plate 58 in engagement with the control arm 56 of the switch 54. A three-position main power switch 62 is manually movable to a "forward" position to energize the motor 17 thereby causing rotation of the feed screw 25 and movement of the carriage in a right-hand direction along the base 13 as seen in FIG. 4. The speed of the motor 17 may be adjusted by a rheostat control 50. When the actuator plate 58 engages the control arm 56 of the switch 52, the motor 17 is deenergized and rotation of the feed screw 25 is stopped. The carriage 33 is moved back to the FIG. 4 position by manually moving switch 62 to its "reverse" position which reverses the rotational direction of the motor 17 and the feed screw 25. The carriage 33 then moves in a left-hand direction until the actuator plate 58 engages the arm 56 of the switch 54 whereupon the motor 17 is deenergized until the main switch 62 is returned to the "forward" position.

A vise assembly, generally indicated at 61 in FIGS. 1-4 is positioned atop the carriage 33 for movement therewith and is also adjustable transversely of the direction of carriage movement. This vise assembly 61 includes a jaw 65 and a plate 66 and is positioned upon a cross-slide 67 moveable transversely of the carriage 33. The jaw 65 is fixed to an upwardly extending arm 48 of the cross-slide 67 by suitable means, such as screws 68, while the jaw 65 is fixed to a plate member 69 by suitable means such as screws 71. See FIG. 2. A spooling carriage 66 is provided with an abrasive specimen 64 against downward movement within the jaws 63 and 65 and can be locked in a variety of positions by a clamping screw 70 having a head 72 and extending through an enlarged opening 74 formed in the jaw 65 and threadedly received in the plate 66. Thus, by properly orienting the plate 66 and fixing it against the jaw 65 through the screws 70, specimens of a variety of sizes and configurations can be positioned with a flat surface thereof in a predetermined relation with respect to the top edges of the jaws 63 and 65. In addition, the plate 66 may take a variety of configurations depending on the configuration of specimens being tested.

A lug 73 which may be formed integral with the cross-slide 67 extends upwardly therefrom and is freely positioned within a recess 75 formed in the plate 69. A screw 77 having a head 78 is threadedly received within the plate 69 rearwardly of the recess 75 and has a portion rotatably disposed within the lug 73 and restrained against axial movement therein by a thrust bearing 79. Thus, the vise jaw 65 is moved toward and away from the jaw 63 to grip the abrasive specimen 64 by rotation of the screw 77.

The cross-slide 67 is slidable along the carriage 33 transversely of the direction of movement of the carriage through a dovetail arrangement including a tenon 81 formed on the cross-slide 67 and received within a mortise 83 formed in the carriage 33. A bracket 85 is fixed to the carriage 33 by a pair of screws 87 and has a feed screw 88 having a hand wheel 89 fixed thereto rotatably retained therein by a thrust bearing 91. Thus, the feed screw 88 can be adjusted and threadedly received within the cross-slide 67 and rotation thereof adjusts the position of the cross-slide relative to the carriage 33. Thus, after the abrasive specimen 64 is positioned between the jaws 63 and 65 and the supporting plate 66 properly adjusted as to height and orientation, the screw 77 is rotated to cause the jaws 63 and 65 to securely grip the specimen. Thereafter, the screw 88 is rotated to position the specimen at the desired location on the carriage 33 transversely of its direction of movement along the base 13.

The abrasive dressing and grading assemblies are shown generally at 99 and 101, respectively, and each is fixed to an arm 103 extending upwardly from the base 13 and fixed thereto as by screws 105 and dowel pins 104. The dressing assembly 99 includes a dressing tool spindle 106 having an end portion 107 removably fixed thereto in which is disposed one or a plurality of relatively hard abrasive dressing tools 109. These dressing tools 109 may be constructed of any suitable abrasive substance which is harder than the abrasive specimen 64 to be dressed. For example, diamond impregnated dressing tools have been found to be extremely satisfactory. The spindle 106 is freely rotatably disposed within a spindle housing 111 fixed to the arm 103 by screws 113 and is vertically adjustable relative thereto to insure contact between the tool 109 and the specimen 64 by a pair of ring nuts 115. The nuts 115 threadedly engage the spindle 106 and abut the end portions of the spindle housing 111 to releasably lock the spindle in a desired vertical position.

An electric drive motor 117 for the spindle 106 is fixed to a mounting plate 119 by screws 120 and the plate 119 is in turn adjustably carried by the arm 103. A pivot pin 121 is removably received in suitable openings formed in a pair of spaced ears 123 extending outwardly from the plate 119 along the side thereof and the portion of the pin 121 intermediate the ears 123 extends through a boss 125 formed integrally with the arm 103. The other side of the plate 119 is fixed to a pair of vertically spaced bolts 127 by self-locking nuts 126 and the nuts 126 are in turn adjustably fixed to the arm 103 by nuts 129. The motor 117 has a rotary output shaft 131 fixed to a pulley 133 and retained thereon by a nut 134. An endless belt 135 is disposed over the pulley 133 and a second pulley 137 fixed to the spindle 106 by a nut 138 so that rotation is imparted to the spindle 106. Belts 126, 127, 131 and 137 are spaced. A suitable belt cover 139 is fixed to the arm 103 by a bracket 141 to shield the belt drive assembly and prevent the user from inadvertently or accidentally inserting his hands therein. Thus, after the abrasive specimen 64 is
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5 positioned between and gripped by the vise jaws 63 and 65 and the cross-slide 67 adjusted transversely of the direction of movement of the carriage 33, movement of the carriage 33 along the base 13 by energizing the motor 17 and rotating the feed screw 25 causes the top surface of the specimen 64 to be engaged and dressed by the rotating dressing tools 109.

To assist in positioning the specimen 64 within the vise jaws 63 and 65 for proper contact with the dressing tools 109, a set-up block assembly indicated generally at 143 is provided and is shown in FIGS. 2 and 5. This set-up block assembly 143 includes a gauge block 145 having a generally vertically extending groove 147 along one side edge thereof. A swing bolt 149 is pivotally attached at one end to the fixed vise jaw 63 within a groove 152 adjacent the top thereof by a bushing 153 integral with the bolt 149 and pivoted to the jaw 63 by a pivot pin 154. A sleeve member 150 having an enlarged hand knob 151 is threaded on the other end of the swing bolt 149. In use, the block 145 is positioned atop the jaws 63 and 65 after the specimen 64 is inserted therein. The swing bolt 149 is outwardly positioned upwardly in a position in the groove 147 and the hand knob 151 and sleeve 150 rotated upwardly to clamp the block 145 against the jaw 63 with the shoulder portion thereof 150 atop the block 145. The specimen supporting block 66 is then adjusted vertically and oriented angularly to bring the top edge of the specimen 64 firmly against the bottom surface of the block 145 and thereafter the screws 70 and 77 are tightened to lock the supporting block 66 and vise jaw 65, respectively. The swing bolt 149 is then pivoted out of the way and the set-up block 145 is removed from the vise assembly leaving the specimen top edge ready for dressing.

After the top edge of the abrasive specimen 64 has been dressed by the tools 109, it is ready for grading by the grading tool assembly generally indicated at 101. See FIGS. 1, 3, 4, 5, and 6. The grading assembly 101 includes a force sensing block 171 disposed on a positioning slide 155 having a vertically extending dovetail tenon 157. A base block 161 suitably fixed to the arm 103 by means (not shown) is provided with a mortise 159 slidably receiving the tenon 157. A feed screw 163 is threadedly received in a lug 165 depending from the arm 103 and has a reduced diameter lower end portion 167 threadedly received within the dovetail tenon 157 of the slide 155 and is formed with a hand wheel 169 at its upper end. The pitch of the screw portion of the lug 165 is greater than the thread pitch of the screw portion as 163 and the tenon 157. Thus, the slide 155 is adjustable vertically by rotation of the feed screw through the hand wheel 169.

The force sensing block 171 is pivotally carried by the positioning slide 155 through a suitable pivot pin 173 for movement from a specimen grading position, as illustrated in the drawings, to a position where the lower portion thereof is swung outwardly and upwardly from the grading shown in the drawings. A locking screw 175 having an enlarged hand knob 177 is threadedly received within the mortise 159 and is adapted to engage the block 171 and fix it in its pivoted position. Additionally, the block 171 is beveled at 179 to avoid interference with the slide 155 when pivoted to its upper position. See FIG. 3.

The force sensing block 171 is provided with a beam 181 extending integrally therefrom in cantilever fashion or otherwise carried thereby for limited movement relative thereto. A grading wheel 183 having a relatively hard edge surface is carried by the beam 181 for free rotation relative thereto by a pin member 185. The edge of the wheel 183 is constructed from a relatively hard grade of steel or other suitable material and is a Rockwell hardness number of about 60 has been found satisfactory. The height of the positioning slide 155 is adjusted by rotation of the screw 163 so that as the specimen 64 traverses the base 13, the edge of the grading wheel 183 interferingly engages the specimen top surface to a preselected extent.

The beam 181 is engageable with the bottom of a push rod 187 slidably disposed for vertical movement within the force sensing block 171. The push rod 187 has an enlarged flange 401 which operatively engages a movable gauge pin 402 of a gauge head 197 fixed to gauge plate 189. The gauge plate 189 is, in turn, fixed to one end of a pair of flexible reeds 193 and 403 by screws 195 and 404, respectively. The other end of the reed 193 is fixed by screws 196 to one end of a plate 191, the other end of which is fixed to the force sensing block 171 in cantilever fashion with the plate 191 forming an engaging member for the gauge head 197 and gauge plate 189.

The reed 403 is fixed at its other end to the force sensing block 171 by screws 405. Thus, the deflection of the beam 181 as the abrasive specimen 64 traverses under the wheel 183 is reflected in vertical movement of the push rod 187 and vertical deflection of the gauge pin 402 which actuates the gauge head 197.

The gauge head 197 is, as described above, fixed to the gauge plate 189 and is adapted to monitor movement of the push rod 187 relative to the force sensing block 171. Specifically, the gauge head 197 and each condenser may be the type illustrated and described in the copending application, Ser. No. 351,013, filed Mar. 11, 1964 now U.S. Patent No. 3,308,357, and owned by the assignee of the present application; or it may be the type illustrated and described in the U.S. Patent No. 2,908,980 to M. M. Atlin.

Broadly described, this gauge head 197 monitors the sequence of movement of the push rod 187 relative to the force sensing block 171 as it deflects the gauge pin 402, actuating the gauge head 197 which emits a signal in response thereto in the manner described in the copending application and patent referred to above. Conventionally, this signal is fed to a modular device 199 through a conduit 200 and may be recorded by a recording device 201. In this way, a permanent recording of the relative deflections of the grading wheel 183 during traversal of the specimen 64 is made available.

The grading device 101 of the present invention is designed to determine the hardness or bond strength between abrasive particles in an abrasive specimen. This is done by measuring relative deflection of the grading wheel 183 and the force beam 181 during specimen traversal. The grading wheel 183 is set for a predetermined amount of interference with the dressed top surface of the specimen 64 so that as the specimen traverses the grading wheel, the effect will be one of crushing of the abrasive by the wheel. The extent of interference between the grading wheel 183 and the specimen 64 is selected by adjusting the grading wheel to a correspondingly dimensioned elevation below the dressing tools 109. Thus, the specimen is first dressed by the tools 109 and then traversed across the grading wheel 183.

The relative heights of the dressing tools 109 and the grading wheel 183 are determined by indexing the carriage 33 to a position where the tool 109 and thereafter the wheel 183 engage an indicator assembly shown generally at 203. See FIGS. 2 and 3. This indicator assembly 205 includes one or a pair of gauges 205 each having a vertically movable actuator arm 207. The gauges 205 are movably fixed to a plate 209 having an integral arm 214.

An extension 218 of the arm 214 is fixed to the arm portion 66 of the cross-slide 67 by screws 216. An actuating pad 213 is provided for each of the indicators 205 and each is disposed for limited vertical movement adjacent the pad 214. A resilient cushion 215 is positioned between the pad 214 and each of the pads 213 to normally maintain the pads in an upward position as shown in the drawings.

Thus, the pads 213 has a downwardly depending portion 217 engageable with a respective one of the actuator arms 207. Thus, the relative heights of the dressing tools 109 and the grading wheel 183 are determined by indexing the carriage 33 to a position where the tools 109 and
the wheel 183 engage a respective one of the pads 213. The deflection of these pads 213 is reflected in deflection of the arms 207 and is read on the gauges 205. In the case where only one gauge 205 and pad 213 is provided, the first the grading tools 109 and then the grading wheel 183 are engaged with the pad 213 with the relative deflections of the arm 207 read on the gauge 205. The relative height differential between the dressing tools 109 and the grading wheel 183 is attained by adjustment of either the dressing tool spindle 206 or the positioning slide 155. In the specimen is mounted in the vise using the set-up block as indicated above. The relative elevations of the tool 109 and the wheel 183 are gauged and adjusted by adjusting the spindle 107 and the screw 165, respectively. Thereafter, the grading wheel assembly is moved to its out-of-the-way position by loosening the screw 175, swinging the block 171 outwards and upwardly and retightening the screw 175. The cross-slide 67 is positioned along the carriage 33 by rotating the hand wheel 89 and the screw 88 so that the dressing tools 109 can engage the specimen 64. The carriage is traversed along the base 13 by moving the switch 62 to the forward position of the wheel 183. During the operation, the specimen hardness is measured through actuation of the gauge pin 402 and gauge head 197 and recorded by the recorder 201. A modified form of grading assembly is shown in FIG. 7 and includes a positioning slide 255 slidably disposed upon a base block 261 in a fashion similar to the slide 155 and block 161 of FIGS. 1–5. A feed screw 263 is threaded and received within a block 265 and has a lower portion 267 threaded and engaged in the slide 255. A suitable hand wheel 269 is provided for the screw 263 for rotation thereof and positioning of the slide 255 and the block 265 is fixed to the block 261 by suitable means such as a screw 270. The grading device in the device of FIG. 7 is seen to include a grading tool 283 having an end portion constructed from a suitably hard material such as diamond retained within a tool holder 284 by a plurality of screws 285. A flexible beam 281 has one end fixed to the tool holder 284 by a screw 286 and the other end fixed to the lower end of a plate 287 by a screw 289. The upper end of the plate 287 is pivotally disposed on the slide 255 by a pivot pin 273 for movement from a grading position, as shown in FIG. 7, to an out-of-the-way position, outwardly and upwardly from the grading position. A screw member 275 having a hand knob 277 is threaded and engaged thereby the plate 287 and is adapted to engage the plate 287 and lock it in either pivoted position. Thus, as the dressing abrasive specimen traverses the tool 283, the interference therebetween will result in a breaking away of abrasive particles from the specimen and lateral deflection of the tool and beam 281. The amount of deflection 281 is a function of the specimen hardness or particle bond strength and this deflection is monitored by a gauge head assembly 297 and recorded as in the device of FIGS. 1–5 above. Conventionally, the gauge head 297 may include a mounting bracket 299 fixed to the slide 255 by a ball 301 and carrying a plunger 304 assembly including an air nozzle 303 provided with a slidable plunger 304. Air is directed through the air nozzle 303 and against the plunger 304 to move it against the tool holder 284. During use, the grading tool 283 engages the abrasive specimen and the tool holder 284 moves against the plunger 304 an amount related to the hardness of the specimen. This deflection is either monitored directly or the variation in air pressure in the nozzle 303 caused by plunger 304 movement may be read directly or monitored and recorded to indicate the specimen hardness. The dressing tool assembly, carriage and vise assembly and the controls therefor are the same as in the device of FIGS. 1–5 and will not be described in detail here. While the preferred embodiments of the present invention have been illustrated and described in detail, various additions, substitutions, modifications and omissions may be made thereto without departing from the spirit of the invention as defined by the appended claims. What is claimed is:

1. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a fixture carried by said carriage and adapted to receive an abrasive specimen, dressing tool means on said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means including a tool adapted to interfering-ly engage said dressed surface of said abrasive specimen during movement of said carriage, said grading means further including a deflectable beam carried by said support and supporting said grading tool, said beam having a rigid mounting, said grading means and said dressing tool being relatively adjustable in a direction transversely of the direction of movement of said carriage whereby the degree of interference of said tool with a specimen surface dressed by said dressing tool may be set, and whereby said grading tool is deflected during engagement with said abrasive specimen to an extent reflective of the hardness of said specimen,

2. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a fixture carried by said carriage and adapted to receive an abrasive specimen, dressing tool means on said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means including a tool adapted to interferingly engage said dressed surface of said abrasive specimen to a predetermined depth during movement of said carriage, said grading means further including flexible means carried by said support and supporting said grading tool, means for gaging the relative distance of said dressing and grading means from a plane parallel to the path of movement of said carriage whereby the degree of interference of said grading means with a surface dressed by said dressing means may be determined, and whereby said grading tool is deflected during engagement with said abrasive specimen to an extent reflective of the hardness of said specimen,

3. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a fixture carried by said carriage and adapted to receive an abrasive specimen, dressing tool means on said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means carried by said support including a slide means adjustably mounted for movement toward and away from said abrasive specimen, a freely rotatable wheel having a relatively hard edge
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portion adapted to interferingly engage said dressed surface of said abrasive specimen to a predetermined depth during movement of said carriage, a deflectable cantilever beam rigidly mounted on said slide means and supporting said wheel, whereby said wheel is deflected during engagement with said abrasive specimen to an extent reflective of the hardness of said specimen.

4. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a fixture carried by said carriage and adapted to receive an abrasive specimen, a rotary tool means adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means carried by said support including a slide means and engaged with said rotary dressing tool to receive an abrasive specimen, a freely rotatable wheel having a relatively hard edge portion adapted to interferingly engage said dressed surface of said abrasive specimen to a predetermined depth during movement of said carriage, means for gauging the relative distance of said rotary tool and said grading means from a plane parallel to the path of movement of said carriage whereby the degree of interference of said wheel with a surface dressed by said rotary tool may be determined, means supporting said wheel in cantilever fashion upon said slide means, and signal producing means responsive to deflection of said wheel during engagement with said specimen.

5. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a cross-slide member carried by said carriage and movable transversely of said direction of carriage movement, said cross-slide having a fixture member adapted to receive an abrasive specimen, rotary tool means carried by said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means carried by said support for movement toward and away from said fixture and a grading tool having a relatively hard edge positioned to interferingly engage said specimen dressed surface during movement of said carriage, a deflectable cantilever beam supporting said grading tool for engagement with said abrasive specimen, said cantilever beam being rigidly supported on said support, whereby said grading tool deflection may be measured to indicate the hardness of said abrasive specimen.

6. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a cross-slide member carried by said carriage and movable transversely of said direction of carriage movement, said cross-slide having a fixture member adapted to receive an abrasive specimen, rotary tool means carried by said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means carried by said support for movement toward and away from said fixture and a grading tool having a relatively hard edge positioned to interferingly engage said specimen dressed surface during movement of said carriage, a deflectable cantilever beam and engageable with said rotary dressing tool and said grading tool for indicating the relative heights thereof,

means supporting said grading tool for limited deflection during engagement with said abrasive specimen, whereby said grading tool deflection may be measured to indicate the hardness of said abrasive specimen.

7. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a cross-slide member carried by said carriage and movable transversely of said direction of carriage movement, said cross-slide having a vise including a pair of spaced movable jaws adapted to receive an abrasive specimen and an intermediate specimen supporting member adjustably carried by said jaws, stop means positionable above said spaced jaws and engageable with an exposed surface of said abrasive specimen and in conjunction with said intermediate specimen supporting member adapted to properly position said specimen between said jaws, rotary tool means carried by said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means adjustably carried by said support for movement toward and away from said fixture and a grading tool having a relatively hard edge positioned to interferingly engage said specimen dressed surface during movement of said carriage, means supporting said grading tool for limited deflection during engagement with said abrasive specimen, whereby said grading tool deflection may be measured to indicate the hardness of said abrasive specimen.

8. An abrasive grading apparatus comprising a support having a carriage disposed thereon for longitudinal movement relative thereto, a cross-slide member carried by said carriage and movable transversely of said direction of carriage movement, said cross-slide having a fixture member adapted to receive an abrasive specimen, rotary tool means carried by said support adapted to dress an exposed surface of said abrasive specimen during movement of said carriage, grading means adjustably carried by said support for movement toward and away from said fixture and a grading tool having a relatively hard edge positioned to interferingly engage said specimen dressed surface during movement of said carriage, a deflectable cantilever beam supporting said grading tool for engagement with said abrasive specimen, said cantilever beam being rigidly supported on said support, whereby said grading tool deflection may be measured to indicate the hardness of said abrasive specimen.

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