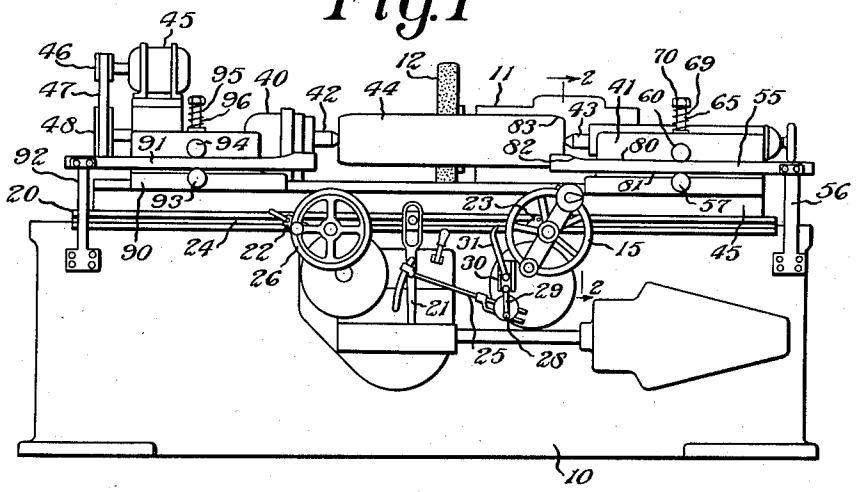
June 1, 1937. H. J. GRIFFING ET AL 2,082,734

FORM GRINDING APPARATUS

Filed June 26, 1936

Fig. 1



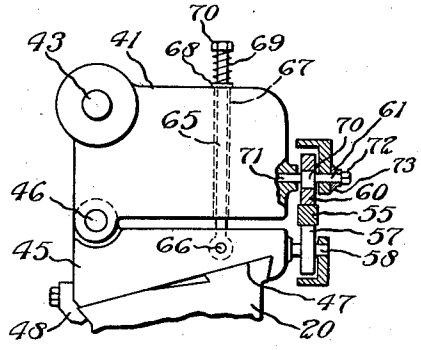


Fig. 2

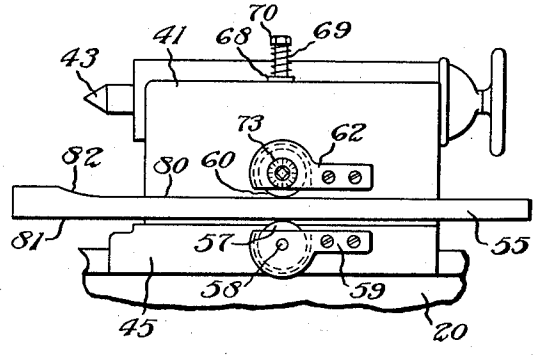


Fig. 3

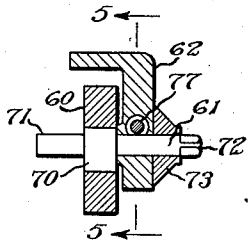


Fig. 4

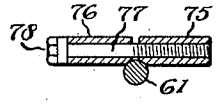


Fig. 5

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FORM GRINDING APPARATUS

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Application June 26, 1936, Serial No. 87,506

6 Claims. (Cl. 51—94)

This invention relates to a grinding machine, and more particularly to a forming device for grinding a curved or irregular face on the periphery of a work piece.

One object of this invention is to provide a simple and thoroughly practical grinding machine for grinding the periphery of a work piece to an irregular contour as the work piece and grinding wheel are reciprocated longitudinally relative to each other. Another object of this invention is to provide a means to cause a transverse movement of one or both ends of the work axis toward or from the grinding wheel during a relative longitudinal reciprocation between the grinding wheel and work piece to grind an irregular shape on the periphery of a work piece. A further object of the invention is to provide a pivotally mounted footstock and/or headstock, one or both of which may be rocked to move the work axis relatively toward and from the grinding wheel axis during a relative longitudinal reciprocatory movement between the wheel and work to grind a predetermined contour or form on the periphery of the work piece. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of various possible embodiments of the mechanical features of this invention,

Fig. 1 is a front elevation of a grinding machine embodying this invention;

Fig. 2 is a fragmentary end elevation of a tilting footstock, taken approximately on the line 2—2 of Fig. 1;

Fig. 3 is a front elevation of the parts shown in Fig. 2;

Fig. 4 is a fragmentary sectional view, showing the adjustment of the roller, on an enlarged scale, and the parts shown in Fig. 2; and

Fig. 5 is a fragmentary sectional view, taken approximately on the line 5—5 of Fig. 4, showing the clamping means for locking the eccentric stud in adjusted position.

A grinding machine has been illustrated in the drawing, comprising a base 10 which supports a transversely movable grinding wheel slide 11 which is adapted to slide transversely on a V-way and flat way (not shown) on the base 10. The wheel slide 11 supports a rotatable grinding wheel 12. The wheel slide 11 and grinding wheel 12 may be moved transversely relative to the base 10 by means of a wheel feeding mechanism comprising a feed screw and half nut (not shown) which may be actuated by means of a manually operable feed wheel 15. The parts of the feed mechanism are not considered a part of the present invention and consequently have not been illustrated in detail. These parts are substantially identical to those shown in the prior expired U. S. Patent to Norton No. 762,838 dated June 14, 1904, to which reference may be had for a more detailed disclosure.

The base 10 also supports a longitudinally movable work supporting table 20 which is arranged to be reciprocated longitudinally relative to the base 10 by means of a power operated table reciprocating mechanism, such as that shown in the prior patent to Norton No. 762,838. A table reversing lever 21 is pivotally mounted on the base and is arranged to be actuated by adjustable dogs 22 and 23 which are adjustably mounted in a T-slot 24 on the front edge of the longitudinally movable table 20. The table 20 may, if desired, be traversed longitudinally by means of a manually operable hand wheel 26 which is connected through a reduction gear mechanism to a rack and gear beneath the table so that when the hand wheel 26 is rotated, the table 20 is moved longitudinally in either direction, depending on the direction of rotation of the traverse wheel 26.

If desired, the wheel 12 may be fed transversely by a manual rotation of the feed wheel 15 or, if desired, the feed wheel 15 may be actuated automatically at the ends of the reciprocatory stroke of the table 20. This is preferably accomplished by providing a connecting link 25 which serves to rotate a crankpin 28 which is connected by a link 29 to reciprocate a vertical slide 30. The vertical slide 30 carries a feed pawl 31 which is arranged to engage ratchet teeth on the periphery of the feed wheel 15. These parts are all more fully disclosed in the prior patent above mentioned.

The table 20 is provided with a rotatable work support comprising a headstock 40 and a footstock 41 which are provided with centers 42 and 43 respectively and serve to rotatably support a work piece 44 in operative relation with the grinding wheel 12. The headstock 40 may be of a belt driven or motor driven type, the latter type being illustrated as showing a motor driven headstock of the type shown in the prior United States Patent No. 1,631,458, in which an electric motor 45 is mounted on top of the headstock 40. A motor pulley 46 is connected by a belt 47 with a pulley 48 mounted on the outer end of the work spindle.

In grinding certain work pieces, it is frequently necessary to grind a work piece which is cylindrical in shape throughout a greater part of its length, but in which the end portions of the work piece are tapered or rounded off to a predetermined shape and form. In order to

grind such a shape on the work piece, it is desirable to provide a construction in which the parts are so arranged that the work piece may be moved transversely toward or from the grinding wheel to grind a predetermined shape thereon as the table 20 is reciprocated longitudinally. In the preferred construction, the footstock 41 is arranged so that it may be moved transversely and is preferably formed in two parts, an upper part 41 which is pivotally mounted to a lower part 45 by means of a pivot pin or stud 46. The part 41 may be rocked so as to move the footstock center 43 toward and from the wheel axis to change the position of the work axis during the longitudinal reciprocating motion thereof. The lower part of the footstock 45 is provided with a surface 47 which mates with a correspondingly shaped surface on the table 20 and is arranged to be clamped in adjusted position thereon by means of a clamping block 48.

A mechanism is provided for rocking the footstock 41 as the table 20 is reciprocated longitudinally so as to produce a predetermined face on the periphery of the work piece. In the preferred construction, a forming bar 55 is fastened at one end to a bracket 56 which is supported on the base 10. The bar 55 engages a rotatable roller 57 which is carried by a stud 58 supported at one end by a bracket 59 and at the other end in the lower part 45 of the footstock 41. A rotatable roller 60 is supported on a stud 61, one end of which is carried by a bracket 62 and the other end of which is supported in the footstock 41. The upper pivotally mounted portion 41 is held by a yieldable means so that the roller 60 is maintained in operative contact with the upper surface of the forming bar 55, while the under surface of the bar rests on the rotatable roller 57. A rod 65 is pivotally connected to the lower part 45 of the footstock by means of a stud 66. The rod 65 passes through a clearance hole 67 in the footstock 41. A thrust washer 68 surrounds the

sition. This may comprise a binding mechanism comprising a threaded bushing 75 and a bushing 76 which slides on a cylindrical portion of a clamping screw 77. The screw 77 is screw threaded into the bushing 75 and is provided with a hexagonally shaped head 78. When the stud 61 has been adjusted to a predetermined extent, a wrench may be applied to the head 78 to rotate the screw 77 and to draw the bushings 75 and 76 toward each other to clamp the stud 61 in its adjusted position.

It will be readily apparent from the foregoing disclosure that when the table is traversed longitudinally, the roller 57 serves as a backing roller to support the under side of the forming bar 55 and the upper roller 60 serves to transmit any motion formed in the forming bar 55 to rock the footstock 41 and thereby cause a transverse movement of the footstock center 43 toward and from the grinding wheel. As illustrated, a major portion of the bar 55 is provided with opposed parallel sides 80 and 81 which transmit no relative motion to the footstock and consequently grind a cylindrical surface on the work piece. A curved portion 82 on the bar serves, when the table 20 moves toward the right, to cause a transverse rocking movement of the footstock 41 as it reaches the end of its stroke so as to cause the footstock end of the work axis to approach the grinding wheel axis at a controlled rate and to thereby produce a curved surface 83 on the work piece 44. By shaping the bar to a predetermined shape, any form may be produced on the roll or cylindrical work piece being ground. By adjusting the eccentric 70, the footstock center may be offset relative to the path of travel of the table so that a taper will be ground on the periphery of the work piece and as the work piece approaches the end of its stroke, a curved face 83 will be produced on the end of the tapered surface.

Similarly, if desired, the headstock 40 may be formed in two parts and the headstock 40 rocked

headstock or the footstock or both of them may be arranged for a rocking motion to shift the work axis during grinding to produce a predetermined shape on the periphery of the work piece, as desired.

The operation of this mechanism is readily apparent from the foregoing disclosure. The work piece **44** is mounted on the headstock center **42** and the footstock center **43** and is rotated in the usual manner by means of a driving pin or dog (not shown) which is well known in the art. Assuming the rollers **60** and **94** have been previously adjusted to position the headstock center **42** and the footstock center **43** in the desired position for grinding, the table is then reciprocated either by power or manually traversed by means of the manually operable traverse wheel **26**. As the table moves longitudinally, the rollers **57** and **60**, and **93** and **94**, follow the surface of the bars **55** and **91** respectively to rock the footstock **41** and the headstock **40**, as desired, to grind a predetermined irregularly shaped face on the periphery of the work piece **44**. The grinding wheel **12** may be fed automatically at the ends of the table stroke, as above described, or it may be advanced manually by rotation of the feed wheel **15** as desired.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

We claim:—

1. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable wheel slide on said base, a longitudinally movable work table, means to feed said slide transversely, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock, a work supporting center on the headstock and footstock to rotatably support the opposite ends of a work piece, a longitudinally extending pivot for said footstock, and means independently to rock said footstock transversely during the longitudinal movement of said table to cause a transverse movement of said footstock center during the grinding operation.

2. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable wheel slide on said base, means to feed said slide transversely, a longitudinally movable work table, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock each of which is provided with a work supporting center, a longitudinally arranged pivotally mounted support for said footstock, a forming bar supported on said base, and a follower on said footstock which engages the forming bar and serves independently to rock the footstock transversely when the table is traversed longitudinally to produce a transverse approaching and receding movement of said footstock center relative to the grinding wheel axis during the longitudinal movement between the wheel and work support.

3. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable wheel slide on said base, means to feed said slide transversely, a longitudinally movable work table, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock each of which is provided with a work supporting center, an independent longitudinally arranged pivotally mounted support for said headstock, a forming bar supported on said base, and a follower on said headstock which engages the forming bar and serves independently to rock the headstock transversely when the table is traversed longitudinally to produce a transverse approaching and receding movement of said headstock center relative to the grinding wheel axis during the longitudinal movement between the wheel and work support.

4. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable slide on said base to support said wheel, a longitudinally movable table, means to feed said slide transversely toward and from said table to produce a grinding action, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock each having a work supporting center which are arranged to rotatably support opposite ends of a work piece, an independent longitudinally arranged pivotal support for either the headstock or the footstock, and means to rock the pivotally mounted member during the longitudinal movement of said table to produce an independent transverse movement of one end of said work toward and from the axis of the grinding wheel during the grinding operation.

5. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable wheel slide therefor supported on said base, a longitudinally movable table, means to feed said slide transversely toward or from said table, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock each having a work center which are arranged to rotatably support the opposite ends of a work piece, a pivotal support between the headstock and the table, a pivotal support between the footstock and said table, and means to independently rock said headstock and said footstock during the longitudinal movement of said table to produce a transverse movement of said work centers during the grinding operation.

6. In a grinding machine, a base, a rotatable grinding wheel, a transversely movable wheel slide therefor supported on said base, a longitudinally movable table, means to feed said slide transversely toward or from said table, means to reciprocate said table longitudinally, a rotatable work support thereon including a headstock and a footstock each having a work center which are arranged to rotatably support the opposite ends of a work piece, a pivotal support between the headstock and the table, a pivotal support between the footstock and said table, and means including a forming bar adjacent to each end of said base and arranged to independently rock said headstock and said footstock during the longitudinal movement of said table to produce a transverse movement of said work centers during the grinding operation.

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