Aug. 21, 1928. 1,681,902

C. H. NORTON

CYLINDRICAL GRINDING MACHINE

Filed June 29, 1926 2 Sheets-Sheet 1

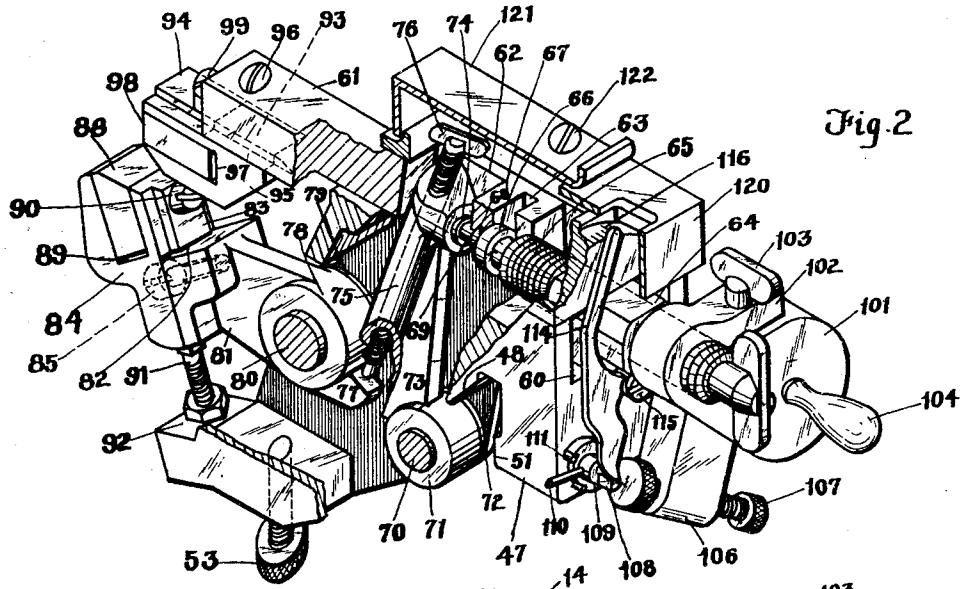

Fig. 2

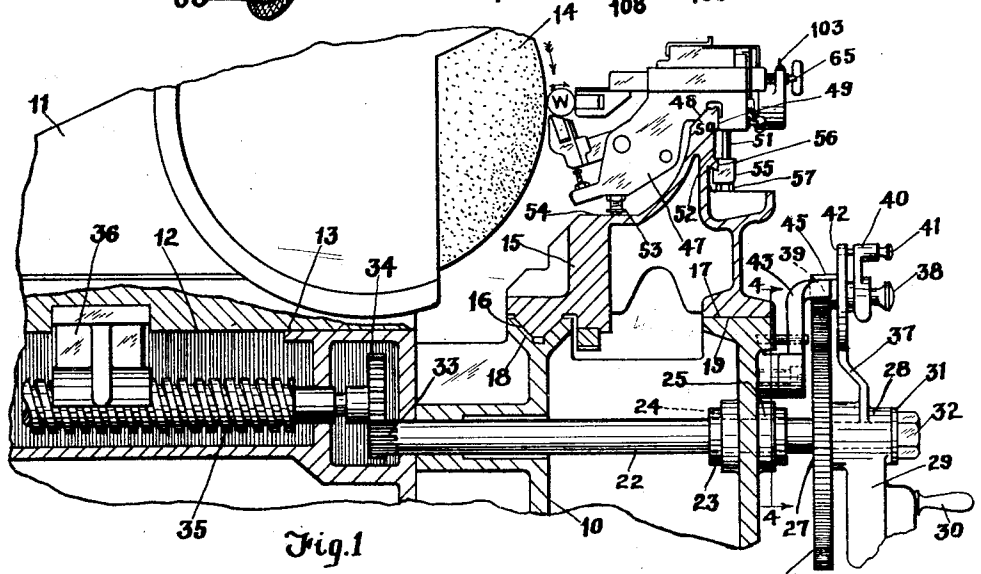

Fig. 1

Witnesses

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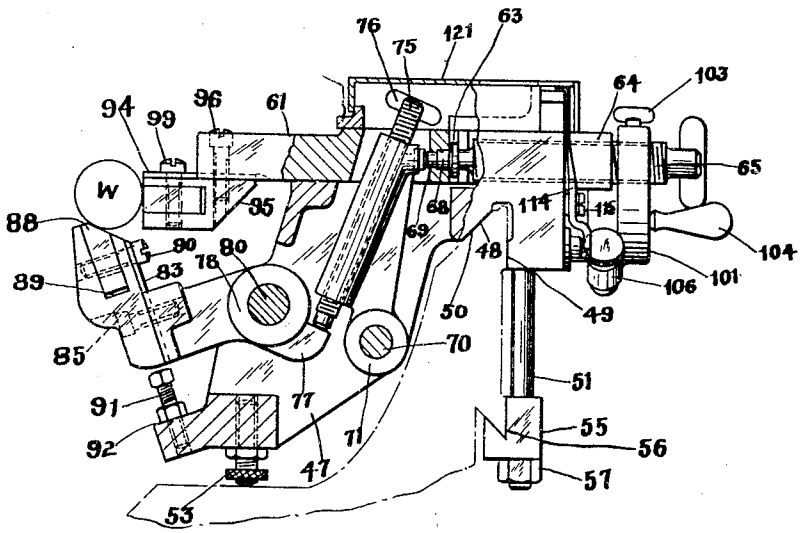

Fig. 3

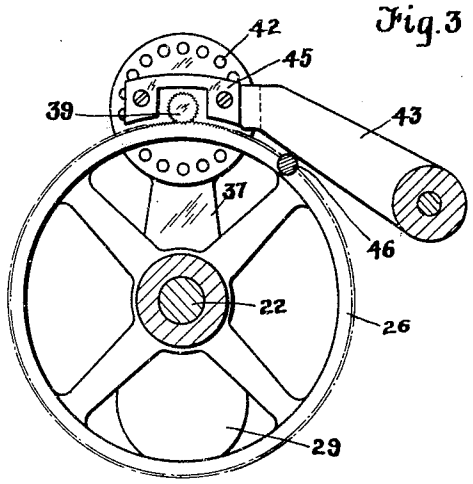

Fig. 4

Witnesses

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UNITED STATES PATENT OFFICE.

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CYLINDRICAL GRINDING MACHINE.

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This invention relates to cylindrical grinding machines and particularly to that type in which the work is mounted upon centers and positively rotated while it is being ground.

A machine of this type comprises a grinding wheel mounted on a slide which is moved by means of a large accurately fashioned screw engaging a half nut depending from the slide. The screw is turned by means of a manually operated micrometer cross feed mechanism of the type shown in the prior Patents No. 762,838 and No. 1,339,860. This device has been found to be very accurate and capable of moving the grinding wheel axis always to the same position within the limits normally required in a grinding operation. Due, however, to the fact that the grinding wheel wears away, it is not ordinarily possible, by using this cross feed mechanism, to grind the work to a predetermined size without calipering it one or more times during the grinding operation. In such machines, and particularly where the work is long and likely to bind under the pressure of the grinding operation, the work is supported opposite the grinding wheel by means of a steadyrest. In such a device a work supporting shoe is moved by a precision mechanism to adjust the position of the work accurately relative to the grinding wheel.

It is one object of the invention to provide a grinding machine which functions like a calipering device to indicate the size of the work as it is being ground and which may be employed to grind a piece of work to a desired size without interrupting the grinding operation.

It is a further object of my invention to construct a simple and efficient type of steadyrest in which the work shoe movement may serve to indicate or measure the size of the work.

It is another object to provide a steadyrest which operates automatically to support the work correctly opposite the grinding wheel, and particularly one in which the work supporting shoes move simultaneously to maintain contact with the work as it reduces in size.

A further object is to provide a grinding machine having a steadyrest of such a construction that it will accurately measure the work size during the grinding operation and which may cooperate with the micrometer cross feed mechanism to indicate the wear of the grinding wheel and therefore make it feasible for the operator to grind the work to the desired size.

With these and other objects in view as will be apparent to one skilled in the art, my invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

In accordance with this invention, I have provided a grinding machine which has a micrometer cross feed mechanism and a work measuring device so coordinated that each serves as one arm of a caliper, whereby one may feed the grinding wheel axis forward to a definite position, as determined by the location of a stop, and then by observing the reading on the work size indicating device one may determine the amount of grinding wheel wear and so feed the grinding wheel through a further measured extent and thereby reduce the work to the correct size.

The indicating device, which measures the extent of the grinding operation and the reduction in size of the work as it is being ground, may be combined with a steadyrest and so arranged that the movement of one of the shoes, which is held in contact with the work, is constantly indicated, preferably by a pointer and index. In the preferred form this is accomplished by means of an index pointer operatively connected with one of the steadyrest shoes, and a stop is also set relative to the desired final position of the work steadying shoes so that when the work has reached its desired finished size the steadying shoe will have reached the stop and the indicating pointer a zero index mark.

I further provide a new type of steadyrest in which a steadying work shoe is moved automatically as the work decreases in size to maintain proper contact therewith and which will resist any rearward thrust due to the pressure of the grinding wheel. In the preferred form, two work steadying shoes are provided and they are preferably moved forward by means of a screw operated by an automatic device, such as a weight, which tends to turn the screw in one direction and hold the shoe in proper contact with the work.

The invention will be more clearly understood from the following description in con-

junction with the accompanying drawing; in which,

Fig. 1 is a partial sectional elevational view of a grinding machine embodying the invention;

Fig. 2 is a perspective detail view of the work steadying member on the machine shown in Fig. 1;

Fig. 3 is an elevational view of the work steadying member shown in Fig. 2; and

Fig. 4 is a detail elevational view of a portion of the machine shown in Fig. 1.

In the drawings, I have illustrated a grinding machine embodying the invention comprising a frame 10 which carries a cross slide 11 provided with suitable slideways 12 adapted for engagement with slideways 13 on the frame. A grinding wheel 14 is mounted in suitable bearings (not shown) in the slide 11, and may be rotated rapidly in the direction indicated by the arrow (Fig. 1) from any appropriate source of power (not shown). A traverse slide 15 is provided with a V slideway 16 and a flat slideway 17 adapted for engagement with V and flat slideways 18 and 19 respectively in the frame 10. Head and tail stocks are suitably mounted upon the slide 15 for rotatably holding the work W, as is well understood.

The slide 11 may be moved to feed the grinding wheel into the work by a mechanism such as shown in my prior patents comprising a shaft 22 suitably mounted for rotation in the frame 10, axial movement of the shaft 22 being prevented by the provision of a pair of collars 23 secured upon the shaft 22 by set screws 24 and adapted to abut bosses 25 integral with the frame 10. A gear 26 is keyed upon a reduced portion at one end of the shaft 22 and rests against a shoulder 27 thereon (Fig. 1). A hub 28 having a crank arm 29 and a crank handle 30 is mounted to rotate about the reduced portion of the shaft 22 and is held against the gear 26 by means of a washer 31 and a nut 32. A pinion 33 is secured upon the other end of the shaft 22 and is adapted to engage a gear 34 secured upon one end of a screw 35, which engages a nut 36 fixed to the slide 11. The hub 28 is provided with a radially extending arm 37 in which a shaft 38 is mounted carrying a pinion 39 which meshes with the gear 26. An arm 40 is secured upon the shaft 38 and may be moved to rotate the shaft 38 and turn the pinion 39 around the gear 26. A spring pressed plunger 41 is mounted at the outer end of the arm 40 and is adapted to engage any one of a plurality of holes 42 arranged in a circular path in the arm 37 (as shown in Fig. 4). A stop 43 which is pivotally mounted to turn about a stud 44 in the frame 10 projects upwardly and outwardly into the path circumscribed by a lug 45 projecting from the arm 37. A pin 46 accurately positions the stop 43.

The casing 47 of a work steadying member is provided near its forward end with a pair of bearing surfaces 48 and 49 adapted for engagement with similarly shaped bearing surfaces 50 and 51 on an upwardly extending projection 52 of the slide 15. The other end of the work steadying member is supported by an adjustable screw 53 in the casing 47 which is adapted to rest upon a flat bearing surface 54 on the slide 15. A clamping device 55 is arranged to engage a V slideway 56 upon the projection 52 and may be held securely thereagainst by a wing screw 57 passing through the clamping device and engaging threads in the casing 47 of the work steadying member.

The casing 47 is provided with a groove 60 which serves as a bearing surface for a slide 61 which is provided with a hole 62 and a T-shaped slot 63. A nut 64 integral with the casing 47 is provided at one end of the groove 60 to engage a wing screw 65, one end of which is provided with a flange 66 fitting within the T-shaped slot 63. A web 67 between the hole 62 and the T-shaped slot 63 on the slide 61 is formed with a hole 68 for a shouldered pin 69 with which the end of the screw 65 may come in contact. A shaft 70 extends between and is mounted in the vertical longitudinal walls of the casing 47 and carries a hub 71 which is rotatably mounted between the bosses 72 on the walls of the casing. An arm 73 integral with or otherwise appropriately secured to the hub 71 extends upwardly therefrom into the hole 62 and is provided near its upper end with a projection 74 adapted for engagement with the shouldered pin 69 so that the arm 73 may be turned about the shaft 70 as the screw 65 is moved. The barrel shaped portion 75 of the arm 73 is threaded to receive a wing adjusting screw 76, the lower end of which is adapted for engagement with a projection 77 on a hub 78 rotatably mounted between the bosses 79 on the opposite vertical walls of the casing 47.

An arm 81 integral with and extending from the hub 78 is provided with a groove 82 at its outer end for receiving a tongue 83 on a shoe holding member 84 which is held in position on the arm by screw 85. A work engaging shoe 88 is held in position in a pocket 89 in the holder 84 by a screw 90. An adjustable stop screw 91 is provided in the lower portion of the holder 84 for engagement with a bearing surface 92 on the casing 47. The slide 61 is provided with a groove 93 which is adapted to receive a tongue 94 on a shoe holding member 95 which is held in position on the slide by a screw 96. The holder 95 is provided with a pocket 97 for the insertion of a work engaging shoe 98, which is held therein by a screw 99. Preferably, the work engaging shoes 88 and 98 are constructed of a substantially non-wearable material,

such as an abrasive block made by uniting fine abrasive grains with a relatively large amount of vitrified bond. This material is of such a nature that it will not load with abrasive grains during the grinding operation and so scratch the work, as is likely to happen with the ordinary relatively softer materials heretofore employed. It is made of the hardest available material, which will not injure the work, so that the setting of the indicator will be correct for a long time. Otherwise, the indicator needle will not register the distance through which the grinding wheel should be fed forward after the feed mechanism has struck its stop.

The screw 65 may be moved forward in the nut 64 either manually or automatically. A suitable automatically operating device for this purpose may comprise a weight 101 formed with a split nut portion 102 adapted for engagement with the screw 65. A wing screw 103 is provided for clamping the nut 102 securely in a desired position upon the screw 65. A crank handle 104 is secured upon the weight 101 so that the screw 65 may be turned to withdraw the shoes 88 and 98 away from and out of engagement with the work. An arm 106 is formed as an integral part of the weight 101 and carries an adjustable screw 107, one end of which is adapted to engage a removable stop, such as a sector-shaped stop 108 projecting from the end of a shaft 109 mounted to turn in the casing 47. A crank arm 110 is secured upon the shaft 109 to move between a pair of stops 111 mounted upon the casing 47. An indicating pointer 114 is mounted to turn about a screw 115 in the casing so that one end may sweep over a scale 116 formed upon an upper portion of the casing 47. The pointer 114 is constructed and arranged so that its other end will be maintained by its own weight in contact with the adjustable screw 107 at a point in close proximity with the point of contact between the screw 107 and the stop 108. The top of the casing 47 is provided with a fixed cover 120 and with a movable cover 121 adapted to be turned about the offset screw 122.

When it is desired to grind successive work pieces to a desired predetermined finish size, a standard work piece of the desired dimensions is mounted in grinding position between the head and tail stocks of the machine and the wing screw 65 is turned to move the slide 61 and bring the shoe 98 in contact with the surface of the work. The shoe 88 is then brought into contact with the work by turning the wing screw 76. While making these adjustments, the weight 101 is permitted to hang loosely upon the screw 65 so that the screw 107 may maintain engagement with the stop 108. When these adjustments have been made, the weight 101 is secured firmly upon the screw 65 by turning the screw wing 103 to clamp the split nut 102 thereupon. The shoes 88 and 98 are then moved out of contact with the standard work piece by turning the screw 65 by means of the handle 104 on the weight 101 counterclockwise to withdraw the slide 61 and permit the arm 81 to drop until the screw 91 engages the bearing surface 92. A work piece to be ground is then placed in grinding position between the head and tail stocks in place of the standard work piece and the weight 101 moved clockwise until the shoes 88 and 98 are just brought into contact with the surface of the work. The action of gravity upon the weight 101 will cause movement of the screw 65 so as to move the shoes 88 and 98 and maintain them in contact with the surface of the work during the grinding operation as the work becomes reduced in size.

When making these adjustments, it is preferable also to bring the grinding wheel 14 into contact with the standard work piece. This may be done by turning the crank arm 29 which rotates the screw 35 within the nut 36 to move the slide 11 and grinding wheel 14 toward the work. When the grinding wheel 14 just comes in contact with the standard work piece, the operator should withdraw the spring plunger 41 from the hole 42, in which it is lodged, and move the pinion 39 about the gear 26 to bring the lug 44 into contact with the stop 43. The spring plunger 41 is then permitted to engage the nearest hole 42. When these adjustments are completed the indicator 114 should point to 0 upon the scale 116 and if it does not it can be made to do so by turning the adjusting screw 107.

It will be apparent to those skilled in the art that the grinding machine of the invention functions like a caliper in which the grinding wheel and its actuating cross feed mechanism serves as one arm of the caliper and the work positioning shoes 88 and 98 and their actuating mechanism serve as the other arm of the caliper. Under normal conditions, the work will be ground accurately to finished size when the grinding wheel and the shoes 88 and 98 are brought to their stop positions. When the grinding wheel becomes worn, the scale 116 will show that the work is oversize. It will be understood that the graduations upon the scale 116 may be calibrated to indicate in thousandths of an inch the variation in the size of the work being ground, and the holes 42 on the arm 37 may be spaced in positions representative of thousandths of an inch variation in the diameter of the work being ground so that the extent of wear upon the grinding wheel may be indicated accurately by the indicator 116. Such wear may be compensated for by moving the spring plunger 41 to another appropriate hole 42

on the arm 37 which will permit the grinding wheel to move further toward the work and grind it to the desired finished size.

The work positioning shoes, preferably, are constructed of an appropriate wear resisting material and normally will not wear an appreciable amount over long periods of time. One may easily determine if these shoes have worn, however, by turning the shaft 109 by means of the arm 110 to remove the sector shaped stop 108 from its normal position. This permits the weight 101 and the crank arm 106 to move downward and cause the shoes 88 and 98 to come in contact with the surface of the work. If the work is then at finished size, the wear of the shoes may be compensated for by turning the screw 107 until the pointer 114 indicates zero on the scale 116. But if the shoes have not worn an equal amount it may be necessary to bring shoe 88 against the work by turning the screw 76. During grinding, the screw 65 may be turned manually, but in the machine illustrated is actuated automatically by the action of gravity upon the weight 101, and the pin 69 moves against the projection 74 and the arm 73 to move the latter about the shaft 70, thereby bringing the screw 76 against the projection 77 with more pressure and causing the arm 81 to turn about the shaft 80 and move the shoe 88 toward the work so as to maintain contact therewith during the grinding operation. At the same time the grinding wheel may be fed into the work periodically as will be readily understood by the art.

If desired, the steadyrest of the invention may be adjusted by grinding the first work piece to size as indicated by a micrometer. The sector shaped stop 108 may be turned to an inoperative position, opposite to that indicated in Fig. 2 of the drawings, so that the indicator 114 may pass the zero mark upon the scale. The shoes 88 and 98 are brought into contact with the work to steady the same during the grinding operation and the work piece is ground to the desired size as indicated by a micrometer. The screw 107, which may consist of two screws checking each other, is then adjusted until the pointer 114 indicates zero. The wheel stop 43 is removed and the next work piece is ground until the pointer indicates zero at which time the handle 30 is turned to back the grinding wheel away from the work.

It will be noted among the advantages obtained by the invention that any movement of the work toward the work steadying member due to the thrust of the grinding wheel is prevented, and the machine may be constructed and arranged to indicate automatically the extent of progress of the grinding operation. Furthermore, any wear upon the grinding wheel is indicated automatically and wear upon the work positioning members may be readily and easily determined without upsetting the adjustment of the machine.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A grinding machine comprising a rotatably mounted grinding wheel, means for moving the grinding wheel mounting to feed the wheel a predetermined distance into the work, a movably mounted work steadying member, and an automatically operated mechanism for positively moving said member forward so that it will maintain contact with the work at a uniform pressure as it is reduced in size, which is constructed and arranged to effectively resist movement in the opposite direction by forces set up during the grinding operation.

2. A grinding machine comprising a rotatably mounted grinding wheel, precision mechanism for feeding the grinding wheel into the work, a movably mounted work steadying member, means constructed and arranged to move said member to maintain contact with the work as it is reduced in size and to effectively resist movement in the opposite direction due to the thrust of the grinding wheel upon the work, and precision means for continuously indicating to the operator the reduction in size of the work.

3. A grinding machine comprising a rotatably mounted grinding wheel, micrometer cross feed mechanism for moving the grinding wheel axis to a predetermined position, a movably mounted work steadying member adapted to engage the work opposite the grinding wheel, an adjustable mechanism for positively moving said member through a predetermined and variable distance while maintaining contact with the work during the grinding operation, and precision means for indicating the size of the work.

4. A grinding machine comprising a rotatably mounted grinding wheel, micrometer mechanism for feeding the grinding wheel forward, an adjustable stop cooperating therewith to limit such movement, a movably mounted work steadying member engaging the work upon a line diametrically opposed to the line of contact of the work and wheel, means for moving said member to hold it against the work during the grinding operation, and precision means actuated with said member for indicating the further movement required of the wheel to grind the work to a desired size after said stop has become effective.

5. A grinding machine comprising a grinding wheel, means including a cross feed mechanism to feed the grinding wheel into the work and an adjustable stop associated with the cross feed mechanism to limit the forward motion of the grinding wheel, a work steadying member mounted on the grinding machine to steady the work during the grinding operation, means to move said member for-

ward as the work is reduced in size and prevent movement in the opposite direction by rearward thrust thereon, and an indicator associated with said member which measures the extent of movement thereof and indicates the reduction in size of the work, said parts being so associated and arranged that when the grinding wheel feed mechanism has come against its stop the indicator will indicate the extent of wear of the grinding wheel.

6. A steadyrest for a grinding machine comprising a stand, a movably mounted work steadying member, a mechanism constructed and arranged to move said member, a stop operatively associated therewith for limiting the movement of said member, means for precisely adjusting the position of the stop, and means permitting said member to be moved freely in either direction throughout its effective length of travel.

7. A steadyrest for a grinding machine comprising a stand, separately movable work bearing members thereon, automatically actuated mechanism for moving said members to hold them against the work during the grinding operation and means independent thereof for manually adjusting the position of each member relative to the work.

8. A steadyrest for a grinding machine comprising a stand, separately movable work bearing members thereon, precision means for separately adjusting the position of one of said members, and automatically actuated mechanism for continuously moving the members forward simultaneously and holding them under a substantially uniform pressure in contact with the work during grinding.

9. A steadyrest for a grinding machine comprising a stand, a movably mounted work steadying member, a screw actuated mechanism for moving said member progressively to maintain contact with the work as it is reduced in size, and precision means for indicating to the operator when the work has been ground to the desired size.

10. A steadyrest for a grinding machine comprising a stand, a movably mounted work steadying member, a screw actuated mechanism for moving said member, a weight suspended from said screw to actuate the same by the action of gravity so as to move said member forward progressively.

11. A steadyrest for a grinding machine comprising a stand, a movably mounted work steadying member thereon, and a screw to actuate the same, actuating mechanism adjustably connected with the screw to move the member forward automatically, and manually operated means for turning the screw without moving the actuating mechanism to adjust the position of the work steadying member.

12. A steadyrest for a grinding machine comprising a stand, a pair of work steadying members movably mounted on said stand, a single screw connected to feed the members forward simultaneously, and means positively acting to turn the screw in one direction automatically as the work is reduced in size.

13. A steadyrest for a grinding machine comprising a stand, a work steadying member movably mounted on said stand, automatically operating means to move the work steadying member forward and prevent movement in the opposite direction by rearward thrust thereupon, and a measuring device connected therewith to indicate the extent of forward movement of the member.

14. A steadyrest comprising a stand, a work steadying member movably mounted on said stand to engage the work at a point substantially diammetrically opposed to the grinding wheel, a second work steadying member adapted to engage the under side of the work, means including a screw to move said members automatically forward as the work is reduced in size, and a stop to limit the forward movement of the screw.

15. A steadyrest comprising a stand, a work supporting shoe movably mounted on said stand to engage the work substantially on a diameter opposite the grinding wheel, automatically operative means effective to move the shoe in a forward direction as the work reduces in size, and prevent rearward movement thereof, means permitting manual adjustment of the position of the shoe in either direction, and means to indicate the extent of movement of the shoe in a forward direction.

16. A steadyrest comprising a stand, a work steadying member engageable with the work, a screw operatively associated therewith to move said member forward, a second work steadying member pivotally mounted on the stand, and connections between said screw and said pivotal mounting to move the two work steadying members simultaneously into engagement with the work.

17. A steadyrest comprising a stand, a work steadying member arranged to engage the work substantially on a diameter with the line of contact with the grinding wheel, a screw operatively associated with said member to move it back and forth, a second work steadying member pivotally mounted on the stand to engage the under side of the work, and a connection between said screw and said lever operating to rock said lever so that the two members will move simultaneously into engagement with the work.

18. A steadyrest comprising a stand, a work steadying member pivotally mounted on said stand, an adjustable stop to limit the downward movement of said member, a second work steadying member, means to adjust the position thereof, and connections between said means and said lever effective to

rock said lever about its pivotal point and bring the two work steadying members simultaneously into contact with the work.

19. A steadyrest for a grinding machine comprising a stand, a movably mounted work steadying member, a screw mechanism for moving said member, a weight suspended from said screw in such manner as to actuate the same and move said member forward progressively, an adjustable screw mounted on an integral part of said weight, a stop mounted in the path of the adjustable screw to limit the extent of movement of said member, and an indicating pointer adapted for engagement with the adjusting screw which normally indicates that the work is ground to finished size when the adjustable screw engages said stop.

Signed at Plainville, Connecticut, this 23rd day of June 1926.

CHARLES H. NORTON.