O. S. WALKER.

GRINDING MACHINE.

APPLICATION FILED OCT. 22, 1914.

1,162,832. Patented Dec. 7, 1915.

3 SHEETS—SHEET 1.

Fig. 1.

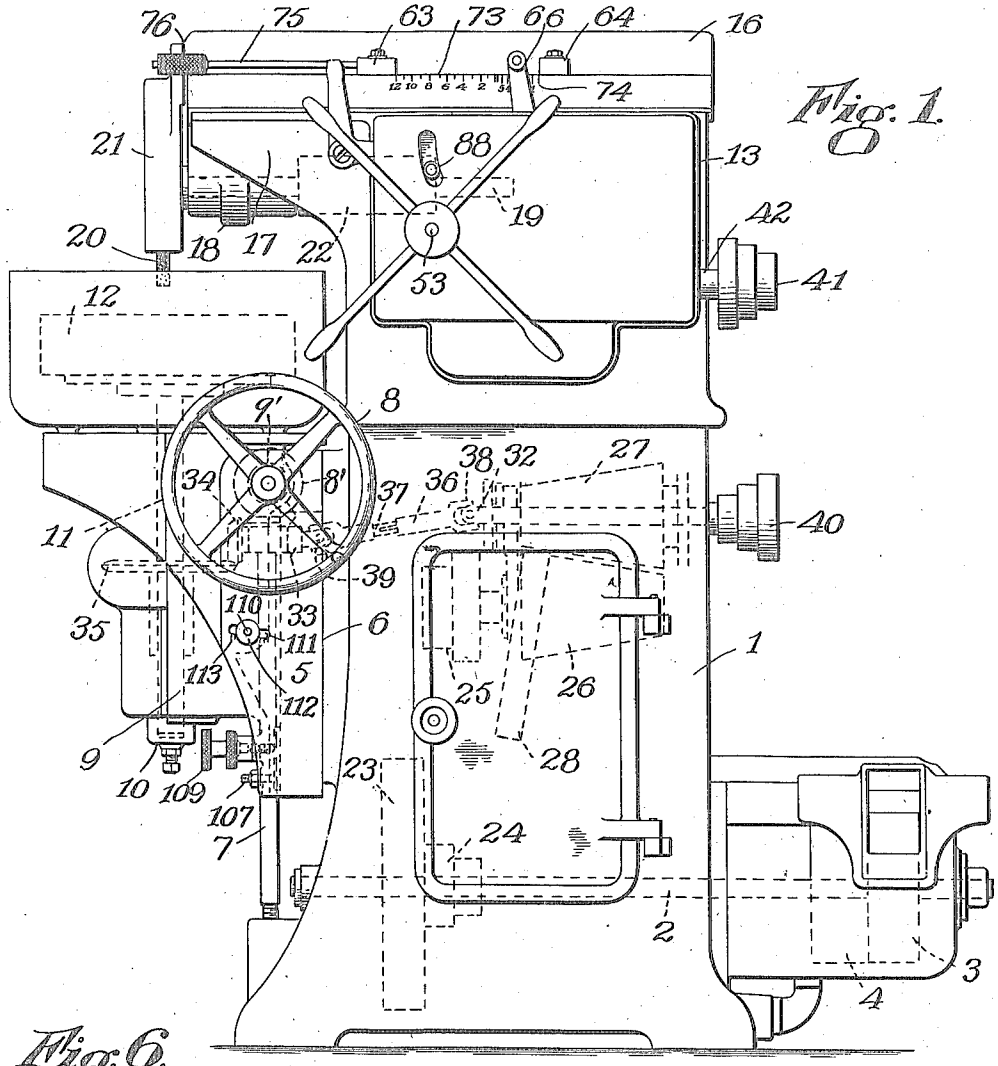


Fig. 6.

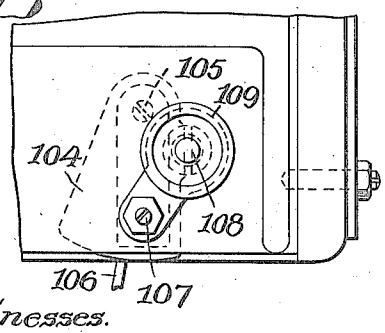
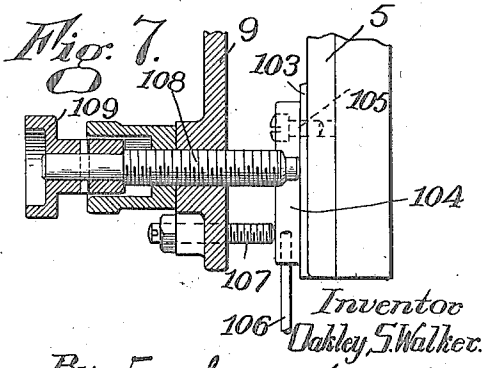


Fig. 7.



Witnesses.

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3 SHEETS—SHEET 2.

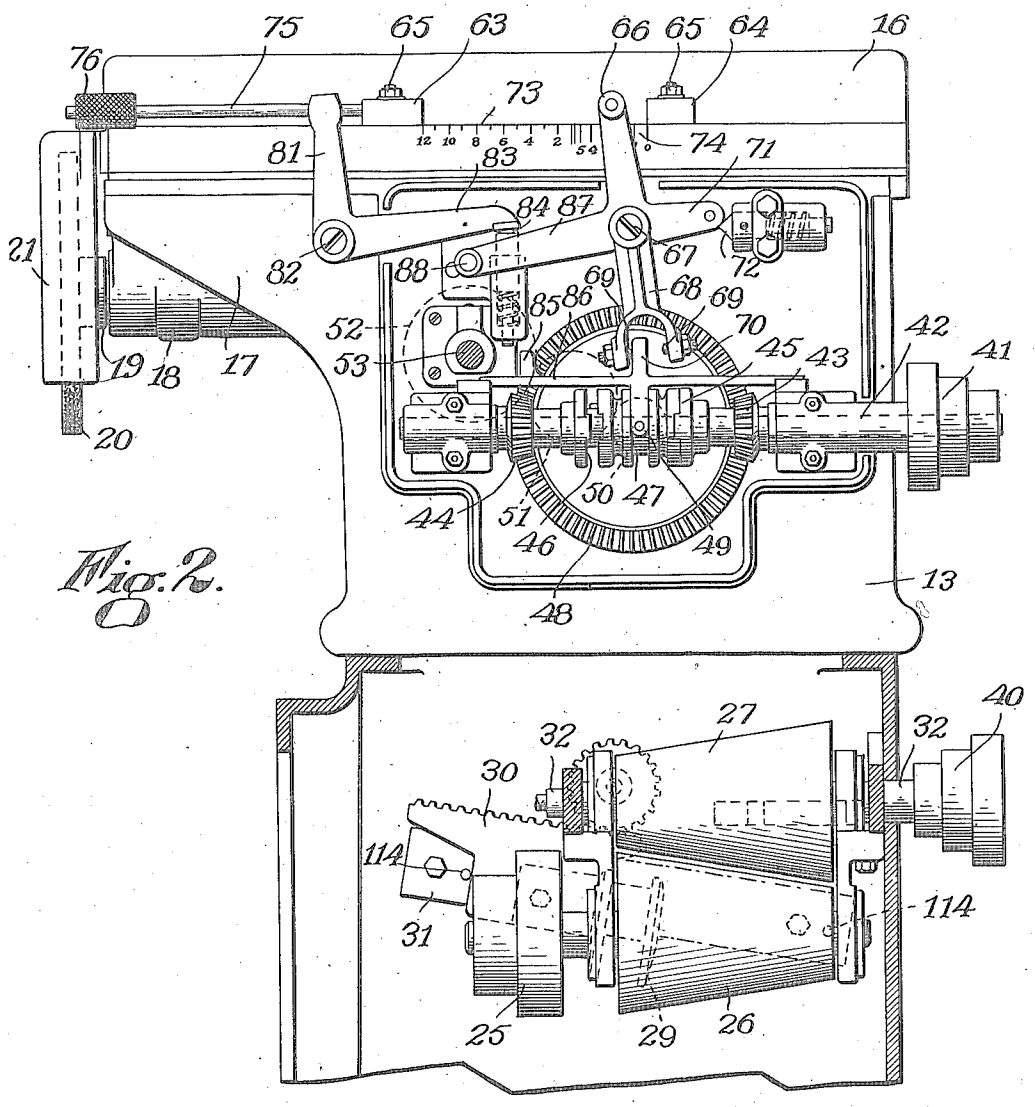


Fig. 2.

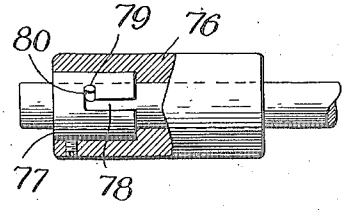


Fig. 5.

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3 SHEETS—SHEET 3.

Fig. 3.

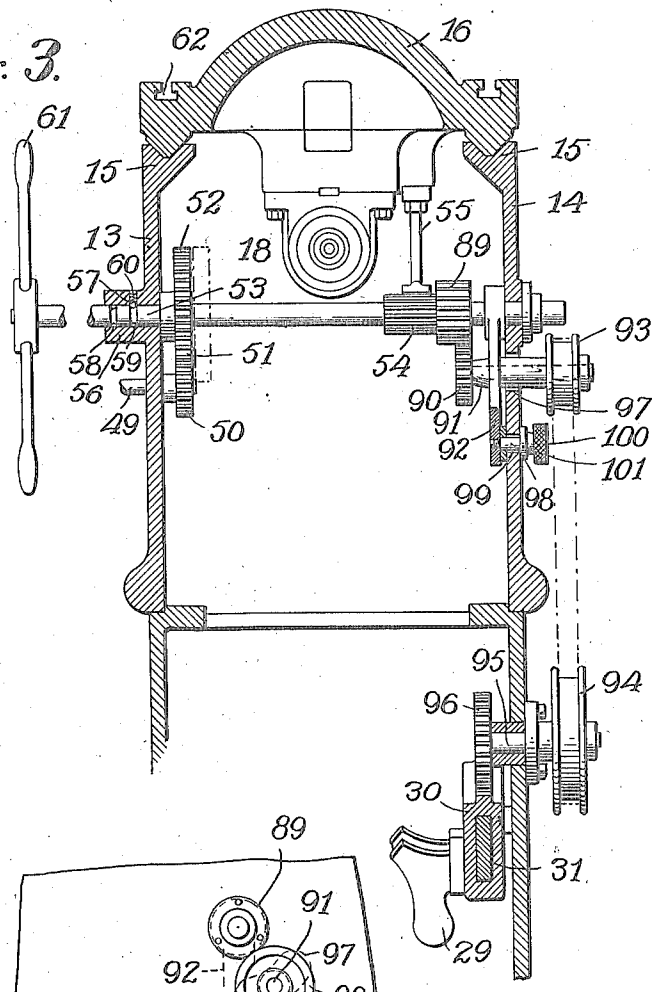


Fig. 4.

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UNITED STATES PATENT OFFICE.

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GRINDING-MACHINE.

1,162,832. Specification of Letters Patent. Patented Dec. 7, 1915.

Application filed October 22, 1914. Serial No. 868,106.

To all whom it may concern:

Be it known that I, OAKLEY S. WALKER, a citizen of the United States, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, have invented a new and useful Improvement in Grinding-Machines, of which the following, together with the accompanying drawings, is a specification.

The present invention relates to grinding machines and has particular reference to a machine adapted for the grinding of relatively extended surfaces, such as the faces of disks, or annular metallic plates. It is the general practice to impart to such work a rotative movement, in order to bring all portions of its surface into contact with the rotating abrasive element, or grinding wheel, the latter being mounted so as to have a traversing movement toward and from the axis of rotation of the work in order that all portions of the surface may be acted upon, with the result that the path of action of the abrasive element on the face of the work takes the form of a spiral, as will be readily understood.

With a uniform speed of rotation of the work, and a uniform traversing speed of the abrasive element thereacross, it will be apparent that the character of the abrasive cut will vary across the entire face of the work, from the center of rotation to its outside edge, owing to the difference in linear speed of points at different distances, from said axis of rotation. Obviously, the ground surface near said center will be of a different character than the same area of ground surface near the periphery of the work, owing to the relatively longer period during which said centrally disposed surface is in contact with the abrasive element. Furthermore, in addition to the non-uniformity of the finished surface above described, machines of this character have heretofore been operated at the serious disadvantage of being unable to utilize the greatest practicable speeds both of work rotation and of wheel traverse except at the very periphery of the work, it being obvious that under conditions of uniform work rotation and uniform traversing speed of the wheel, the actual area ground in a given interval of time decreases as the wheel approaches the center of rotation of the work.

The present invention aims to overcome the defects in existing machines of this class, by the elimination of the practical difficulties above enumerated; its objects are embodied in the production of a machine having a uniform abrading action with respect to all portions of the surface of the work, thereby securing a ground surface of absolute uniformity, and also the production of a machine of this character capable of operating at all times at the utmost limit of its efficiency, thereby shortening appreciably the time required to grind a surface of a given area, over other machines previously used for such work.

Other objects and advantages will appear from the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a front view of a machine embodying my invention. Fig. 2 is a similar enlarged view of the same, with portions of the inclosing casing removed to disclose the interior working parts. Fig. 3 is a fragmentary cross-sectional view of a portion of the machine. Fig. 4 is a fragmentary rear view of a portion of the machine, viewed from the right hand side of Fig. 3. Fig. 5 is a view, partly in section, of an adjustable stop device. Figs. 6 and 7 are fragmentary end elevational and sectional views, respectively, of an improved mechanism for adjusting the angular position of the work supporting means of the machine.

Like reference characters refer to like parts throughout the different figures.

Referring to the drawings, and in particular to Fig. 1, the numeral 1 indicates a hollow stand or framework within and upon which the operative parts of the machine are supported, the same having journaled in its base a driving shaft 2, provided with tight and loose pulleys 3 and 4, by means of which a belt connection with a suitable source of power, not shown, may be established and cut off at will. In common with other machines of this class, means are provided for regulating and adjusting the vertical position of the work to be operated upon, the same comprising a bracket 5 hav-

ing a sliding movement in vertical ways 6 carried by the framework. The bracket 5 is vertically adjustable by means of a vertical screw shaft 7, having thereon a bevel gear 7′ meshing with a bevel gear 8′ on the horizontal shaft of a hand wheel 8, by the rotation of which the vertical movement of the bracket is effected, in the usual manner. Said shaft of the hand wheel carries a sleeve 9′ on which is pivoted a swinging table 9 having journaled therein, and supported in a step bearing 10 thereof, a vertically disposed rotatable shaft 11, carrying on its upper end the work supporting and holding means of the machine. The latter in the present instance is shown as a magnetic chuck 12; it is apparent, however, that any well known work supporting and holding means, disposed for rotating movement upon the shaft 11, may be used for this purpose.

The framework 1, along the upper edges of its front and rear sides 13 and 14 is provided with parallel horizontal ways 15, 15, for the guidance and support of a slidable head or ram 16, which forms in effect a cover extending across the open upper end of the framework. As will be seen from Fig. 1, the front and rear sides 13 and 14 of the framework 1 have forwardly disposed portions 17 extending approximately as far as the center of rotation of the work, so that said guideways 15, 15, overlie the inner half of the work supporting means, and, by means of their extension in this manner, enable the ram to be supported throughout its entire length, when the same is at the limit of its forward stroke, as shown in Fig. 1. The ram 16 has a central depending bearing 18 disposed to move between the forward portions 17 of the framework, as shown in Fig. 3, said bearings serving for the support of a rotatable shaft 19, which carries on its forward end a grinding wheel 20 partially surrounded by a suitable stationary shield 21. In the reciprocation of the ram 16 the wheel 20 moves in and out between the forwardly extended portions 17 of the framework 1, so that it is afforded a rigid and unyielding support in all positions. An elongated pulley 22 carried by the shaft 19 has a belt connection with a pulley 23 carried on the driving shaft 2, providing for the rotation of the grinding wheel at a constant rate of speed in any position assumed by the ram 16.

The driving shaft 2 also carries a stepped pulley 24 having a belt connection with a corresponding stepped pulley 25 on the driving shaft of a speed accelerating mechanism suitably supported within the framework 1. Said speed accelerating mechanism is shown in the present instance in the form of the well known Evans drive, and comprises a frusto-conical driving pulley 26 and a similarly shaped driven pulley 27, the two pulleys being oppositely disposed one above the other, and having their peripheral surfaces spaced apart slightly to receive between them a loose endless belt 28, the thickness of which is sufficient to constitute a frictional driving connection between said surfaces. The belt 28 is movable longitudinally of said pulleys by means of a shipping fork 29 carried by a slidable rack 30 disposed for reciprocating movement upon a way 31 which is preferably inclined to correspond to the line of travel of the belt between the peripheral surfaces of said pulleys. The reciprocation of said rack, by means hereinafter described in detail, moves the belt lengthwise of the space between said pulleys, and thereby varies the driving ratio between them at each increment of such movement, with the belt in the position shown in Figs. 1 and 2, the driven shaft 32 carrying the pulley 27 has imparted thereto a relatively rapid rotation from the uniformly rotating driving pulley 26, but as the belt is gradually moved to the right the driving ratio is decreased, and at the limit of right hand movement of said belt, the driven shaft 32 is caused to rotate at a slower speed than the uniformly rotating driving pulley as will be clearly understood.

At its forward end the shaft 32 has an operative connection with a short horizontal shaft 33, carried by the table 9, and serving, by means of intermeshing bevel pinion 34 and gear 35, to rotate the shaft 11 which carries the work supporting and holding means 12. To compensate for the vertical and also the swinging movement of which the table 9 is capable, this operative connection preferably consists of a pair of telescopic shafts 36 and 37, splined together to rotate in unison and having universal joint connections 38 and 39 at their opposite ends with the contiguous ends of the shafts 32 and 33. By the means above described, the work supporting and holding means 12 is caused to rotate in synchronism with the variable speed shaft 32. At its other end the shaft 32 carries a stepped pulley 40 having a belt connection with a corresponding stepped pulley 41 on the end of a shaft 42, supported for rotation in the upper end of the framework. The shaft 42 has oppositely facing loosely journaled beveled pinions 43, 44 thereon, the hubs of which present oppositely facing toothed clutch surfaces 45 and 46, respectively, adapted to be engaged selectively by a slidably mounted clutch collar 47, keyed to rotate with said shaft 42. The bevel pinions 43 and 44 are in mesh with a bevel gear 48 on diametrically opposite sides of the latter; the movement of the clutch collar 47 to lock the pinion 43 to shaft 42, causes rotation of gear 48 and its shaft 49 in one direction, while the movement of

said clutch collar to lock the pinion 44 to the shaft 42 causes rotation of the gear 48 and shaft 49 in the opposite direction. When the collar 47 is moved to its intermediate position, out of engagement with both of the clutch surfaces 45 and 46, no rotation is imparted to the shaft 49. Said shaft 49 carries a pinion 50, in mesh with an idle gear 51, which in turn meshes with a gear 52 on a transverse shaft 53, said train of gears serving to drive shaft 53 at a greatly reduced speed from shaft 49. A pinion 54 carried by said shaft 53 meshes with a rack bar 55 secured to and depending from the under side of the ram 16, whereby the sliding movement of said ram in its ways 15, is effected. The pinion 54 is made long enough to remain in mesh with the rack in spite of the longitudinal movement of which the shaft 53 is capable, in order to carry the gear 52 into and out of mesh with gear 51, as shown in full and dotted lines, Fig. 3. To provide for this longitudinal movement of shaft 53, the outer bearing 56 of the same carries a pin 57, the rounded end of which is held yieldingly within either one of a pair of spaced annular recesses 58 or 59 by a light spring 60. When the shaft 53 is forced inwardly, bringing the recess 59 into operative relation, the connection of said shaft with the source of power is destroyed, leaving it free to be rotated by a hand wheel 61, to effect the movement of the ram 16 in the desired direction.

The ram 16 on its upper side has a longitudinal undercut groove 62, in which a pair of movable stop blocks 63 and 64 are capable of being held, by their retaining nuts 65, in any desired position of adjustment, one on each side of a substantially vertical arm 66 of a four arm lever, pivoted at 67 to the inside of the framework. A depending arm 68 of said lever is forked at its end, and provided with oppositely extending contact screws 69, 69, adapted to engage on opposite sides of a projection 70 of the clutch collar 47, to move the latter in one direction or the other, in response to the contact of one or the other of the stop blocks 63, 64 with the vertical arm 66 of the lever. Another arm 71 of said lever has a rounded end in engagement with the tapered end of a spring pressed pin 72, carried in a suitable socket on the framework, and adapted to yieldingly retain the clutch collar in each of the operative positions into which it is moved by the lever, until the vertical arm 66 is engaged by the other of the stop blocks 63 or 64 to forcibly carry the lever in the other direction, whereupon the curved end of arm 71 acts to depress the pin 72 in moving past the same, as will be well understood.

The rocking of the four armed lever by the engagement of its arm 66 with one or the other of the spaced stop blocks 63, or 64, depending upon the direction in which the ram is moving, effects the movement of the clutch collar 47 to reverse the rotation of the bevel gear 48, as previously described, and through the connected gearing, to reverse the movement of the ram 16. In the position of the parts shown in Figs. 1 and 2 the stop block 64 has just moved the arm 66 to the left, effecting the movement of the clutch collar 47 to the right and causing the rotation of the gear 48 to be imparted by the pinion 43. As a result the ram 16 has just begun its traversing movement toward the right, and it will be noted, is moving at its greatest speed, due to the illustrated position of the belt 28 between the two cones of the Evans drive. The ram moves with constantly decreasing speed toward the right until the stop block 63 forcibly engages the arm 66 to shift the clutch collar toward the left, causing the pinion 44 to be substituted for the pinion 43 in the drive of the gear 48 and thereby reversing the movement of the ram.

The edge of the ram, adjacent the groove 62 is graduated, as shown, at 73 and 74 to provide for the proper setting of the two blocks 63 and 64, respectively, in accordance with the length of stroke required of the ram by the size of the work. The graduations 73, for use with the block 63, are employed to determine the length of travel of the ram away from the center of rotation of the work, while the graduations 74, for use with the block 64, are employed to determine the distance from said center of rotation at which the ram reverses, when moving toward said center.

The stop block 63 has a forwardly extending rod 75, carrying on its extreme end a loosely fitting knurled bushing 76. The outer end of said bushing is recessed to receive a short bushing 77, Fig. 5, having a longitudinal slot 78 therein, which receives a pin 79 carried by the rod 75. The slot 78 has a continuation 80 at right angles thereto, adapted to receive the pin 79 when the bushing 76 is pushed rearwardly of the rod and then rotated slightly. When thus restrained against endwise movement, the said bushing 76, upon the movement of the ram to the right, is in position to strike the arm 81 of a bell crank lever 82 at the same time the stop block 63 engages the vertical arm 66. The resulting downward movement of the other arm 83 of said bell crank depresses a spring pressed pin 84 into the path of a lug 85 carried on a longitudinal extension 86 of the clutch collar 47, the parts being so timed and spaced that the sliding movement of the clutch collar is arrested midway between the opposing toothed clutch surfaces 45 and 46, thereby disconnecting the ram from its automatic drive, and causing it to come to a stand still at the limit of

its movement away from the center of rotation of the work. The fourth arm 87 of the four armed lever has a projecting knob 88 which furnishes a manual means by which the operation of the automatic feed for the ram 16 may be started or stopped when desired.

The rotation of the shaft 53, whether the same be power or hand driven, as previously set forth, is capable of being transmitted to drive the rack 30, by means of which the belt 28 of the speed accelerating mechanism, or Evans drive, is reciprocated. To this end said shaft carries a gear 89, in mesh with a gear 90 carried upon a stub shaft 91, which is journaled in a box on an arm 92, pivotally suspended from the shaft 53. The shaft 91 carries a pulley 93 having a belt connection with a pulley 94 on a stub shaft 95, the inner end of which carries a gear 96 in mesh with the teeth of the rack 30. The reversals of the travel of belt 28 are thereby rendered simultaneous with the reversals of travel of the ram 16. When desired, however, the speed varying feature of the machine may be dispensed with, by rendering ineffective the belt connection between the pulleys 93 and 94, as shown in Figs. 3 and 4, the shaft 91, which is carried upon the swinging arm 92, extends through an elongated segmental slot 97 in the rear side 14 of the framework, and the free end of said arm has a horizontal projection 98 extending through a second elongated segmental slot 99 in said framework. By means of a knob 100, screw threaded on the outer end of said projection 98, and bearing against an interposed washer 101, the arm 92 may be retained at the limit of its swinging movement to the right, Fig. 4, to hold the belt tight, but when said knob is loosened, the tension of the belt necessary to furnish a driving connection is destroyed. To enable the arm to be swung in the direction to create a driving tension, the washer 101 has an extension 102 in convenient position to be seized by the operator.

The table 9 has been previously described as being capable of swinging movement with respect to the bracket 5, in order to provide for the inclination of the work holding face of the chuck 12 when a concave or convex grinding operation is desired. As shown in Figs. 6 and 7, the lower end of the bracket 5 is formed with a shallow boss 103, having a finished surface, against which is normally disposed a hardened steel plate 104, pivoted at 105, and having a depending finger 106 by means of which it may be moved into and out of its normal position. The table 9 carries on its lower end an inwardly projecting screw 107, constituting a spacing means of fixed and predetermined length, adapted when in contact with the face of plate 104, to insure the exact horizontal disposition of the face of the chuck 12. The table 9 also carries an adjustable screw 108, above and to one side of the fixed screw 107, the end of the said screw 108 adapted to engage the surface of the boss 103 at one side of the plate 104. The swinging of the plate 104 out of the path of the screw 107, rendering the latter inoperative, enables the table to be swung in either direction about its pivotal suspension, depending upon the direction in which the screw 108 is turned by its knurled handle 109.

A projection 110 of the table, extending through an elongated slot 111 of the bracket, carries a retaining nut 112 by means of which the table may be rigidly secured in any desired position, as determined by the graduations of a suitable scale 113, of the type ordinarily provided for this purpose. By the provision of the parts above described, it will be apparent that the horizontal position of the chuck face, once determined, is easily and accurately reëstablished, whenever desired, and moreover, is made entirely independent of the scale 113, with the result that any errors in said scale, or any chance for inaccuracy on the part of the operator in securing a nice adjustment thereon, are entirely eliminated.

To one skilled in the art to which this invention appertains, the adaptability of the machine to many forms of surface grinding, and particularly to disks or annular plates, will be readily apparent from the foregoing. The synchronous acceleration of the rotating work, and the traversing head or ram, as the abrading element carried by the latter approaches the center of rotation of said work, insures the production of a uniformly ground surface, it being a requisite characteristic of the change speed mechanism or Evans drive that the proportions of the latter are such as to insure the submission of substantially equal areas of the surface of the work to the action of the wheel 20, in equal increments of time during its traverse in both directions. In other words, the resultant of the two factors which determine the character and extent of the abrasive action, namely the linear speed of the work and the traversing speed of the abrading element, is kept substantially constant during both the forward and reverse strokes of the ram. Assuming, as is perfectly proper, a maximum value for such a resultant, or a limit of area possible to be ground in any given increment of time, as determined by the depth of cut, character of the metal speed of the wheel, etc., it follows that by reason of the construction above set forth, the grinding proceeds at the greatest possible speed during all portions of a complete cut, whereby the time required to grind any given piece of work is reduced to a minimum. Furthermore, by means of the ready adjustment of the stop blocks 63 and 64

with respect to their associated graduations 73 and 74, the extent of the traverse of the ram may be easily and quickly limited to the radial extent of the work, as will be readily understood.

It will be apparent, also, that the above described relation between the rotative speed of the work and the traversing movement of the abrading wheel, is maintained at all times, irrespective of whether the ram 16 be automatically driven from the power shaft, or not. When the shaft 53 is moved longitudinally inward, to render the hand wheel 61 effective for movement of the ram, the interdependence between the position of said ram and the position of the belt 28 is not thereby destroyed, and as a result, the rotative speed of the work still increases or decreases as the ram is moved, by hand, toward or from the center of rotation.

As hereinbefore set forth, the belt connection between the shaft 53 and the driving pinion 96 of the change speed mechanism, or Evans drive, may be rendered ineffective, when desired, thereby permitting the rotation of the work at a constant speed, which is determined by the position which the belt 28 is caused to assume. Under these conditions, and particularly when the ram 16 has been disconnected from its automatic feed by endwise movement of the shaft 53, the proper relation between the traversing positions of the ram 16 and belt 28 is wholly destroyed, with the result that when the automatic feed of the ram is reëstablished, and the aforesaid belt drive for the change speed mechanism is again rendered effective, it is highly probable that the belt 28 and ram 16 will not reach the end of their corresponding strokes simultaneously, as should be the case. This contingency is provided for in a pair of positive stops 114 to limit the movement of the rack 30 in each direction, and this action is made possible by the use of a non-positive or belt connection between the pulleys 93 and 94, which slips on said pulleys, until the aforesaid proper relation is reëstablished.

I claim,

1. In a grinding machine, a fixed framework having a portion thereof overhanging the work to be operated upon, and an abrading element carried thereby, having a traversing movement with respect to the work, the traverse of said element being substantially coextensive with said overhanging portion.

2. In a grinding machine, a fixed framework providing spaced parallel ways overhanging the work to be operated upon, and an abrading element slidable back and forth in the space between said ways.

3. In a grinding machine, means for supporting the work to be operated upon, a fixed framework providing a portion overhanging said work supporting means, and an abrading element suspended below said overhanging portion and slidable longitudinally thereof.

4. In a grinding machine, a rotatable work supporting means, an abrading means having a traversing movement toward and from the center of rotation of said work supporting means, and means for accelerating the speed of said work supporting means, as the abrading means approaches said center of rotation.

5. In a grinding machine, a rotatable work supporting means, an abrading means having a traversing movement toward and from the center of rotation of said work supporting means, and means for synchronously accelerating the rotation of said work supporting means and the movement of said abrading means as the latter approaches the center of rotation of said work supporting means.

6. In a grinding machine, a work traversing abrading means, means for rotating the work during the action thereon of said abrading means, and means for maintaining constant the area of the surface of the work submitted to said abrading means in successive like intervals of time during the period of the traverse of said abrading means.

7. In a grinding machine, means for rotating the work to be operated upon, means for traversing the surface of said work with an abrading element, and automatic means for maintaining the abrasive action of said element substantially constant with respect to successive intervals of time during the period of its traverse over said work.

8. In a grinding machine, means for supporting the work to be operated upon, means for traversing the surface of said work with an abrading element, and means for rotating said work supporting means at variable speeds, whereby to present substantially equal areas of the surface of said work to the action of said abrading element during like increments of time.

9. In a grinding machine, means for rotating the work to be operated upon, an abrading element adapted to have a traversing movement toward and from the center of rotation of said work, and means for moving said abrading element at varying speeds, whereby to act upon substantially equal areas of the surface of said work in like increments of time.

10. In a grinding machine, a work supporting means, an abrading element having a traversing movement with respect to said work supporting means, and means for rotating said work supporting means at varying speeds, as determined by the radial distance of said abrading element from the center of rotation thereof.

11. In a grinding machine, a work supporting means, an abrading element having a traversing movement with respect to said work supporting means, and means for rotating said work supporting means at speeds inversely proportional to the radial distance of said abrading element from the center of rotation of said work supporting means.

12. In a grinding machine, means for rotating the work to be operated upon, means for traversing the surface of said work with an abrading element, means for accelerating the rotation of the work and the traversing movement of the abrading element as the latter approaches the center of rotation of the work, and means for maintaining a predetermined relation between the rotative speed of the work and the traversing position of said abrading element when the latter is disconnected from said accelerating means.

13. In a grinding machine, means for rotating the work to be operated upon, means for traversing the surface of said work with an abrading element, an automatic accelerating mechanism effective jointly upon the rotation of the work and the traversing movement of the abrading element, means for disconnecting said abrading element from said automatic accelerating mechanism, and means for thereafter controlling the action of said automatic accelerating mechanism in response to the traversing position assumed by said abrading element.

14. In a grinding machine, means for rotating the work to be operated upon, an abrading element capable of a traversing movement toward and from the center of rotation of said work, adjustable stops for determining the extent of traversing movement of said abrading element in each direction, and a graduated scale, associated with each of said stops, for determining the position of said stops with reference to the outer and inner diameters respectively of the rotating work.

15. In a grinding machine, an abrading element having a reciprocating movement with respect to the work to be operated upon, stops operable at the end of the stroke of said element in each direction to effect a reversal of its movement, and means carried by one of said stops, and movable into a fixed position with respect thereto, for effecting the disconnection of said abrading element from its driving power at the end of its movement in one direction.

16. In a grinding machine, an abrading element, having a traversing movement with respect to the surface of the work, means for reversing the movement of said abrading element at each end of its stroke, comprising a clutch member movable into two different operative positions, adjustable blocks carried by said abrading element for effecting the movement of said clutch member, and means carried by one of said blocks and movable into a fixed position with respect thereto, for stopping said clutch member in an intermediate inoperative position at the end of a stroke of said abrading element.

17. In a grinding machine, a work supporting table capable of swinging movement to vary the inclination of its work supporting face, and means coöperating with said work supporting table for insuring the horizontal disposition of said work supporting face, said means being movable into an inoperative position to permit the adjustment of said table for other positions of said face.

18. In a grinding machine, a fixed framework, a member pivoted thereto, a work supporting table capable of swinging movement to vary the inclination of its work supporting face, means carried by said table for contact with said pivoted member when said work supporting face is in a horizontal plane, and adjustable means, operative upon the movement of said pivoted member into inoperative position, for securing the disposition of said work holding face in planes inclined from the horizontal.

19. In a grinding machine, an abrading element having a path of movement across the work to be operated upon, mechanism for moving said element at varying rates of speed in a predetermined relation to its position with respect to said work, means for disconnecting said element from said change speed mechanism, and means for insuring the reëstablishment of the same relation between said element and said change speed mechanism when they are thereafter operatively connected together.

20. In a grinding machine, an abrading element having a path of movement across the work to be operated upon, mechanism for reciprocating said element at varying speeds in response to its position with respect to the work, means for rendering said change speed mechanism inoperative, and means for insuring the reëstablishment of the same driving relation between said element and said mechanism when said mechanism is thereafter rendered operative.

21. In a grinding machine, an abrading element having a path of movement across the work to be operated upon, mechanism for reciprocating said element at varying speeds in a predetermined relation to its position with respect to the work, said mechanism comprising a frictional driving member reciprocating in synchronism with said abrading element, a non-positive driving connection between said change speed mechanism and said abrading element, and means for limiting the movement of said driving member in either direction, whereby to in-

sure the maintenance of the relation between the position of the abrading element and the position of the driving member.

22. In a grinding machine, a work supporting means, a fixed framework having a portion overhanging said work supporting means, and providing spaced parallel ways therein, a member slidable in said ways, and an abrading element suspended from said member in the space between said ways.

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Witnesses:
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