Feb. 9, 1937. J. SUNNEN 2,070,381

PINHOLE GRINDER

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FIG. 1.

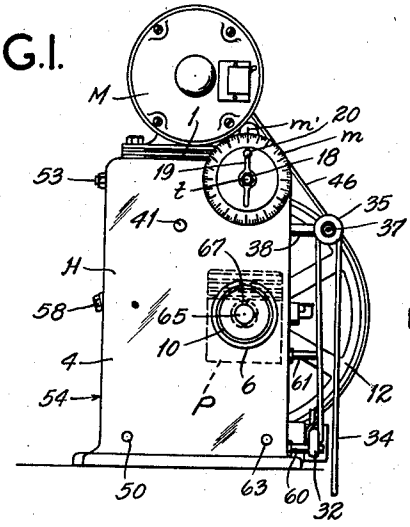


FIG. 2.

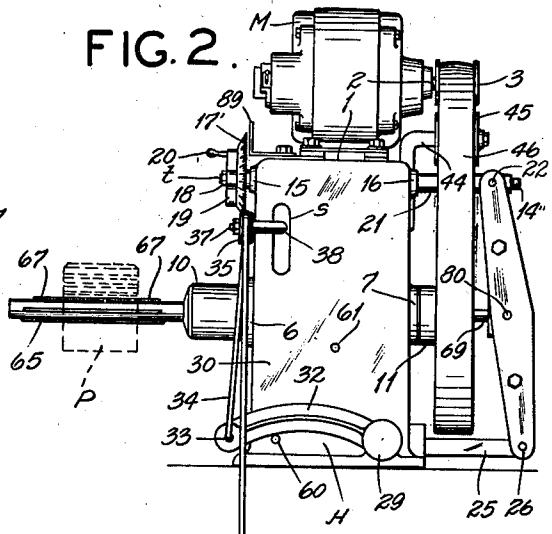
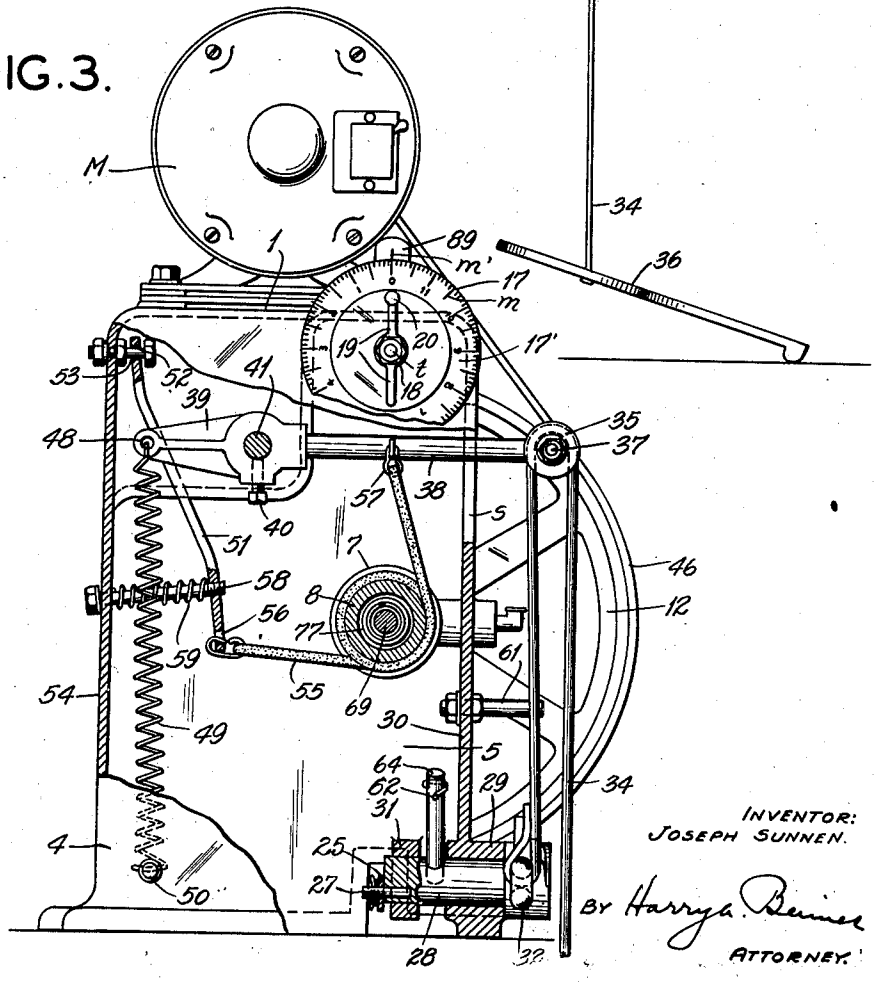


FIG. 3.



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FIG. 4.

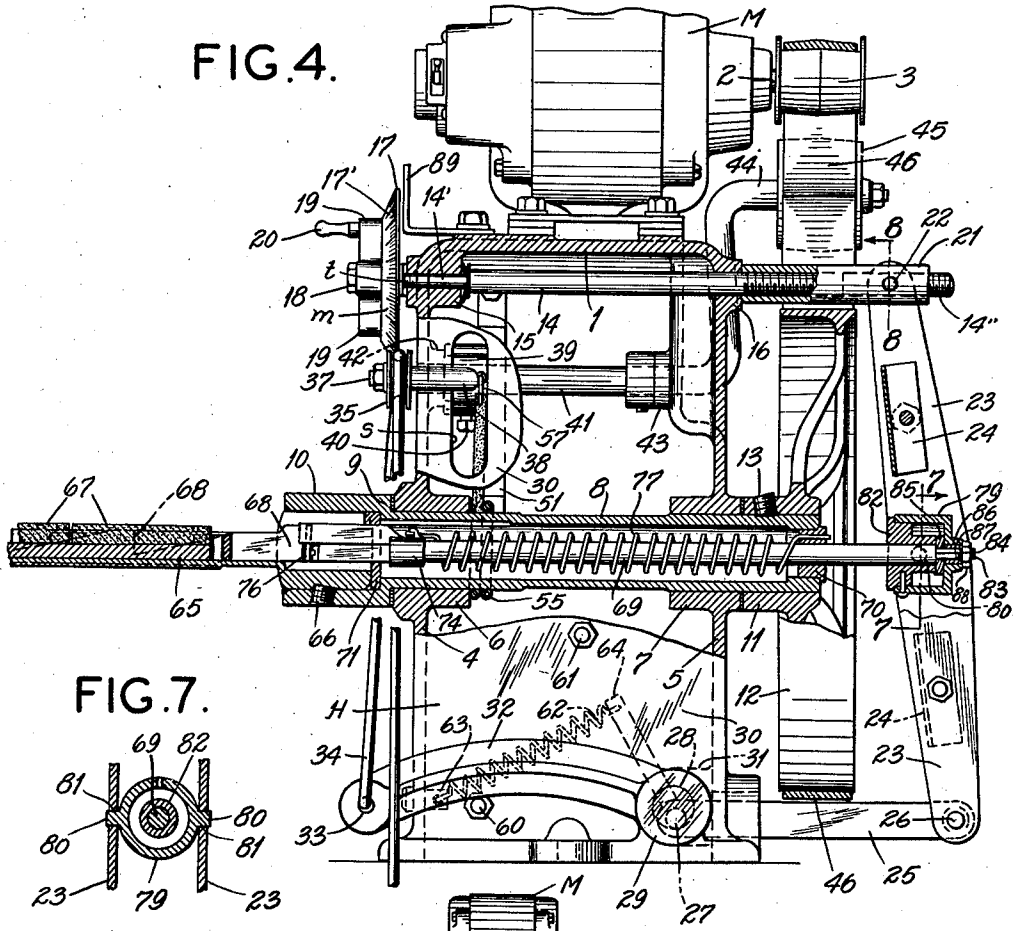
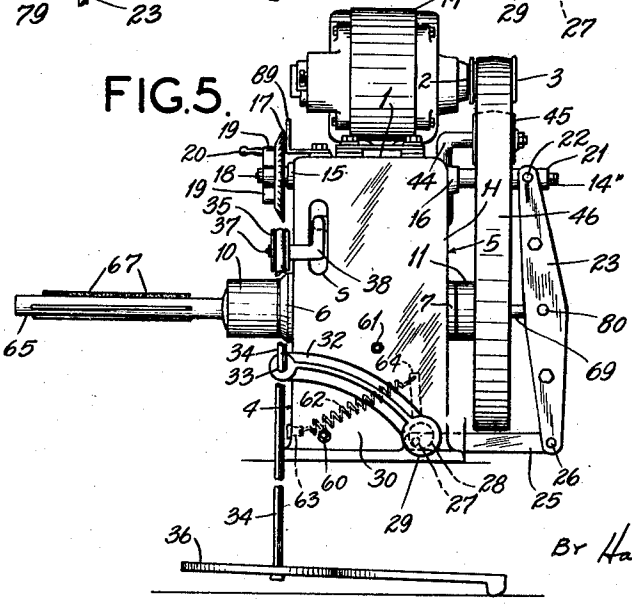


FIG. 7.

FIG. 5.



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FIG. 6.

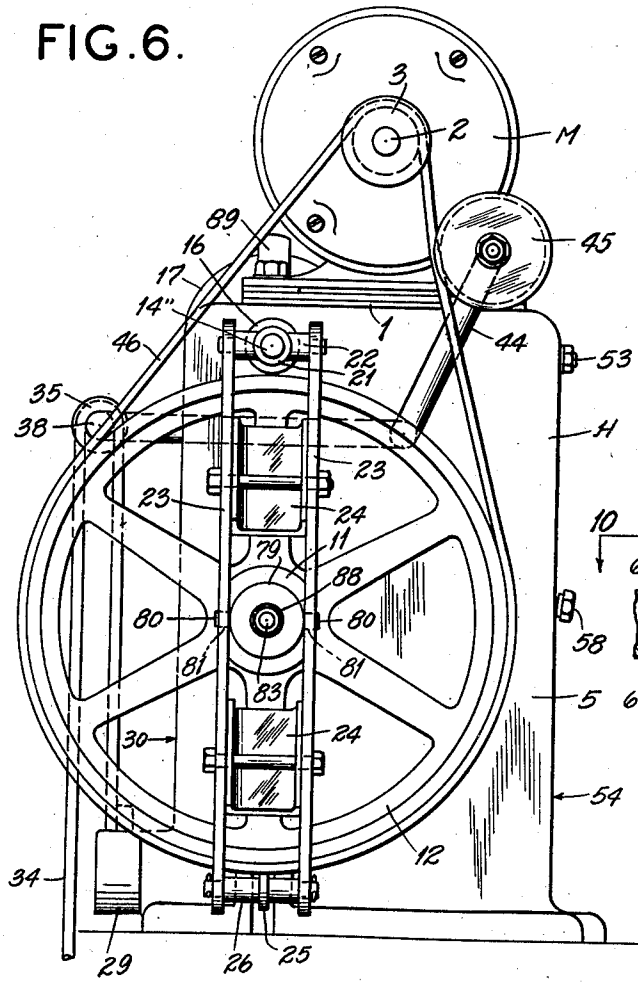


FIG. 8.

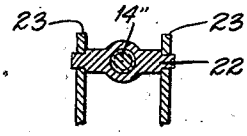


FIG. 9.

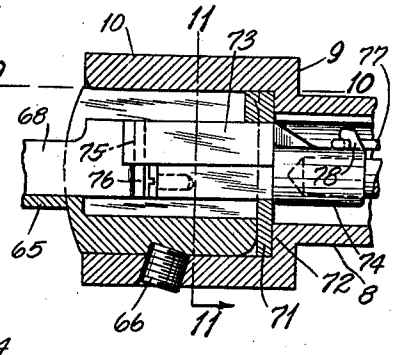


FIG. 10.

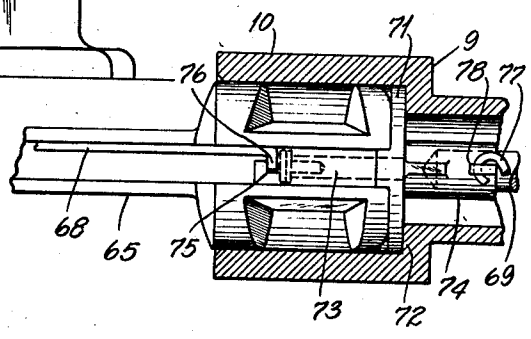
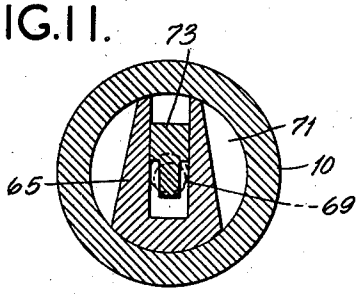


FIG. 11.



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UNITED STATES PATENT OFFICE

2,070,381

PIN HOLE GRINDER

Joseph Sunnen, Kirkwood, Mo.

Application April 23, 1935, Serial No. 17,819

6 Claims. (Cl. 51—72)

My invention has relation to improvements in grinding machines and consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

The present invention is directed more particularly to machines for grinding small cylindrical holes, such as the wrist pin holes of pistons, connecting rods and cylinders of small compressors, etc. The invention is an improvement over that described in my co-pending application, Serial No. 737,366, filed July 28, 1934, and like that of said application the grinding machine comprises a mandrel which carries an abrasive stone operable in the hole to be ground.

The principal object of the present invention is to provide a pedally operated control which not only controls the rotation of the mandrel but also controls the feeding of the abrasive stone radially for carrying out the grinding operation.

A further object of the invention is to provide a manual feed control for advancing the abrasive stone during the cutting operation, said manual control also serving the function of a limiting gauge to fix the limit of feed to which the abrasive stone may be advanced by the operation of the foot pedal. It is also one of the objects of the invention to regulate the tension of the drive belt automatically as the friction of the grinding operation increases.

The manner of accomplishing these objects, as well as other advantages inherent in the invention, will be better apparent from a detailed description of the same in connection with the accompanying drawings, in which:

Figure 1 is a front elevation of my improved grinding machine; Fig. 2 is a side elevation thereof showing a piston on the mandrel for the purpose of grinding the wrist pin holes thereof, and the foot pedal being in the raised position when the machine is idle; Fig. 3 is a front elevation of the grinding machine on an enlarged scale with the front wall of the housing broken away to show the mechanism within the housing; Fig. 4 is a side elevation similar to Fig. 2, however, on an enlarged scale and with parts broken away so as to show some of the machine in longitudinal section; Fig. 5 is a side elevation similar to that shown in Fig. 2, except that the foot pedal is fully depressed and the machine in operation; Fig. 6 is a rear elevation of the grinding machine; Fig. 7 is a cross-sectional detail taken on the line 7—7 of Fig. 4; Fig. 8 is a cross-sectional detail taken on the line 8—8 of Fig. 4; Fig. 9 is an enlarged longitudinal section of the drive spindle head, feed rod and the end of the mandrel connected therewith; Fig. 10 is a cross-sectional detail taken on the line 10—10 of Fig. 9; and Fig. 11 is a cross-sectional detail taken on the line 11—11 of Fig. 9.

Referring to the drawings, H represents a grinding machine housing on the top 1 of which is mounted an electric motor M, on the shaft 2 of which is the drive pulley 3 disposed toward the rear of the housing H.

In the front and rear walls 4 and 5, respectively, there are formed bearings 6 and 7 for a hollow spindle 8 held therein by shoulder 9, produced by the enlarged spindle head 10, and the hub 11 of a pulley 12 fixed by a set-screw 13 to the spindle 8. Disposed above and in vertical alinement with the spindle 8 is a rod 14 rotatably mounted in bearings 15 and 16 in the front and rear housing walls 4 and 5, respectively. The forward end 14' of the rod 14 is of reduced diameter and is provided with screw threads *t* for receiving a dial 17 and lock-nut 18 whereby the dial is securely fixed to the rod 14. The dial 17 is provided with oppositely disposed wings 19, 19 and a handle 20 for ease of manipulation. The rearward end 14'' of the rod 14 is provided with screw threads for receiving a threaded sleeve 21, to which is pivotally connected by means of pins 22 the upper end of a yoke comprising a pair of spaced bars 23, 23. The bars 23, 23 are maintained in fixed spaced relation by channel pieces 24, 24 riveted or spot-welded to the bars 23 as shown. The lower end of the yoke has connection with a link 25 through the medium of a pivot pin 26, the opposite end of said link 25 being connected to a pin 27 eccentrically fixed into the end of a rock shaft 28 rotatably mounted in a bearing 29 formed in side wall 30 of housing H, and a bearing 31 spaced from the bearing 29 and projecting from the rear wall 5 of said housing.

The rock shaft 28 is integrally formed with a lever 32 on the outside of housing H and extending forwardly thereof, said lever having an eye 33 at its forward end in which is secured one end of a flexible element 34, such as a cord, said cord then extending upwardly over a pulley 35 and downwardly to a foot pedal 36, to which the flexible element is also secured.

The pulley 35 is rotatably mounted on a reduced end 37 of an L-shaped arm 38 traversing a slot *s* in housing wall 30 and fixed into one end of a rocking lever 39, secured by means of a set-screw 40 to a rock shaft 41 mounted in bearings 42, 43 in the front and rear housing walls 4 and 5, respectively. The shaft 41 passes through the rear

wall 5 of the housing and is bent to provide a crank arm 44, on the end of which is mounted an idler pulley 45. The length and position of the crank 44 is such that the idler pulley 45 operates in contact with belt 46 passing over the motor pulley 3 and grinding machine pulley 12. The arm 38 is longer than the opposite lever arm 39, into the terminal eye 48 of which is secured one end of a coiled spring 49, the opposite end of said spring being anchored to a pin 50 secured in housing wall 4 near the bottom thereof. The spring 49 together with a braking member about to be described serves to hold the rocking lever 38, 39 in horizontal position (Fig. 3).

The braking member comprises a bracket 51 having an opening 52 at its upper end whereby it is loosely connected to a bolt 53 secured in housing side wall 54, and a belt 55 fixed at one end in an eye 56 in the lower end of bracket 51, said belt being wrapped around the spindle 8 and having its other end fixed in a screw-eye 57 fastened into the lever arm 38. The lower end of bracket 51 is anchored to the housing wall 54 by a bolt 58 on which is coiled a spring 59. The lever 32 operates between a lower stop 60 and an upper stop 61, said lever being held in contact with the lower stop 60 when the machine is idle by reason of a coiled spring 62 connected between a pin 63 secured in housing wall 4 and a stem 64 fixed in rock shaft 28. In the operation of the machine the upper pin 61 serves as a stop for the lever 32 during the movement of all of the parts set in motion by the operator when he depresses the foot pedal 36.

The driving mandrel 65, on which no claim is made in this application, is fixed in the head 10 of spindle 8, the set-screw 66 contributing to hold the mandrel securely in the head 10, and the longitudinally disposed grinding stones 67, 67 are adjusted radially by the wedge-bar 68 connected to a feed rod 69 mounted for longitudinal sliding movement in the spindle 8. The feed rod 69 is supported by a bushing 70 fixed into the rear end of spindle 8 and by a slotted disk 71 fixed in the bottom of the spindle head 10 against a shoulder 72. A link 73 has a socket 74 into which the outer end of the feed rod is secured and also has a transverse slot 75 near its free end to receive a lip 76 turned over at the end of wedge-bar 68 of the mandrel 65. Thus, the wedge-bar is connected to the feed rod 69 so that longitudinal movement of the feed rod, either out or in, will be communicated to the wedge-bar and effect adjustment of the grinding stones 67, 67. The connection of the wedge-bar 68 with a sliding feed rod for the purpose of adjusting the grinding stones is not new per se as such a device is shown in my co-pending application, Serial No. 737,366 above referred to. The novelty of the present invention is restricted to the grinding machine exclusive of the mandrel or other tool carried by the machine. A spring 77 is coiled about the feed rod 69 and has one end connected to a hook 78 projecting from the socket 74, and the other end is fixed in the bushing 70, the tendency of the spring being to hold the feed rod rearwardly and take up the longitudinal play thereof. Since the feed rod 69 rotates with the driving spindle 8 and is also connected to the yoke comprising the spaced bars 23, 23, the latter connection must be swiveled.

This is accomplished by the housing 79 having diametrically opposed pins 80, 80 rotatably supported in openings 81, 81 of bars 23, 23 and bearing 82 fixed in the housing 79 in which bearing the end of feed rod 69 is rotatably mounted. The diameter of the feed rod 69 is reduced at its rearward extremity to provide a stem 83 and a shoulder 84, said shoulder operating against a washer 85 to take the end thrust of the feed rod 69. The stem 83 passes through an opening 86 in the end of housing 79 and a bushing 87 is disposed about said stem to take the wear. The end of stem 83 is threaded to receive a nut 88.

From the foregoing it is apparent that the yoke comprising the bars 23, 23 may be moved to operate the feed rod 69 without interfering with the rotation of said feed rod. It will be observed that the beveled face 17' of disk 17 has graduation marks *m*, some of which are numbered from one to eleven. The spaces between successive numbers are to indicate adjustments of the feed rod 69 to effect a grinding operation of .001". The spaces between the numbered graduations are again divided into ten parts to effect adjustments as small as .0001", all of which will be explained more in detail hereinafter. In order to facilitate the accuracy of these adjustments a bracket 89 is mounted on the housing H so as to project above the center of disk 17 and a base graduation mark *m'* appears on the face of the bracket 89 to which the graduations on the disk face 17' are referred in order to effect a reading.

The operation of my improved grinding machine will be best understood from a detailed description thereof as follows:

The operation of the foot pedal 36 produces two functions. It sets the spindle 8 and mandrel 65 in motion and it advances the grinding stones 67, 67 radially outwardly as the grinding operation progresses. Since the belt 34 passes over pulley 35 and is connected to the end of lever 32, said pulley will be pulled downwardly, and the lever 32 upwardly with a downward movement of the pedal 36. Of course, the downward movement of the pulley 35 rocks the lever arm 38 downwardly and rotates the rock shaft 41 so that the idler pulley 45 will press against the drive belt 46 to tighten the same until the pulley 12 is driven by the motor pulley 3. The downward movement of the lever arm 38 loosens the brake strap 55 so that the spindle 8 will rotate freely. When the pedal 36 is released the lever 32 and the lever arm 38 will be restored to their at rest positions under the tension of springs 62 and 49, respectively, and the idler pulley 45 will move away from the belt 46 which will become slack and ride freely over the pulley 12. The upward movement of the lever arm 38 under the tension of the spring 49 tightens the brake strap 55 around the spindle 8 causing said spindle to come to rest almost immediately.

As the lever 32 is raised the rock shaft 28 is rotated and the eccentric pin 27 moves forward, drawing on the link 25 which oscillates the yoke 23, 23 about the pivot pin 22. This oscillation of the yoke pushes the feed rod 69 forwardly so that the wedge-bar 68 will advance the grinding stones 67, 67 radially outwardly. Thus, when the operator steps on the pedal 36 he not only causes the mandrel 65 to rotate, but also feeds the grinding stones. The harder he steps down on the pedal 36 for the purpose of speeding up the grinding operation the more tension is automatically imposed on the belt 46 by the idler pulley 45.

While it is possible to feed the grinding stones 67, 67 into the work by the operation of the disk 17 alone it is preferable that this disk be used as a stop gauge to set the limit to which the stones

67, 67 may be fed. This is done by operating the machine in the following manner.

We will assume that the piston P (shown dotted in Figs. 1 and 2) is to be refitted with piston pins. Obviously, the wrist pin holes must be rebored or accurately ground to the proper size for the new oversize pins. The first grinding operations restore the wrist pin holes to true cylindrical shape. After this is accomplished the operator calibrates the holes to find out how near they are to the correct size for receiving the new wrist pin. We will assume that the calibration shows that the holes must be increased in size about .003". The operator now rotates the hand operated dial 17 in a counter-clockwise direction so as to move the upper end of the yoke rearwardly to withdraw the feed rod so that the stones 67, 67 will be retracted and clear of the wrist pin holes when the foot pedal 36 is depressed to raise the lever 32 its maximum amount to encounter the stop pin 61. Now, with the foot pedal depressed, the operator turns the dial 17 in a clockwise direction until the stones 67, 67 have been forced outwardly sufficiently to operate lightly within the wrist pin hole. The operator now releases the foot pedal 36 so that the stones will be withdrawn by the release of the lever 32 which is now pulled downwardly in contact with the stop pin 60. With the foot pedal released the operator now turns the dial 17' three graduations in a clockwise direction which advances the stones 67, 67 .003" so that when the foot pedal is again depressed its maximum amount the stones 67, 67 will be .003" further advanced than they were before the dial 17' was last adjusted.

Thus, the hand dial 17' may be used to determine the maximum advancement of the stones 67, 67 by the operation of the foot pedal to perform the grinding operation. When the foot pedal is entirely depressed and the lever 32 reaches its uppermost position in contact with stop pin 61 the grinding operation is completed as the desired .003" has been removed from the wrist pin holes.

If the operator should find that the .003" that has been ground from the hole in the preceding operation has not enlarged the hole sufficiently and a very small additional amount of grinding is necessary he may keep his foot on the pedal 36 so as to hold the lever 32 in contact with stop pin 61 and, by means of the hand dial 17', adjust the grinding stones 67, 67 so as to advance them any amount from .0001" and beyond. Thus, in addition to using the hand dial 17' as a stop gauge to set the limits of the grinding operation this dial may be used to effect minute adjustments of the grinding stones such as are necessary when the grinding operation is near completion.

Having described my invention, I claim:

1. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding element and feed rod for adjusting the former with a movement of the latter, a driving pulley, means for actuating said pulley, a driven pulley on the spindle, a belt passing over said pulleys, a belt tensioning device therefor, an actuating pedal, connections between said pedal and feed rod, and connections between the pedal and tensioning device whereby the belt tension is increased as the pedal is operated.

2. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding element and feed rod for adjusting the former with a movement of the latter, a driving pulley, means for actuating said pulley, a driven pulley on the spindle, a belt passing over said pulleys, a belt tensioning device therefor, an actuating pedal, connections between said pedal and feed rod, connections between the pedal and tensioning device whereby the belt tension is increased as the pedal is operated to advance the feed rod, a brake operatively associated with said spindle and connected with the belt tensioning device whereby the brake is released as the pedal is operated, and means for automatically applying said brake when the pedal is released.

3. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding element and feed rod for adjusting the former with a movement of the latter, means for rotating said spindle, a yoke having both swivel and pivotal connection with the feed rod, said yoke having an adjustable fulcrum at one end, and means connected to the other end of the yoke for oscillating said yoke on said fulcrum.

4. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding element and feed rod for adjusting the former with a movement of the latter, means for rotating said spindle, a yoke having both swivel and pivotal connection intermediate its ends with the feed rod, a fulcrum member having pivotal connection with one end of said yoke, an actuating lever, suitable connections between said lever and the other end of the yoke for oscillating the same about said fulcrum, and means for moving said fulcrum member to oscillate said yoke when the actuating lever is stationary.

5. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding element and feed rod for adjusting the former with a movement of the latter, means for rotating said spindle, a yoke having both swivel and pivotal connection intermediate its ends with the feed rod, a fulcrum member having pivotal connection with one end of said yoke, an actuating lever, suitable connections between said lever and the other end of the yoke for oscillating the same about said fulcrum, rotatable means for moving said fulcrum member to oscillate said yoke when the actuating lever is stationary, and a graduated dial associated with said rotatable means to indicte the effective movement of the feed rod.

6. A grinding machine comprising a housing, a spindle mounted in said housing, a grinding tool fixed in the head end of said spindle, said tool including a radially movable grinding element, a feed rod mounted for longitudinal movement in said spindle, means interconnecting the grinding

element and feed rod for adjusting the former with a movement of the latter, means for rotating said spindle, a yoke having both swivel and pivotal connection with the feed rod, said yoke having an adjustable fulcrum at one end, means connected to the other end of the yoke for oscillating said yoke on said fulcrum, and a clutch interposed between the spindle and rotating means therefor, automatic means for disengaging said clutch with the operation of the means for oscillating said yoke.

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