Sept. 11, 1934. R. E. W. HARRISON ET AL 1,973,626

GRINDING MACHINE

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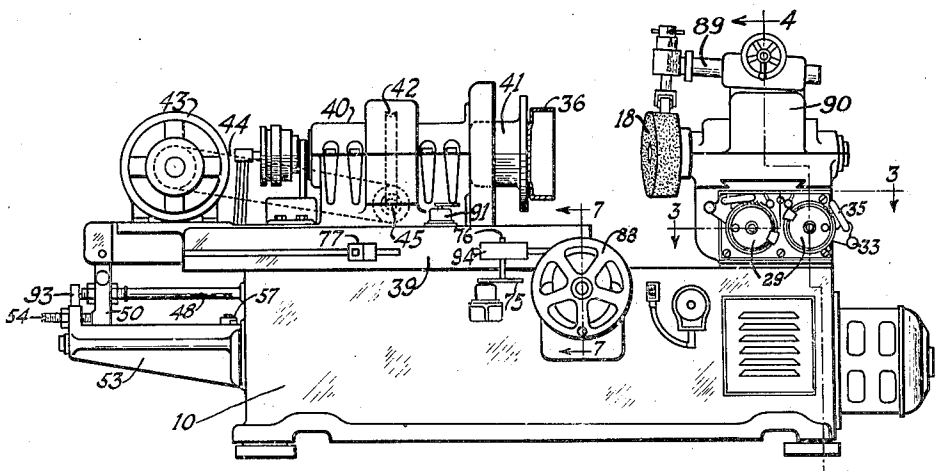



FIG. 1

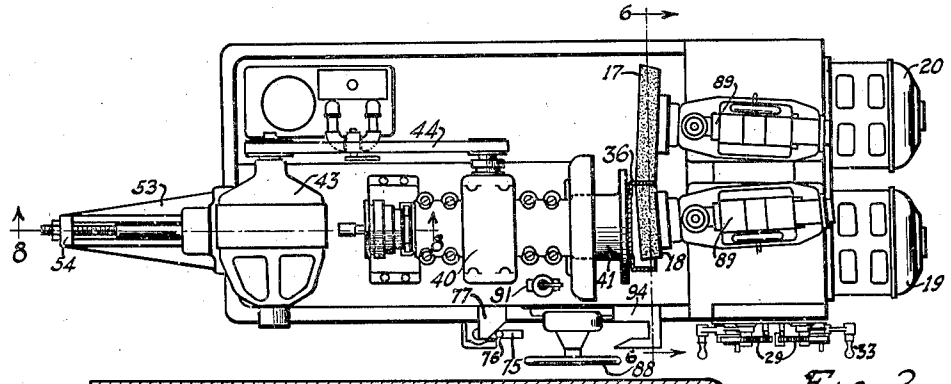



FIG. 2

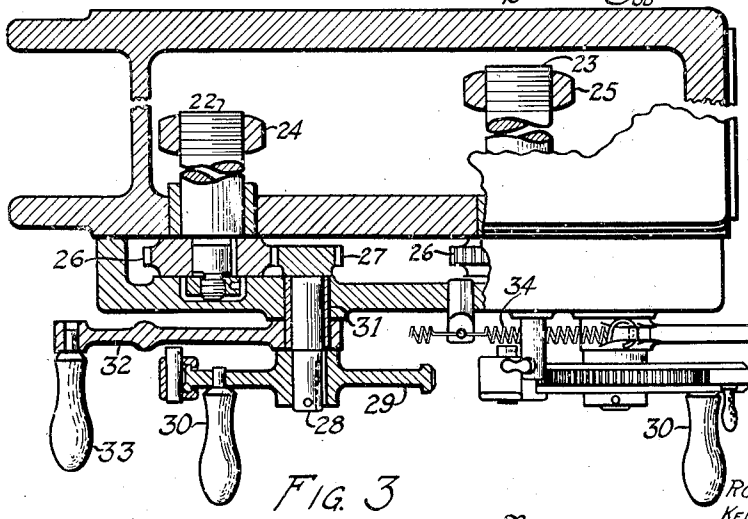



FIG. 3

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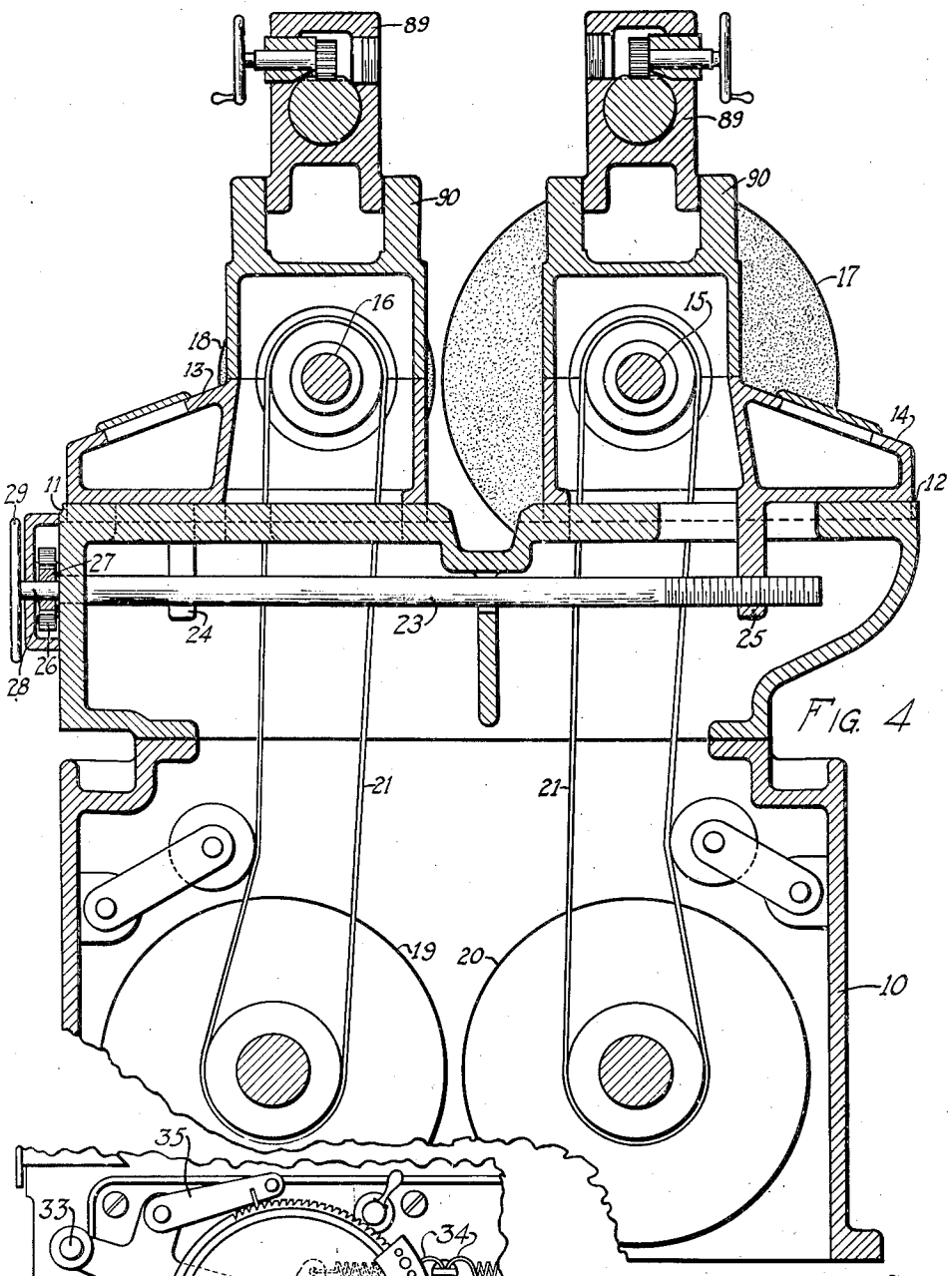



FIG. 4

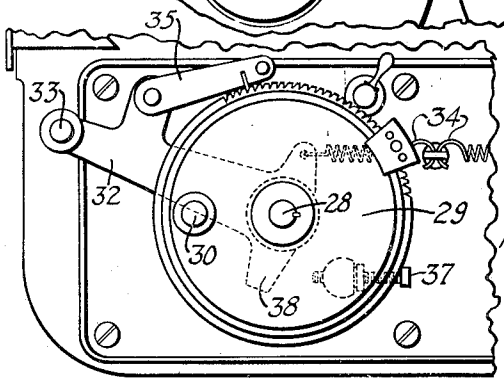



FIG. 5

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GRINDING MACHINE

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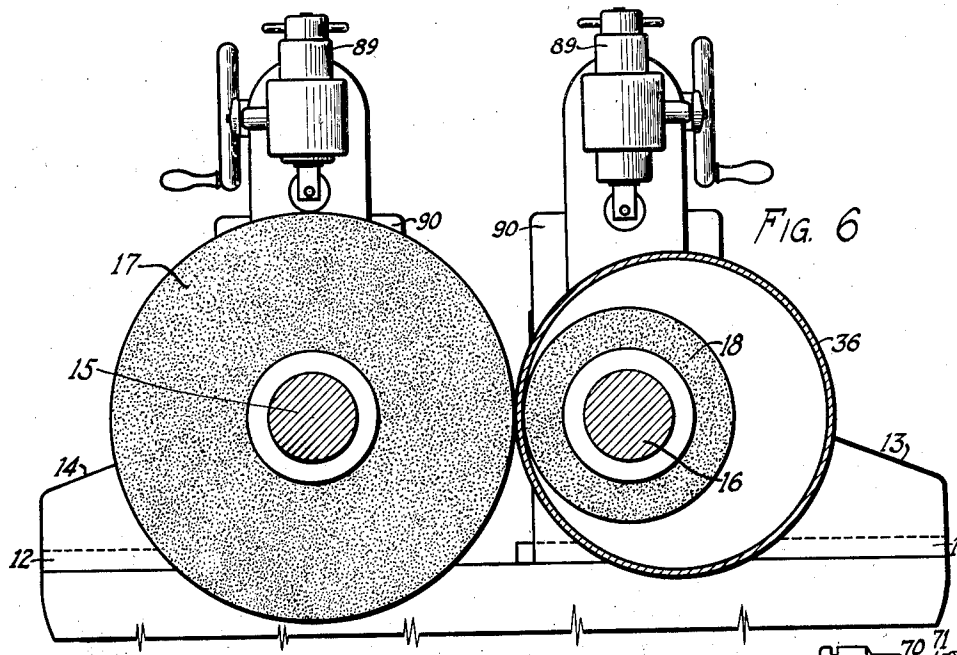



FIG. 6

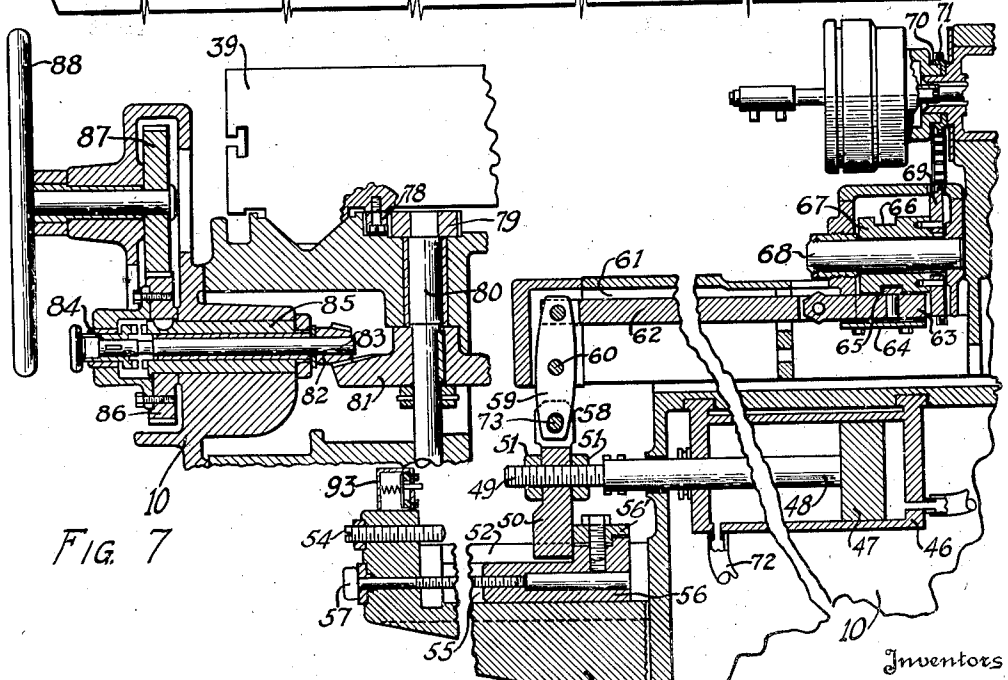



FIG. 7

FIG. 8

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Patented Sept. 11, 1934

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# UNITED STATES PATENT OFFICE

1,973,626

## GRINDING MACHINE

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Application January 16, 1929, Serial No. 332,935

24 Claims. (Cl. 51—84)

This invention relates to improvements in grinding machinery and particularly to mechanism for operation upon a tubular or like article.

One of the objects of the present invention is the provision of a machine which shall be particularly adapted for the simultaneous production of inner and outer surfaces of a tubular article.

A further object of the invention is the provision of a machine which may be satisfactorily utilized for the concentric production of inner and outer brake drum surfaces and which shall be capable of handling either the separate drums or complete hub and drum assemblies as may be preferred.

Another object of the invention is the provision of a mechanism of this character which will properly prevent formation of grooves or circumferential grinding lines on the work during simultaneous action upon opposite surfaces thereof by a reciprocation of the workpiece in operative relation to the grinding wheels.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings forming part thereof, and it will be understood that we may make any modifications in the specific details hereinafter disclosed within the scope of appended claims without departing from or exceeding the spirit of the invention.

Figure 1 is a front elevation of a grinding machine constructed in accordance with and embodying the principles of the present invention.

Figure 2 is a plan view thereof.

Figure 3 is a fragmentary sectional view on line 3—3 of Figure 1.

Figure 4 is a vertical sectional view through the wheel head adjusting mechanism as on line 4—4 of Figure 1.

Figure 5 is a fragmentary enlarged view illustrating the manual actuating means for wheel slide adjustment.

Figure 6 is a vertical sectional view through the wheels and work on line 6—6 of Figure 2.

Figure 7 is a fragmentary sectional view on line 7—7 of Figure 1, illustrating the mechanism for manual adjustment of the work carrying table, and

Figure 8 is a fragmentary longitudinal sectional view on line 8—8 of Figure 2 illustrating the power means for imparting the several desired movements to the work table.

Broadly speaking, the invention contemplates a machine particularly adapted for use in the grinding of brake drums or similar articles which will satisfactorily present the article to be operated upon to a pair of grinding wheels for simultaneous grinding of the internal and external surfaces of the drum.

The invention further contemplates a rapid presentation of the work to the grinding wheels and a rapid withdrawal therefrom, preferably under fluid pressure, together with means for imparting a relative axial reciprocating movement to the work and grinding wheels to prevent grooving and breaking up the grinding lines which might otherwise be produced while the workpiece is in operative relation to the grinding wheels.

In the embodiment of the invention chosen for purposes of illustration, the bed 10 of the machine is provided with ways 11 and 12 for the wheel head slides 13 and 14 respectively.

These slides have journaled therein the spindles 15 for the external grinding wheel 17 and 16 for the internal grinding wheel 18, the internal grinding wheel 18 being carried by the slide 13 and the external grinding wheel 17 by the slide 14. It will be particularly noted by reference to Figure 2 of the drawings that these spindles are disposed at divergent angles one to the other and the respective wheel surfaces of the outer grinding wheel 17 and internal grinding wheel 18 are of frustro-conical form.

As a result they provide sharp, easily maintained edges for cutting up close to the face of the drum member. By forming both wheels of this particular formation, the additional advantage is attained that it is possible to utilize the wheels to a maximum degree, since when the outer wheel has been considerably worn down it may be replaced with a new wheel of full size and the worn wheel transferred to the opposite spindle and utilized as the internal grinder.

While the grinding wheels may be driven in any suitable manner, use is preferably made of the independent drive members 19 and 20 connected with the respective wheel spindles by belts 21.

To adjust the position of the wheels with respect to each other and to the work, use is made of individual adjusting screws 22 and 23 engaging the depending lugs 24 and 25 on the wheel slides 13 and 14 respectively. Inasmuch as the adjusting mechanisms of these screws are identical although oppositely disposed, detailed description will be given of but one.

The adjusting mechanism comprises a gear 26 keyed on the forward end of each screw 22

and 23 and engageable by a pinion 27 secured to a stud shaft 28 journaled in a bracket on the face of the machine, the forward end of said shaft 28 having a ratchet wheel 29 secured thereto. This ratchet wheel is directly rotatable by handle 30.

A bearing bushing 31 for shaft 28 provides a pivot for a rock lever 32, having a handle 33 on the end thereof.

Mention has been made of the fact that the two adjusting mechanisms are oppositely disposed thus presenting the handles 33 for actuation of the screws 22 and 23 respectively at outer sides of the corresponding ratchet wheels 29.

Springs 34 tend to urge the levers 33 into raised position. Each lever is provided with a gravity pawl 35 for engagement with the teeth of its ratchet 29 so that as the handle is moved upward the pawl will ride over one or more teeth of the ratchet with which said pawl engages. The ratchets and thus the corresponding feed screws will be turned to procure a feeding movement of the grinding wheels as the handles are depressed.

This permits what may be termed a pumping adjustment of the two slides in that the pair of handles 33 may be simultaneously grasped and depressed by the operator, the left hand screw 22 being given a clock-wise rotation forcing the internal grinding wheel toward the rear of the machine to contact with the interior of the brake drum 36 while the right hand handle causes a counter-clockwise rotation of screw 23 moving slide 14, and the wheel 17 carried thereon, toward the front of the machine and into engagement with the exterior of the drum.

It will thus be noted that the two wheels are correspondingly shifted toward each other to bring them into proper engagement with the work piece projecting therebetween.

The movement imparted to rock lever 32 for a given feed stroke may be varied by adjustment of a stop screw 37 which is in a position to contact with arm 38 on the lever to limit the downward movement of said lever, thereby determining the extent of movement of the corresponding grinding wheel for each actuation of the lever.

The work supporting and rotating mechanism for presentation of the brake drum to the simultaneous action of the pair of opposed grinding wheels includes a slide or table member 39 providing bearings 40 in which is journaled a spindle, to the forward end of which the hydraulic or like work retaining chuck 41 is secured. Said shaft is provided with a circumferential worm gear 42, driven from motor 43 by belt 44 and a worm 45 engaging said gear 42. These parts are all mounted on the table member for suitable joint reciprocation which may be effected in any desired manner. In the present instance there has been shown as secured within the bed 10 a cylinder 46 which receives a piston 47 having the piston rod 48 projecting from one end of the bed. This rod 48 is provided with a reduced threaded terminal portion 49 on which is adjustably mounted the slide block 50 suitably secured in place by nuts 51. This block rides in the guiding groove 52 of bracket 53 on the bed, and outward movement of said block is limited by engagement therewith of the adjustable abutment or stop screw 54. Sub-tending the groove 52 in a supplemental groove 55 is an adjustable block 56 bearing an abutment 56' for limiting the inward movement of member 50, and consequently of the piston rod and piston. The position of this slide block 56 is controlled by an adjusting screw 57 carried by bracket 53. It will thus be seen that the slide block 50 is capable of limited reciprocation between the pair of adjustable contact or stop members 54 and 56'.

Pivoted to the block between the furcations 58 thereof is a link 59 intermediately pivoted as at 60 to the hollow portion 61 of the table or carriage member 39 and having its upper end connected by a link 62 with a slide 63 supported by suitable guide members 64 on the under side of the table 39. This slide 63 is provided with a roller 65 riding in groove 66 of the barrel cam member 67, rotatably mounted on the table as by pin 68. This barrel cam has secured thereto a sprocket 69 driven by chain 70 from the sprocket 71 secured on the rotating chuck spindle previously referred to.

Consequently, the barrel cam will rotate at all times when rotation is being imparted to the work holding chuck.

The operation of this mechanism should be understood by reference to Figure 8 from which it will be noted that when a lever 75, which controls the admission of fluid to the cylinder 46, is rotated to the right, thus causing introduction of air or other hydraulic medium to the left hand end of said cylinder through pipe line 72, block 50 will be moved to the right until it contacts with stop 56'. In this movement it will carry with it the intermediately pivoted rock lever 59 and on account of the connection of this lever through pin 60 with the table extension and the second connection through linkage 62 and slide 63 with the end-wise immovable cam 67, the table will be correspondingly shifted with the piston, the parts therefore moving together as a unit.

In addition however, rotation of the cam member will cause a longitudinal shifting of slide 63 with respect to the adjacent portion of the table. This movement is transmitted through link 62 to rock lever 59 oscillating this lever about its pivot 60. Inasmuch as the lower end of the lever while free to swing about its pivotal connection to block 50 cannot transmit motion to block 50 due to the fact that the piston rigidly holds the block against its stop, this rocking movement will operate about the pivot pin 73 as a fixed fulcrum and consequently, slight movement or reciprocation will be imparted to the table 39 as respects the piston and slide block.

This movement, it will be understood is slight, causing what is ordinarily termed an oscillation of the work with respect to the grinding wheel eliminating the liability of abrasive grooves, grinding lines or the like being produced on the work. It is to be understood that the general operation of the machine may be manually or automatically controlled, there preferably being provided the above-mentioned manually operable reversing lever 75 by which the flow of actuating medium may be directed to either end of cylinder 46 as preferred, the action causing a rapid forward or rapid reverse movement of the table and parts associated therewith.

This lever has an extension 76 for engagement with dogs 77 on the table serving to partially close the valve, reducing the speed of movement of the table and thus cushioning its action at each end of the stroke thereof. To

facilitate setting up of the machine and for various adjustments or changes of position thereof, through the same general stroke of movement, the table is provided on the under side with a longitudinally extending rack 78 meshing with pinion 79 on shaft 80. This shaft is in turn provided with a bevel gear 81 rotatable by pinion 82 on shaft 83. Splined on this shaft is the manually shiftable clutch member 84 for effecting a driving connection between the said shaft and a slide 85 carrying a gear 86 meshing with gear 87 rotated directly from the hand wheel 88. When clutch member 84 is pressed inward the drive train extends from hand wheel 88 to pinion 79 and rack 78 facilitating desired manual adjustment of the position of the table, while when the clutch member 84 is drawn outward, wheel 88 is disconnected and will remain stationary during the hydraulic shifting of the table.

To properly form the surface of the two grinding wheels and to preserve their condition for accurate grinding, use is made of suitable truing mechanism 89 carried by bracket portions 90 on the journals for the grinding wheel spindles.

In the operation of the machine with the parts in position shown in Figure 1, the brake drum 36 to be ground has its hub inserted in the hydraulic or air chuck 41 control handle 91 being suitably manually actuated to cause the chuck to properly grip and retain the workpiece in position. The lever 75 is then manually shifted to introduce pressure into the left hand end of cylinder 46, thereby moving the piston 47 to the right to carry the entire carriage mechanism 39, on which the workpiece is mounted in the direction of the grinding wheels. At the same time the motor 43 is energized to rotate the chuck. This may be manually effected or may be automatically performed by switch 93 disposed adjacent stop 54 in such position that it is opened to stop the motor as the carriage reaches its rearward position during withdrawal of the workpiece from the grinding wheels and automatically closed to start rotation of the work as block 50 is moved away from said stop to carry the workpiece into engagement with the grinding wheels. The piston rapidly advances the work toward the grinding wheels until the dog 77 engages with projection 76 of control lever 75 slowing down the movement of the table so that it eases up against stop 56' without shocking or jarring the valve. The valve remains open sufficiently to cause the hydraulic pressure to hold member 50 firmly against member 56'.

The rotation of the chuck 41 procures rotation of the barrel cam 67 whereby an oscillating movement is imparted to lever 59 with a consequent slight reciprocation of the table while the work is in position to be ground.

It will be understood that as the work is moved forward the grinding wheels are sufficiently separated to permit of movement of the brake drum flange therebetween. The depression or actuation of the handles 33 will then rotate the wheel controlling feed screws 22 and 23 corresponding amounts to bring the two wheels into engagement with the work and the grinding operation will be simultaneously performed on the inner and outer surfaces grinding these surfaces concentrically one with the other and providing a uniform thickness of flange wall which will insure satisfactory operation of the brakes when the drums are placed in service. When the grinding has been continued to the desired amount the operator reversely rotates the feed screws by manual actuation of handles 30, separating the two grinding wheels, and disengaging them from the work. The lever 75 is then reversely, manually actuated causing a withdrawal movement of the table to a point limited by the engagement of stop 54 with the block 50. The movement of the table to inoperative position is further controlled by a stop dog 94 on the table which moves the controlling lever 76 to a neutral position as the table approaches rest position, thereby shutting off the actuating fluid from the right hand end of the cylinder. As the table comes to rest, the switch 93 is automatically shifted by said table to stop motor 43 and bring the chuck to rest so that the work may be readily removed therefrom.

We claim:

1. A machine of the character described, including a bed, and a table slidably mounted on the bed, a rotatable work holder mounted on the table, power actuable means carried by the bed for moving the table on the bed, means for imparting a supplemental reciprocating movement to the work holder as respects the bed, and drive connections between the work holder and said supplemental means for actuation of the latter on rotation of the work holder.

2. In a machine of the character described, the combination with a bed, of ways formed thereon, slides supported by the bed on opposite ends of the ways, peripherally opposed grinding wheels carried by the slides for adjustment toward and from each other, means for effecting said adjustment including parallel individual adjusting screws for the slides, and oppositely arranged laterally extending actuating handles for the screws whereby joint actuation of the handles will move the slides one toward the other.

3. In a machine of the character described, the combination with a bed, of ways formed thereon, slides supported by the bed on opposite ends of the ways, peripherally opposed grinding wheels carried by the slides for adjustment toward and from each other, means for effecting said adjustment including parallel individual adjusting screws for the slides, oppositely arranged laterally extending actuating handles for the screws whereby joint actuation of the handles will move the slides one toward the other, and means for operatively coupling the handles with the screws comprising ratchets carried by one of the members and cooperating pawls by the other member of each set whereby the handles may be operated with an oscillatory pumping action to effect successive increments of movement of the slides one toward the other.

4. A grinding machine including a bed, guide ways extending transversely of the bed adjacent one end thereof, slides supported on the ways, grinding wheels mounted on the slides, a means for presenting work in operative relation to said grinding wheels including a table longitudinally movable on the bed toward and from the grinding wheels, a work holding member supported by the table, power means carried by the bed for shifting the table, supplemental manual table adjusting means including a rack carried by the table, a pinion in permanent engagement therewith, a gear train for actuation of the pinion terminating in a hand wheel and a clutch intermediately disposed in the train for controlling

the operative coupling of the hand wheel and pinion.

5. A grinding machine including a bed, guide ways extending transversely of the bed adjacent one end thereof, slides supported on the ways, grinding wheels mounted on the slides, a means for presenting work in operative relation to said grinding wheels including a table longitudinally movable on the bed toward and from the grinding wheels, a work holding member supported by the table, power means carried by the bed for shifting the table, supplemental, manual table adjusting means including a rack carried by the table, a pinion in permanent engagement therewith, a gear train for actuation of the pinion terminating in a hand wheel and a clutch intermediately disposed in the train for controlling the operative coupling of the hand wheel and pinion, and a control member for the clutch underlying the operating hand wheel whereby the wheel serves as a guard preventing accidental actuation of the clutch control member.

6. In a grinding machine for grinding the inner and outer surfaces of a flanged work piece the combination of a bed, a pair of grinding wheels one for operation on the inner face of the flange and the other for operation on the outer face of the flange, a spindle for each grinding wheel having their axes extending at an angle to one another, the grinding wheels having their active faces extending at an angle to the axis of their respective spindles and parallel to one another, the said active faces of the grinding wheels further being of a width substantially equal to the surfaces to be ground, a rotatable work holder, means for moving said work holder from a loading position remote from the grinding wheels to an operative position to place the said work flange between the active faces of the wheels, means for actuating the grinding wheels toward one another to effect a stock reduction on the flange, and supplemental means for effecting a slight reciprocation between the work and the grinding wheels.

7. In a grinding machine for grinding the inner and outer surfaces of hollow work pieces the combination of a pair of grinding wheels having their operative faces parallel to one another and of a width substantially equal to the surfaces to be ground, a support for each grinding wheel, means for actuating the said supports toward one another including an adjusting screw for each support terminating at a common station, and individual means for operating the said adjusting screws, a rotatable work holder for rotatably supporting a work piece in operative relation to the grinding wheels, and means responsive to rotation of said work holder effecting a slight reciprocation of the work holder and work axially thereof to break up grinding lines on the work.

8. In a grinding machine for simultaneously grinding the interior and exterior of a hollow work piece the combination of a bed, ways thereon for supporting a work carrier, means for rotatably supporting a work piece on the carrier including a prime mover, hydraulic means for translating the work carrier from a work receiving position to an operative position, and means coupled with the rotating work holder for effecting an axial reciprocation of the work carrier.

9. In a grinding machine for simultaneously grinding the interior and exterior of a hollow work piece the combination of a bed, ways thereon for supporting a work carrier, means for rotatably supporting a work piece on the carrier including a prime mover, hydraulic means for translating the work carrier from a work receiving position to an operative position, means coupled with the rotating work holder for effecting an axial reciprocation of the work carrier, additional guideways on the bed extending transversely thereof, a pair of slides on the said additional guideways, a grinding wheel supported by each slide for respectively operating on the interior and the exterior of the work, and means for feeding the slides toward one another to effect a stock removal from the work.

10. In a grinding machine for simultaneously grinding the interior and exterior of a hollow work piece the combination of a bed, ways thereon for supporting a work carrier, means for rotatably supporting a work piece on the carrier including a prime mover, hydraulic means for translating the work carrier from a work receiving position to an operative position, means coupled with the rotating work holder for effecting an axial reciprocation of the work carrier, additional guideways on the bed extending transversely thereof, a pair of slides on the said additional guideways, a grinding wheel supported by each slide for respectively operating on the interior and the exterior of the work, and means for feeding the slides toward one another to effect a stock removal from the work, said means including an adjusting screw for each slide, and common actuating means for actuating the individual screws.

11. In a grinding machine, a grinding member and a rotatable work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, and means responsive to rotation of said work holding member to procure a supplemental reciprocation of said carriage.

12. In a grinding machine, a grinding member and a rotatable work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, means responsive to rotation of said work holding member to procure a supplemental reciprocation of said carriage, and means to procure rotation of said work holding member as said grinding member and work holding member are brought into operative relation.

13. In a grinding machine, a grinding member and a rotatable work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, means responsive to rotation of said work holding member to procure a supplemental reciprocation of said carriage, and means to procure cessation of the rotation of the work holding member as said grinding member and said work holding member are moved into inoperative position.

14. In a machine of the class described, a cutting member and a work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, said means being connected to said carriage by a lever pivotally secured to said means and to said carriage, and means for rocking said lever to procure a supplemental re-

ciprocation of said carriage relative to said actuating means.

15. In a machine of the class described, a cutting member and a work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, said means being connected to said carriage by a lever pivotally secured to said means and to said carriage, and means responsive to rotation of said work holding member for rocking said lever to procure a supplemental reciprocation of said carriage relative to said actuating means.

16. In a grinding machine, a grinding member and a rotatable work holding member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, independent means to procure a supplemental reciprocation of said carriage, said independent means being set in operation as the carriage is actuated to bring the grinding member into operative relation to the workholding member, and means to procure cessation of the supplemental reciprocation as the grinding member is withdrawn from operative relation to the work holding member.

17. In a grinding machine for grinding the internal and external surfaces of a workpiece, the combination with a base, of a pair of grinding wheels, a spindle for each grinding wheel, said spindles having their axes extending at an angle to one another, said grinding wheels having their active faces parallel to one another to receive the workpiece therebetween with the width of said active faces of a width substantially equal to the surface to be ground, a rotatable work holder, means for moving said work holder from an inoperative position remote from the grinding wheels to an operative position to place the workpiece between the active faces of the wheels and supplemental means for effecting a slight reciprocation between the work and the grinding wheels when said work is in operative relation to said wheels.

18. In a grinding machine, a grinding wheel and a work-supporting member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, and means responsive to actuation of said work-supporting member for procuring a supplemental reciprocation of said carriage.

19. In a grinding machine, a grinding wheel and a work-supporting member, a carriage on which one of said members is mounted, means for actuating said carriage to move said members into and out of operative relation, means responsive to actuation of said work-supporting member for procuring a supplemental reciprocation of said carriage, and means to procure actuation of said work-supporting member as said grinding member and work-supporting member are brought into operative relation.

20. In a grinding machine, a grinding member and a work-supporting member, a carriage on which one of said members is mounted, means responsive to actuation of the work-supporting member for procuring a reciprocation of said carriage, and means for shifting the position of reciprocation of said carriage.

21. In a grinding machine, a grinding member and a work-supporting member, a carriage on which one of said members is mounted, means to procure a reciprocation of said carriage including a lever pivotally secured to said carriage, and fluid pressure means for shifting the position of the fulcrum of said lever for shifting the position of said carriage.

22. In a grinding machine, a grinding member and a work-supporting member, a carriage on which one of said members is mounted, a fulcrum block, a lever pivotally connected to said carriage and to said fulcrum block, means for oscillating said lever to procure a reciprocation of said carriage, and fluid pressure means for shifting the position of said fulcrum block.

23. In a grinding machine, a grinding member and a work-supporting member, a carriage on which one of said members is mounted, means responsive to actuation of the work-supporting member to procure a reciprocation of said carriage including a lever pivotally secured to said carriage, and fluid pressure means for shifting the position of the fulcrum of said lever for shifting the position of said carriage.

24. In a grinding machine, a grinding member and a work-supporting member, a carriage on which one of said members is mounted, a fulcrum block, a lever pivotally connected to said carriage and to said fulcrum block, means responsive to actuation of the work-supporting member for oscillating said lever to procure a reciprocation of said carriage, and fluid pressure means for shifting the position of said fulcrum block.

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