Aug. 25, 1931. W. F. FRASER 1,820,735

GRINDING MACHINE

Filed Sept. 13, 1926 4 Sheets-Sheet 1

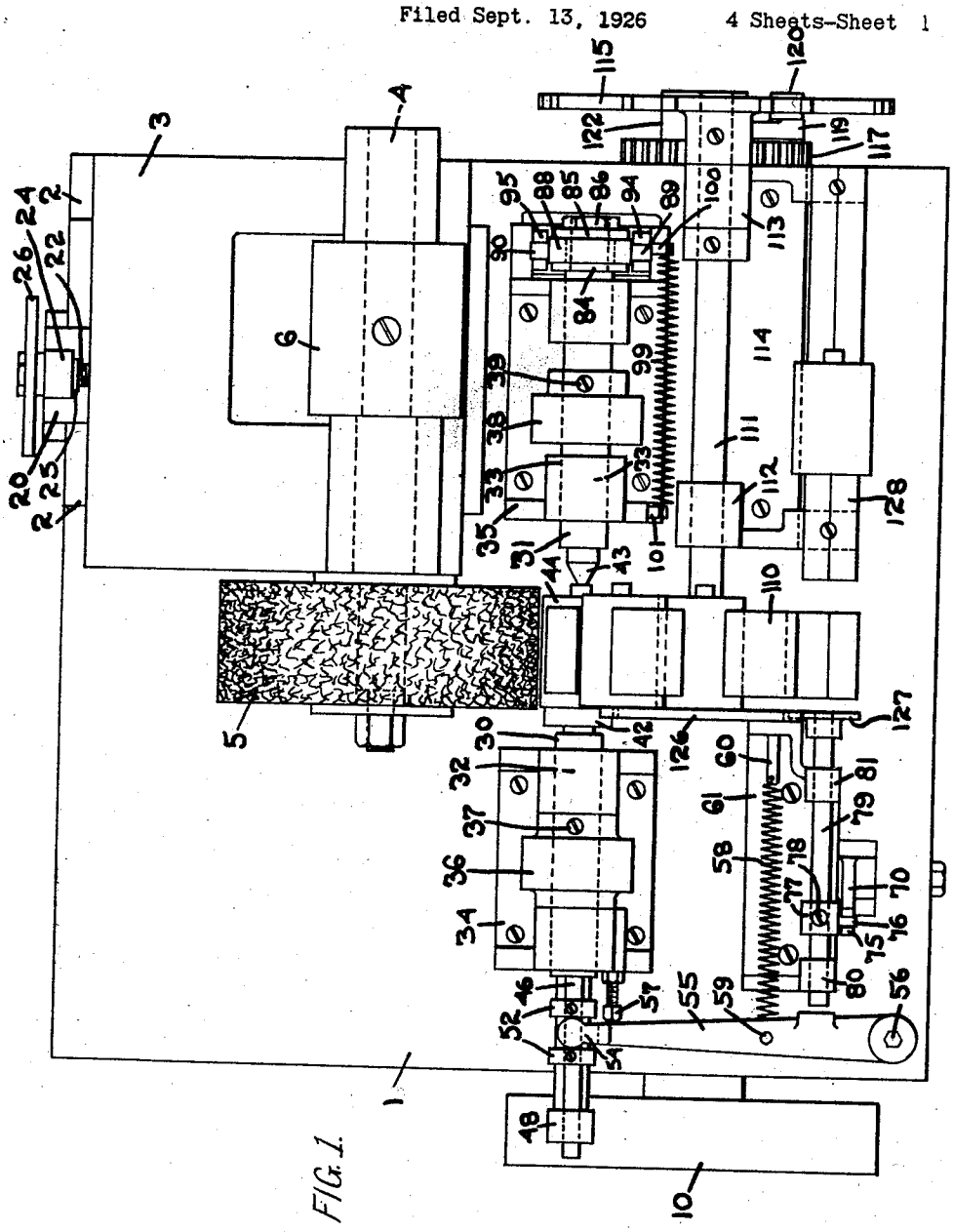


FIG. 1.

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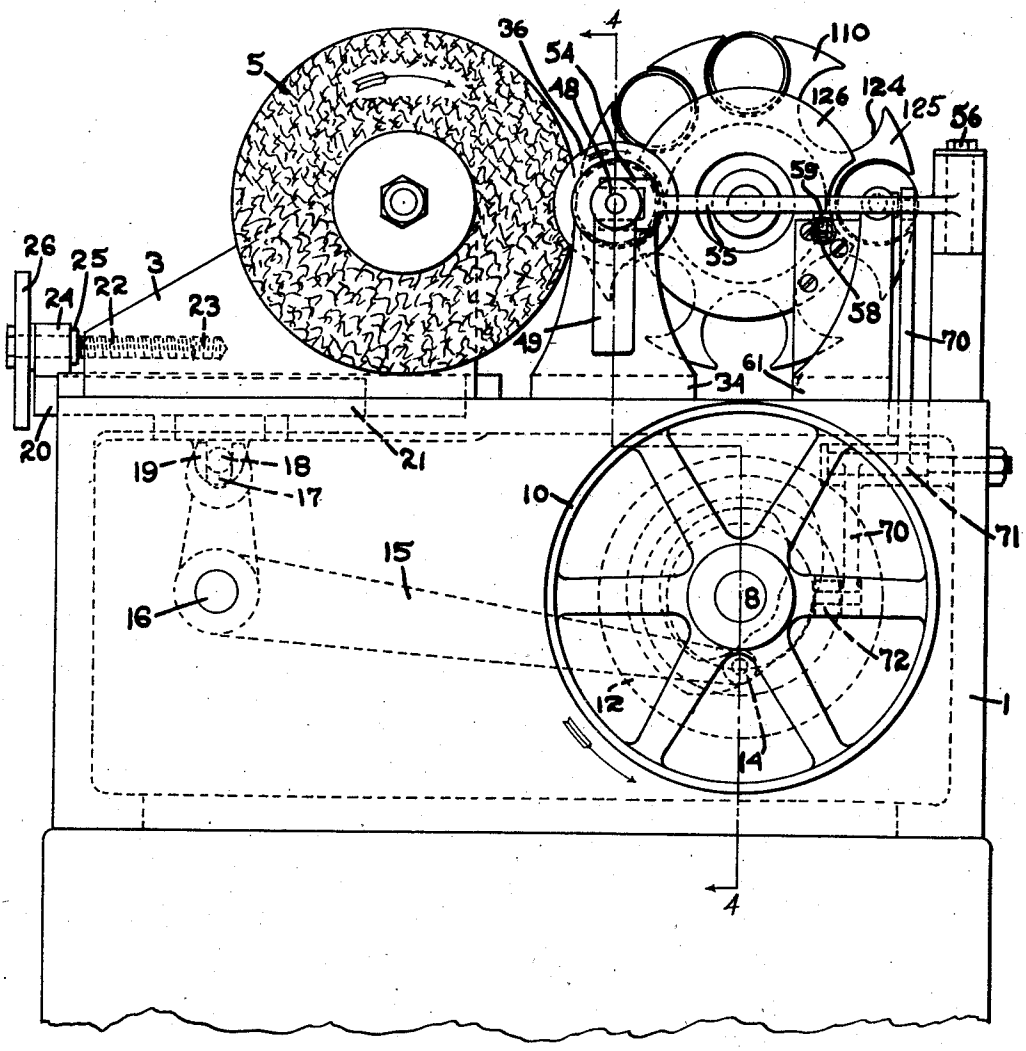



FIG. 2.

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GRINDING MACHINE

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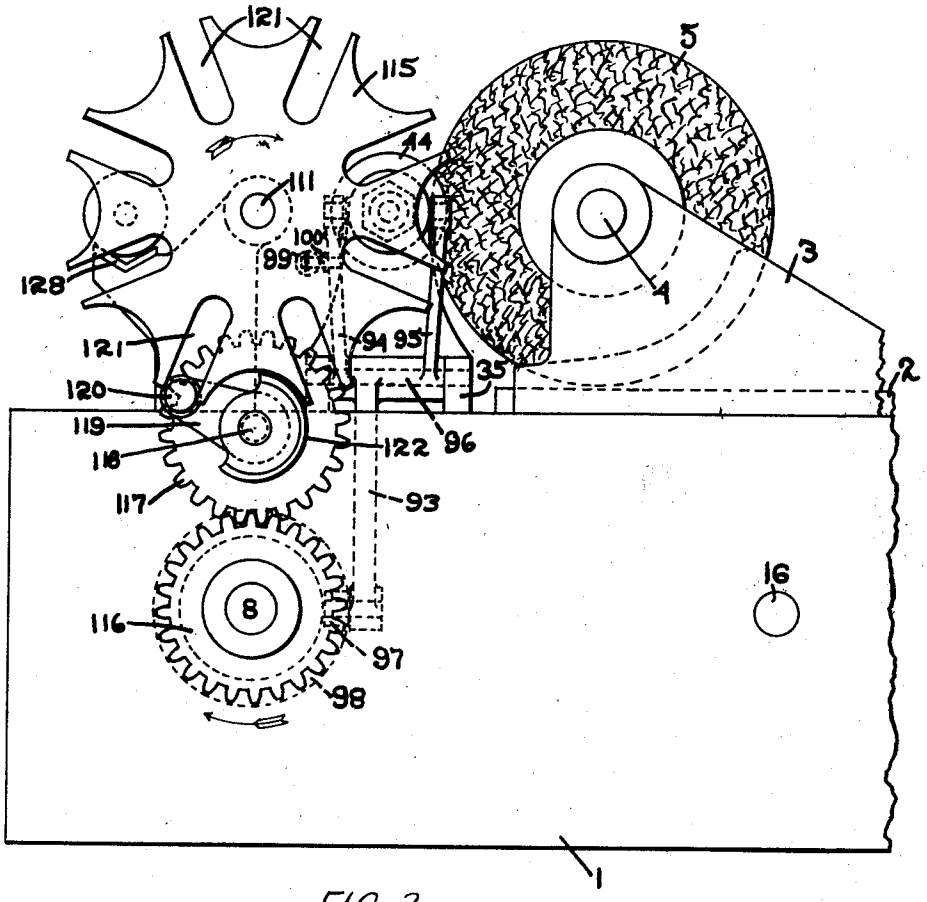



FIG. 3

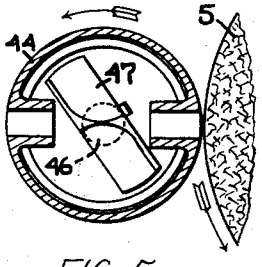



FIG. 5.

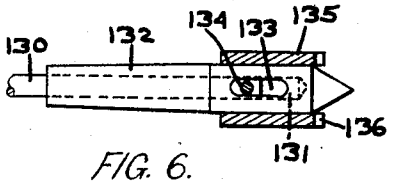



FIG. 6.

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GRINDING MACHINE

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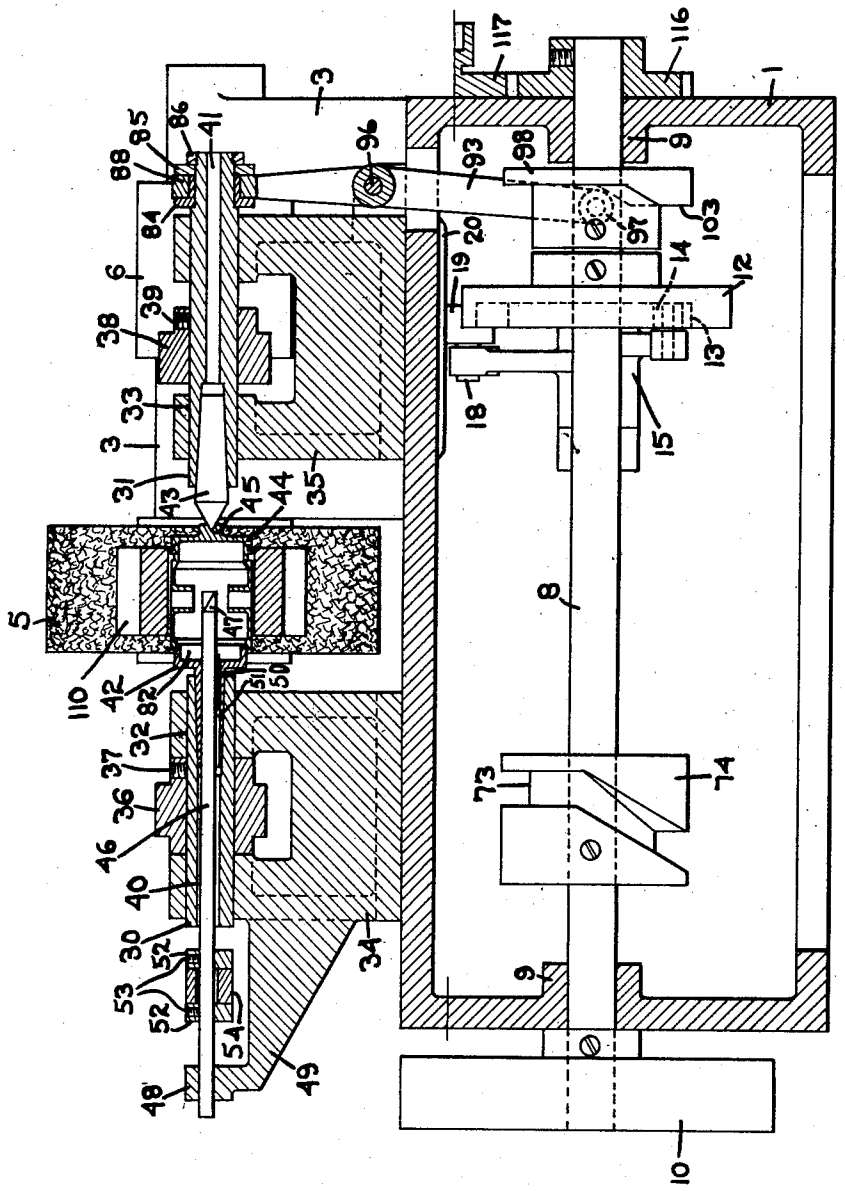



FIG. 4.

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# UNITED STATES PATENT OFFICE

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## GRINDING MACHINE

Application filed September 13, 1926. Serial No. 134,957.

This invention relates to improvements in machines for performing a grinding, polishing or like operation, and more particularly to machines of this type which are constructed to perform their various functions automatically.

Various automatic machines have been developed heretofore but their utility has been restricted due to their construction and principle of operation. It has been common in such machines to drive or rotate the work by rotatable supporting means exerting an end pressure thereon. For this reason such machines have not been satisfactory for grinding or polishing fragile objects of hollow thin walled construction of the type of automotive pistons. If excessive pressure is applied upon the ends of work of this type, the work often is distorted. While a cylindrical surface may be formed upon the work during the grinding operation, nevertheless, when the work is removed from the machine there is a tendency to spring into a distorted form due to the release of the excessive end pressure.

It is one object of the invention to overcome these difficulties and to provide a machine constructed and arranged for supporting and driving work so that it may be ground to the desired shape and size without danger of distortion.

It is a further object of the invention to construct and arrange the supporting and rotating mechanisms so that certain types of work which could not be handled conveniently in machines as constructed heretofore may be supported and positively rotated against the tangential thrust of grinding.

Heretofore, it has been deemed impossible to grind satisfactorily on an automatic cylindrical grinding machine various types of work of large size and peculiar construction, such as pistons and the like of a more or less fragile nature, inasmuch as no satisfactory arrangements had been provided for feeding work to and from the machine. It is essential in certain grinding operations that the work be finished with an accurately ground surface and such work could not be handled conveniently by dropping and sliding from the holding and supporting member. Sliding of finished work pieces into a container necessitates handling with extreme care to prevent undesirable contact between one finished piece of work and another which might mar their highly finished surfaces.

It is another object of the invention to provide mechanism for feeding and conveying a piece of work to a work supporting member without stopping the machine, and thereafter removing the finished piece of work from the carrier preferably automatically without marring or injuring the surface of the work.

In accordance with the invention a machine is provided comprising a rotatably mounted wheel adapted to perform a polishing, grinding or like operation and which is hereinafter referred to as a grinding operation. This wheel is constructed and arranged to move toward and away from the operative grinding zone to bring the work to size and thereafter permit discharge thereof. A mechanism, which may include a turret wheel, is provided for feeding successive work pieces separately into the grinding zone. In the grinding zone the work is taken up by a yielding supporting member and held during the grinding operation independent of the conveying mechanism, at which time a positively rotated driver is brought into contact with a projection upon the work for rotating the same. After the grinding operation is completed, the driver is withdrawn and the work released to the conveying mechanism and brought to a point where it may be automatically discharged.

The invention will be more clearly understood from the following description in conjunction with the accompanying drawings; in which,

Fig. 1 is a plan view of a grinding machine embodying the invention;

Fig. 2 is an end elevation of the same as viewed from one side of the machine;

Fig. 3 is an end elevation as viewed from the opposite side of the machine;

Fig. 4 is a partial sectional elevational view taken approximately through the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary sectional view through a piston while in operative relation to the driver and grinding wheel of the machine; and

Fig. 6 is a view of a modified form of work supporting and driving member adapted to engage projections on the work or to enter recesses therein.

In the drawings I have shown a machine embodying and illustrating the invention comprising a base 1 provided with slideways 2 for a slide 3 movable thereon. The slide 3 is constructed with suitable bearings of any well known construction (not shown in detail) for rotatably mounting a spindle 4 upon which a wheel 5 of suitable polishing or abrading material is mounted. The wheel 5 may be rotated at a suitable speed for polishing or grinding by any desired means, such as a pulley 6 mounted on spindle 4 and driven in any suitable manner, such as by a belt, from any convenient source of power. A main drive shaft 8 for actuating the various mechanisms of the machine is mounted in suitable bearing surfaces 9 in the base 1 and is provided with a pulley 10 suitably secured thereto and adapted to be rotated from any convenient source of power, such as by a belt.

In the machine illustrated the wheel 5 may be moved toward and from the work to grind the work to a predetermined size. For this purpose a grooved cam 12 is mounted upon the main drive shaft 8 for rotation therewith and is provided with a groove 13 adapted to receive a follower roller 14 suitably mounted upon the end of one arm of a bell crank lever 15 which is pivotally mounted upon a shaft 16. The outer end of the other arm of the bell crank lever is provided with a slot 17 adapted to engage a pin 18 on a depending portion 19 of a slide 20 adjustably mounted upon slideways 21 in the base 1. The slide 3 may be adjusted relative to the slide 20 to change the position of the operative surface of the wheel 5 by an adjusting screw 22 engaging a threaded hole 23 in the slide 3 and appropriately secured against endwise movement in an upwardly extending boss 24 on the slide 20 by a collar 25 between the boss and a shoulder on the screw and by a hand wheel 26 appropriately secured upon the end of the screw and engaging the boss.

In accordance with the invention the work to be ground is supported for rotation so as to minimize distortion during grinding. One suitable construction for this purpose may comprise spindles 30 and 31 rotatably mounted in bearing surfaces 32 and 33 in brackets 34 and 35 respectively attached to the base. A driving pulley 36 is secured upon the spindle 30 by a set screw 37, and is mounted thereon between the bearing surfaces 32 so as to prevent axial movement of the spindle. A pulley 38 likewise is secured upon the spindle 31 by a set screw 39, and is so positioned between the bearing surfaces 33 that the spindle 31 may be moved axially. The spindles 30 and 31 are provided with openings 40 and 41 respectively, the adjacent portions of which are tapered for attaching work supporting members 42 and 43 respectively. The member 42 is provided with a chamfered edge for engaging a similar surface upon a hollow work blank 44, such as an automotive piston; and the member 43 is provided with a center for engaging a center hole 45 in the work.

A rod 46 having a driver 47 at one end thereof is positioned within the opening 40 and is mounted for rotation within a bearing 48 on a bracket 49 integral with or otherwise appropriately secured to bracket 34, and is provided with a key 50 engaging a slot 51 in the member 42 for operative connection with the pulley 36. In order that the rod 46 may be moved axially relative to the work supporting member 42 to bring the work driver 47 into contact with a projection within the work, a pair of collars 52 are adjustably mounted upon the rod by set screws 53 on either side of a yoked portion 54 of a lever 55, pivoted to swing in a horizontal plane about the stud 56 in the base 1, so that any movement of the lever is transmitted to the rod. The lever 55 is held yieldingly against an adjustable stop screw 57 in the bracket 34 by a spring 58 extending between a pin 59 on the lever and a pin 60 on a bracket 61, thereby holding the work driving member 47 in any desired position.

The work driver 47 may be retracted from engagement with the work to permit discharge thereof. In the construction illustrated this may be accomplished by a mechanism operating automatically in timed relation with the other mechanisms of the machine. Thus, a lever 70 pivotally mounted upon a stud 71 in the base of the machine is provided at one end with a roller 72 adapted to engage a groove 73 in a cam 74 secured upon the main drive shaft 8. The other end of the lever 70 is provided with a forked portion 75 adapted to engage the pin 76 on a collar 77, adjustably mounted by means of a set screw 78 upon a shaft 79 which in turn is mounted in bearings 80 and 81 in the bracket 61 so that any motion transmitted from the cam 74 moves the shaft 79 axially in its bearings. During the major portion of a cycle of operations, the shaft 79 is held out of contact with the lever 55, but at intervals in proper timed relation with the other mechanisms the shaft 79 moves toward the left (as viewed in Fig. 1) and swings the lever 55 to withdraw the work driver 47 from engagement with the work and move it into an inoperative position within the recess 82 of the work supporting member 42.

One or both of the work supporting spindles 30 and 31 may be moved relatively to-

ward and away from each other in timed relation with the other mechanisms to grip the work and support the same during the grinding operation and thereafter withdraw to release the work. In the construction illustrated, the spindle 30 is mounted for rotation without endwise movement, while the spindle 31 is constructed and arranged for both rotary and axial movement for the purpose above referred to. The outer end of the spindle 31 is provided with collars 84 and 85 held in position on the end of the spindle by a nut 86 and which are so constructed and arranged as to provide a groove for a collar 88 having diametrically positioned projecting pins 89 and 90. A lever 93, having yoked portions 94 and 95 adapted to engage pins 89 and 90, is pivotally mounted to turn about a stud 96 in the bracket 35, and is provided at its other end with a follower roller 97 adapted to engage the operative surface of a cam 98 secured upon the main drive shaft 8. A spring 99, which is secured at one end to a pin 100 on the yoked portion 94 of lever 93 and at the other end to a pin 101 on the bracket 35, serves to hold the roller 97 upon the cam 98 as well as to yieldingly support the spindle 31 and member 43 against the work. The cam 98 is provided with a raised portion 103 arranged so that the spindle 31 and member 43 may be withdrawn from the work in timed relation with the other mechanisms of the machine after the grinding or polishing operation has been completed and the wheel 5 removed therefrom.

A suitable mechanism for feeding successive work pieces separately into the grinding zone and for conveying them therefrom after the polishing or grinding operation has been performed may comprise, as illustrated, a turret wheel 110 secured upon one end of a shaft 111 which is supported for rotation in bearings 112 and 113 in a bracket 114 fixed to the base of the machine. The turret wheel may be actuated intermittently in properly timed relation with the other mechanisms of the machine to feed work pieces into their operative position by a mechanism comprising a Geneva plate 115 secured upon the shaft 111 and operatively connected to a driving gear 116 suitably mounted on the main drive shaft 8. A gear 117 rotatably mounted on a stud 118 in the base of the machine is arranged to mesh with the drive gear 116 and is constructed with an arm 119, integral with or otherwise appropriately secured thereto, having a pin 120 at its outer end adapted to engage slots 121 in the Geneva plate to intermittently turn the plate and the turret wheel. A stop is provided to hold the turret wheel against rotation except during the indexing period of movement and may comprise a partial cylindrical plate 122 secured upon the arm 119 and adapted to mate with concave surfaces on the Geneva plate 115 when the pin 120 is not in engagement with one of the slots 121.

The turret wheel is provided with a plurality of openings 124 to receive successive pieces of work and convey them into the grinding zone. Preferably, the turret wheel is provided with spaced undercut arms 125 which are substantially T-shaped and are so arranged as to provide partially cylindrical openings into which the work pieces may be inserted laterally. These arms are spaced to provide slots or spaces through which the work pieces may project into peripheral contact with the grinding wheel. In this construction the work must be fed to the openings 124 in a direction parallel with the axis of rotation of the turret and must leave the turret in a similar direction. This prevents the work from dropping out of the turret openings after leaving the grinding zone. The work blanks may be inserted in the openings 124 of the turret by hand or by some mechanical device. If desired, a hopper or chute may be arranged to supply work blanks automatically to the openings in the turret wheel as will be understood by those skilled in the art. In order that the work blanks may be aligned so that they will be in proper position to be gripped by the work supporting members 42 and 43, a stop plate 126 is secured to the bracket 61 for the work pieces to rest against as they are inserted in the openings 125 of the turret wheel.

The finished ground or polished work pieces are carried by the turret wheel to a position for discharge diametrically opposite the grinding zone. Any suitable device may be employed to remove the work from the turret, such as an ejector 127 mounted on the right hand end of the shaft 79 (as viewed in Fig. 1.) The cam 74, preferably, is shaped and arranged upon the drive shaft 8 so as to move the upper portion of the lever 70 and shaft 79 carrying the ejector 127 toward the right (as viewed in Fig. 1) to eject the work blank from its position in the opening 124 of the turret wheel onto a V-shaped trough or support 128 while another work blank is being ground or polished.

In Fig. 6 of the drawings a driver and work support of modified construction is shown comprising a rod 130, corresponding to the rod 46 of the machine illustrated in Fig. 4, within an opening 131 in a work support center 132 having a slot 133 for slidably receiving a pin 134 in the rod 130. A work driver 135 having lugs 136 for engaging projections upon the work surrounds the work center 132 and is operatively connected to the rod 130 for rotation therewith by the pin 134.

As the main drive shaft 8 is rotated, the arm 119 swings so as to bring the pin 120 into engagement with one of the slots 121

causing the turret wheel 110 to turn so as to bring one of its work conveying openings 125 into the grinding zone just as the pin 120 leaves the slot 121. The spring 99 is arranged to actuate the lever 93 and cause the spindle 31 and work supporting member 43 to move at this moment to bring the center of member 43 into engagement with the center hole 45 of the work blank 44 and bring said blank into engagement with the chamfered edge of the work supporting member 42, thereby lifting the latter off the supporting surface of the opening 124. The cam 74 is shaped and arranged upon the shaft 8 so as to cause the rod 79 to move and permit the spring 58 to move the lever 55 to the right (as viewed in Fig. 1) and cause the driver 47 to move into position to engage a projection within the work blank to rotate the same. The position of the driver relative to the work may be controlled by the adjusting screw 57.

When the work is properly supported and rotated in this manner the wheel 5 moves into the grinding zone in contact with the work, and the cam 12 is so constructed and so arranged upon the shaft 8 as to cause the wheel 5 to move into the grinding zone at this time. The cam 12, preferably, is so shaped as to impart a relatively fast approach of the wheel 5 towards the work and then a slow gradual feed to properly size the work. After the grinding or polishing operation is completed, the wheel is moved rapidly out of the grinding zone.

As the wheel recedes from the work, the upper portion of the lever 70 will move toward the left (as viewed in Fig. 1) and withdraw the work driver 47 from its driving position in contact with the work blank. At the same time the cam 98 actuates the lever 93 to cause the work supporting member 43 to recede from its operative position in contact with the end of the work and release the work from the supporting members, permitting it to rest within the opening or pocket of the turret wheel. By this time the pin 120 has arrived in a position to turn the Geneva plate 115 in the direction shown by the arrow in Fig. 3 a sufficient distance to remove the finished piece of work from the grinding zone and bring the next piece of work into the grinding zone.

The machines operates continuously and automatically in this manner to bring successive work pieces into the grinding zone and convey ground work to a point for discharge. With each intermittent movement of the turret wheel a finished work piece is brought to a position diametrically opposite the grinding zone for discharge, that is, after the first four movements after initially starting the machine. The ejector 127 is then actuated, when the plate 122 mates with the convex surface on the Geneva plate, to discharge the work upon the trough or support 128. The operator periodically inserts new pieces of work in the openings of the turret wheel after they leave the ejecting positions.

The use of a grinding fluid for cooling the work during the grinding operation is well known and understood in the art. For this reason, and in order not to complicate the illustration of the invention, no provisions have been described or illustrated for supplying such a grinding fluid. Such a device may be provided readily by one skilled in the art.

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

1. A grinding machine comprising a rotatably mounted grinding wheel, a work feeding mechanism for bringing successive work blanks separa ely into the grinding zone, rotatable supports for holding a work blank in the grinding zone, means for rotating said blank, means for moving said wheel and work blank relatively into and out of operative grinding engagement, means for releasing the work blank from the supports for reception by the feeding mechanism, and means for positively ejecting said blank from said feeding mechanism after completion of grinding.

2. A grinding machine comprising a rotatably mounted grinding wheel, a turret mechanism for feeding successive work blanks separately into the grinding zone and for conveying ground work to a point for discharge, rotatable suports for holding work in an operative grinding position out of contact with the turret mechanism, said turret mechanism being constructed and arranged to feed work to and convey it from the grinding zone in a lateral direction, means for releasing work from its support in the grinding zone to the turret mechanism, and means for positively ejecting ground work from the turret in an axial direction.

3. A grinding machine comprising a rotatably mounted grinding wheel, a work receiving turret having spaced undercut arms arranged to hold a multiplicity of duplicate work pieces in the turret, said work pieces being insertable axially between the adjacent arms, means to turn the turret and thereby successively present work pieces in the grinding zone, centering supports for lifting a work piece from contact with the turret arms and accurately positioning it during the grinding operation, and mechanism for moving the centering supports for engaging and releasing the work piece.

4. A grinding machine comprising a rotatably mounted grinding wheel, a work receiving turret having spaced undercut arms arranged to hold a multiplicity of duplicate work pieces in the turret, said work pieces being insertable axially between the adjacent arms, means to intermittently turn the turret

and thereby successively present work pieces in the grinding zone, means for lifting a work piece from contact with the turret arms and centering and rotating it during the grinding operation, mechanism for releasing the work from said centering and rotating means for reception again by the turret, supporting means located near a work piece in the turret to receive the work, and a device actuated in timed relation with the turret movement to eject each finished work piece axially from the turret onto the support when the work has reached a predetermined position.

5. A grinding machine comprising a rotatably mounted grinding wheel, centering members which engage a work piece during its grinding cycle, a driving member slidably supported within one of the centering members, means to rotate the driving member during the grinding cycle, means to move the wheel cyclically towards and from the work, mechanism actuated in timed relation with the grinding cycle to withdraw the driving member from contact with the work and into its centering member, and means to automatically release the work from the centering members.

Signed at Worcester, Massachusetts, this 10 day of September, 1926.

WARREN F. FRASER.