

March 16, 1926.

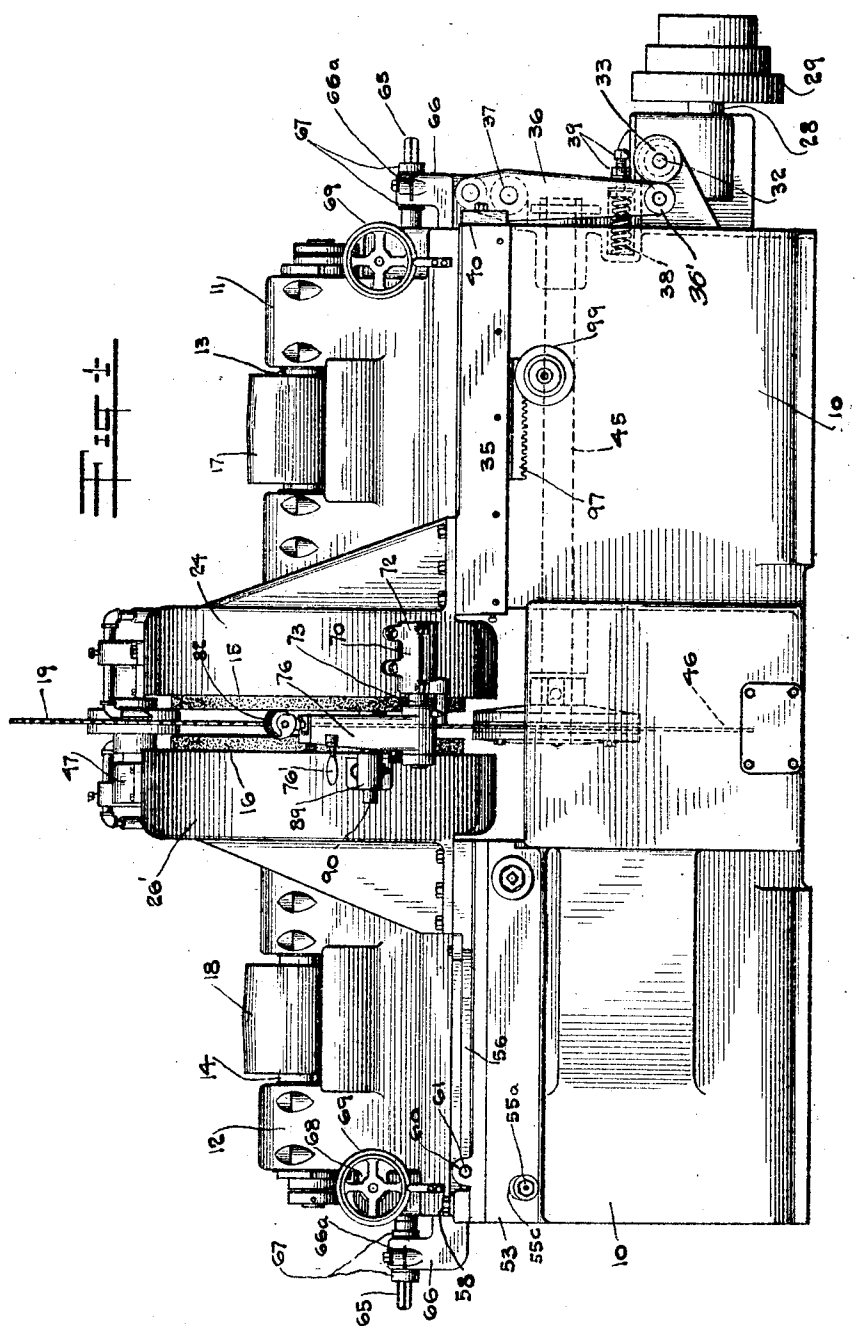
1,576,820

F. E. GARDNER

GRINDING MACHINE

Filed May 27, 1921

5 Sheets-Sheet 1



INVENTOR:

FREDERIC E. GARDNER

By *William Chindall Parker*
ATTY'S.

March 16, 1926.

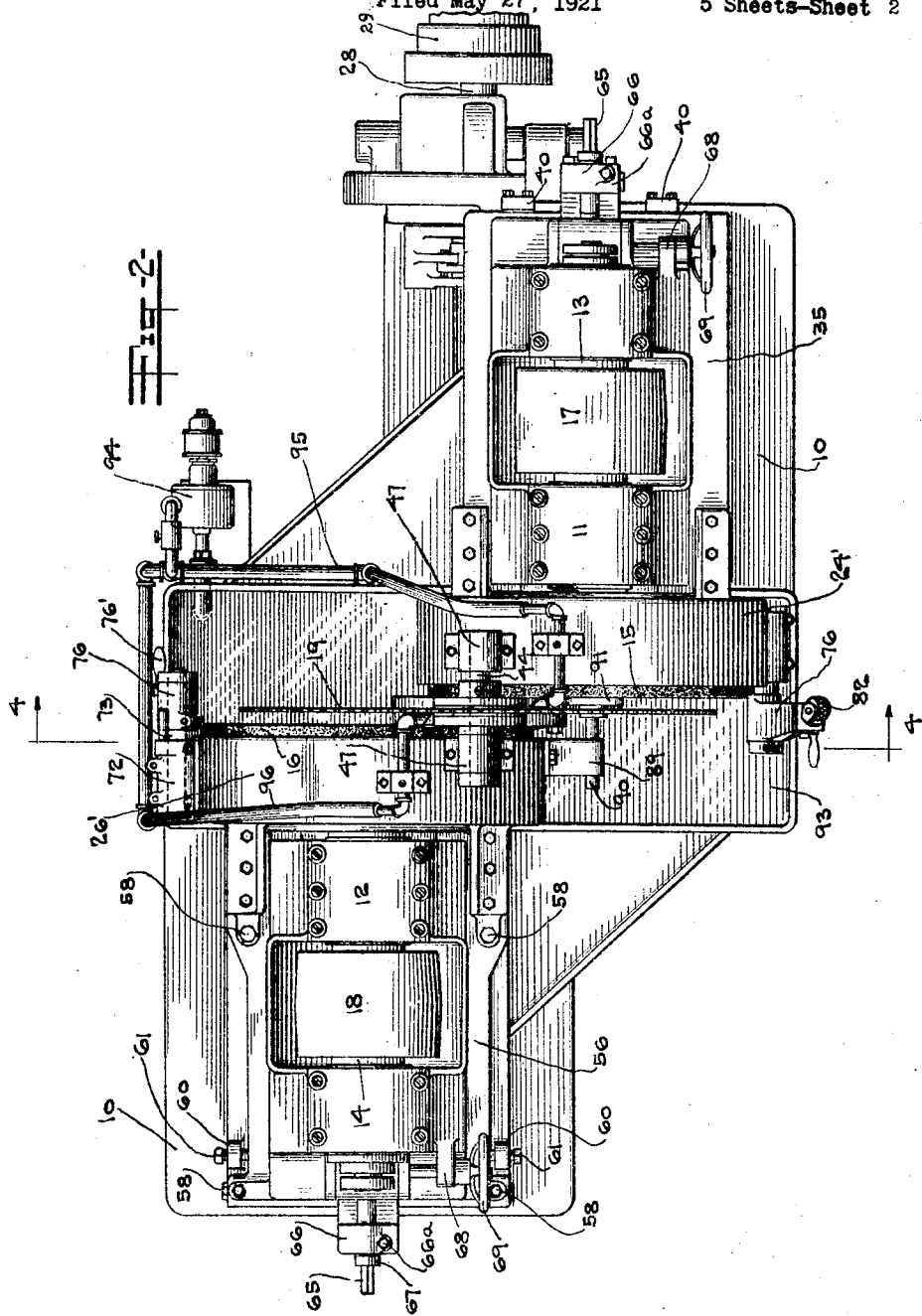
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5 Sheets-Sheet 2



INVENTOR:

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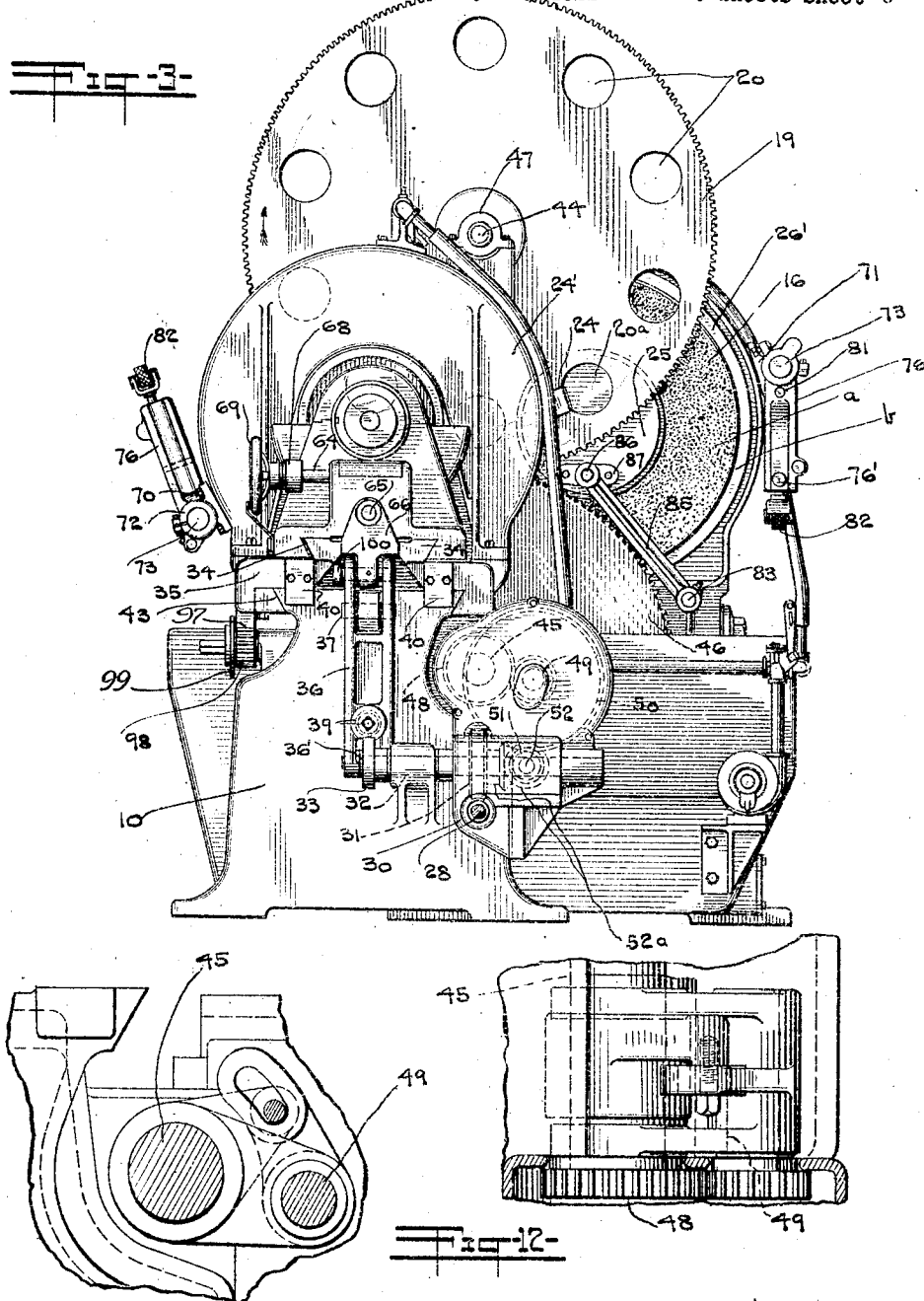
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5 Sheets-Sheet 3



INVENTOR:

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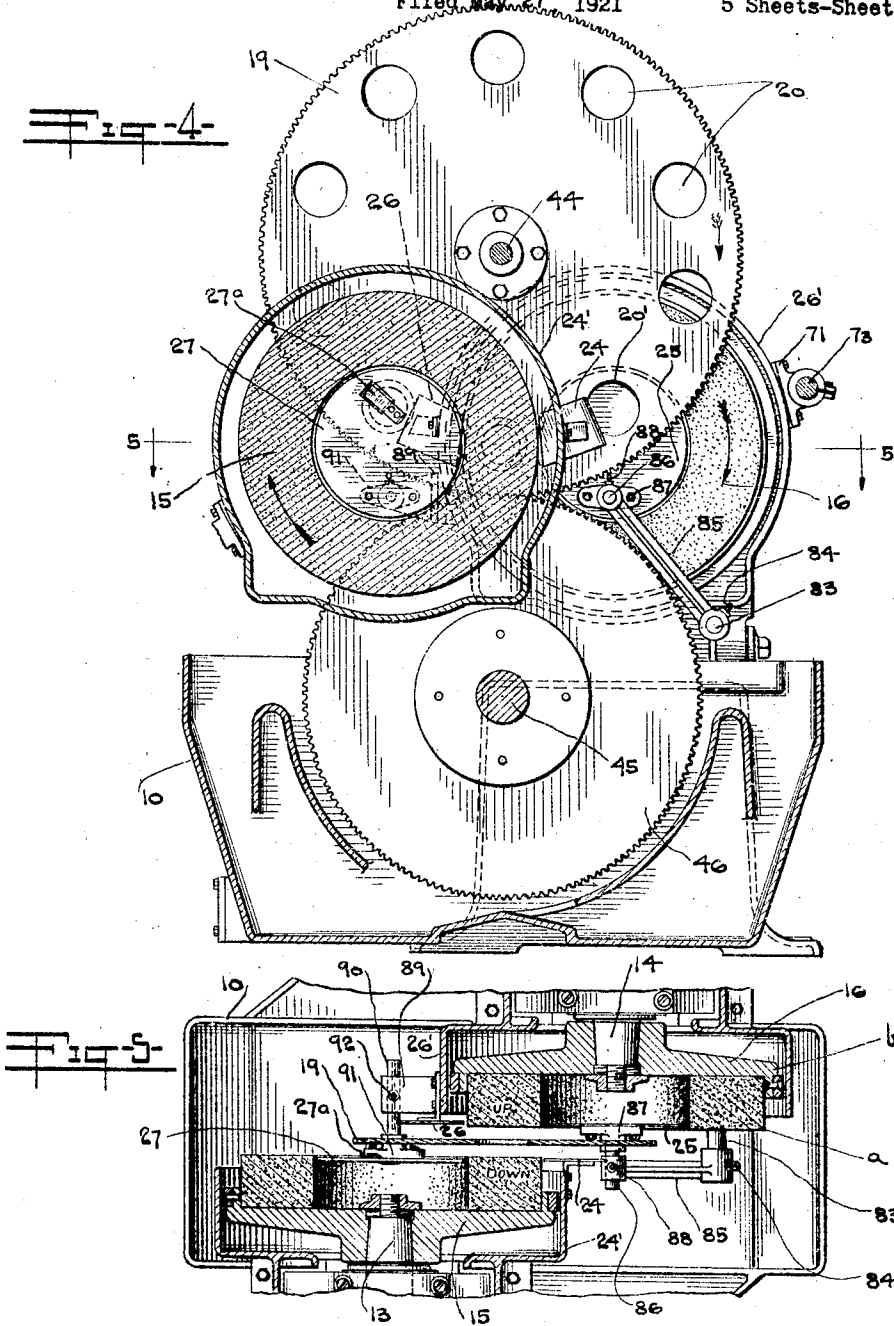
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GRINDING MACHINE

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5 Sheets-Sheet 4



INVENTOR:
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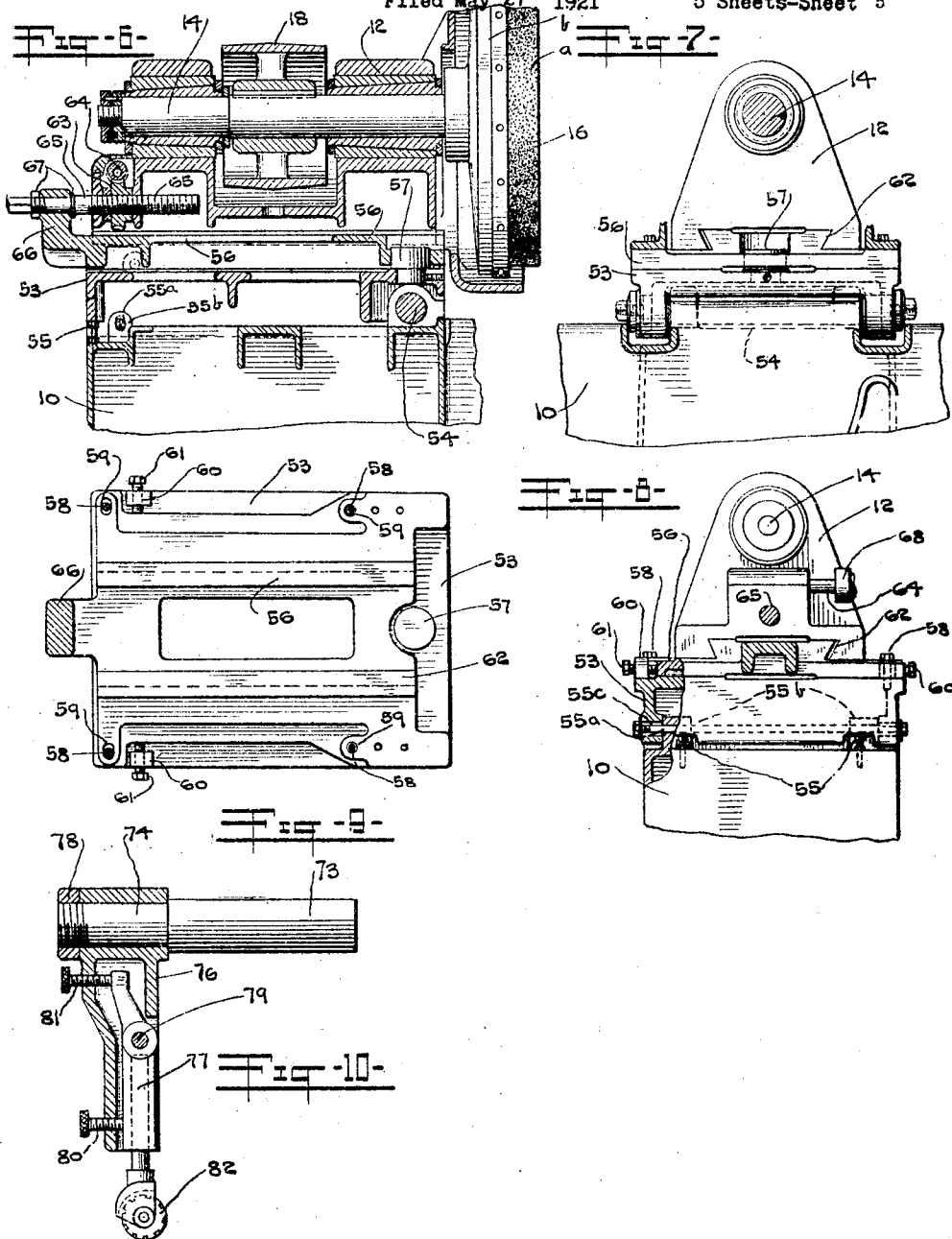
1,576,820

F. E. GARDNER

GRINDING MACHINE

Filed May 27 1921

5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE.

FREDERIC E. GARDNER, OF BELOIT, WISCONSIN, ASSIGNOR TO GARDNER MACHINE COMPANY, OF BELOIT, WISCONSIN, A CORPORATION OF ILLINOIS.

GRINDING MACHINE.

Application filed May 27, 1921. Serial No. 472,977.

To all whom it may concern:

Be it known that I, FREDERIC E. GARDNER, a citizen of the United States, residing at Beloit, in the county of Rock and State of Wisconsin, have invented certain new and useful Improvements in Grinding Machines, of which the following is a specification.

This invention relates to grinding machines of the type known in the trade as disk grinders and the invention refers more particularly to double-disk grinders comprising two grinding wheels in opposed relation, the work being fed between the two parallel grinding faces or the opposed side faces of the wheels, whereby the work is simultaneously ground on opposite sides in parallel planes.

The general object of the invention is to produce an improved machine of this class by means of which parallel faces on pieces of work may be ground automatically with greater speed and accuracy than has heretofore been possible.

A further object of the invention is to provide a novel and advantageous form of work-carrier for presenting successive pieces of work to the grinding wheels.

A further object is to provide novel guard or guide devices which act to prevent escape of pieces of work from the carrier while passing through the machine, and to provide means for ejecting the finished pieces of work from the carrier.

Another object is to provide means for varying the working distance between the two wheels to accommodate different sizes of work.

Another object is to provide a work carrier which is readily demountable so that it may be replaced by another work carrier having a different number or arrangement of receptacles for holding pieces of work, and an object incident to this one is the provision of means whereby the rate of feed of different work carriers may be changed to conform to the number of work receptacles therein.

Finally, it is a general object of my invention to produce a strong, durable and thoroughly practical grinding machine of the general type described, which is semi-automatic in its operation and by which parallel opposite faces of pieces of work may be accurately ground much more rapid-

ly, accurately and efficiently than has been possible with any prior machine.

These objects are attained in the machine shown in the accompanying drawings, but I would have it understood that this particular machine represents only one of many possible embodiments of my invention and that while I have shown and will hereinafter describe the said particular embodiment in detail for the sake of lucidity, I do not intend to limit the invention to the construction disclosed but aim to cover in the appended claims all modifications and equivalents falling within the scope of my invention as determined by the state of the prior art.

In the drawings, Figure 1 is a side elevational view of a grinding machine embodying my invention.

Fig. 2 is a plan view.

Fig. 3 is an end elevation of the right hand end of the machine as seen in Figs. 1 and 2.

Fig. 4 is a vertical, transverse, sectional view through the entire machine taken in a plane adjacent to but spaced from the work carrier which operates between the two grinding wheels.

Fig. 5 is a fragmental, horizontal, sectional view through the grinding wheels and associated parts taken in the plane of line 5-5 of Fig. 4.

Fig. 6 is a fragmental, vertical, sectional view illustrating the means for adjusting the axis of one of the grinding wheels to effect parallelism between the faces of the two wheels.

Figs. 7 and 8 are elevational views, partly in section, of the right and left ends respectively of the adjusting means shown in Fig. 6.

Fig. 9 is a plan view of the lower portion of the said adjusting means shown in Fig. 6.

Fig. 10 is a sectional detail view of one of the means for mounting the wheel dressing devices.

Figs. 11 and 12 are respectively a vertical sectional detail and a fragmental plan view of certain changeable gearing.

In order to give a comprehensive understanding of the general organization of the machine as a whole, I will first describe briefly the various major features of the machine. Upon opposite ends of the main bed

or base of the machine are mounted two main carriages or bearing heads arranged in offset relation, that is to say, with their axes out of alinement. In these carriages
 5 are rotatably mounted two spindles each provided with a pulley whereby it may be separately driven by a belt, and on the adjacent ends of the two spindles are fixed grinding wheels, the adjacent edges of the
 10 two wheels overlapping to some extent. In the present instance these grinding wheels are of the so-called ring wheel type, that is to say, the grinding face of each is of annular form. The two wheels are arranged to
 15 overlap to the extent of the radial dimension or width of this grinding face.

Between the opposed faces of the grinding wheels is a work carrier, in this instance a rotary disk, having receptacles to carry
 20 pieces of work into the space between the grinding wheels. Guard or guide plates each located within the space defined by the annular grinding faces prevent the work from entering such spaces and other guides
 25 are mounted in such position as to prevent displacement of the work in its movement along with the work carrier.

One of the carriages which carries one grinding wheel spindle is mounted to reciprocate axially of the spindle thereby to
 30 move its grinding wheel toward and away from the other grinding wheel to facilitate the introduction of work between the wheels. Automatic means is provided for
 35 reciprocating this grinding wheel and for moving the work carrier in timed relation thereto so that when the wheels are separated a piece of work will be interposed between the two grinding faces.

40 Means is provided for universally adjusting the axis of the other or stationarily mounted grinding wheel to effect parallelism between the grinding faces of the wheels, which adjusting mechanism comprises means
 45 for moving the bearings for the grinding wheel spindle about a horizontal and a vertical axis independently.

Both of the grinding wheels are provided with a quick and a fine adjusting means for
 50 adjusting them toward and away from each other to accommodate work of different thicknesses and to compensate for wear on the wheels. In addition to these adjustments, means is provided for one of the
 55 wheels to permit of quickly moving said wheel a substantial distance away from the other wheel to allow changing the abrading elements of the wheels.

Two wheel dressing devices are mounted
 60 on the hoods or guards enclosing the grinding wheels to swing on horizontal axes parallel to the grinding wheel spindles so as to pass across the annular grinding face of the respective wheels and dress or true such
 65 faces. The offset relation of the grinding

wheels to each other and the arrangement of the wheel dressers and work carrier permits of dressing the wheels at any time during the grinding operation if desired.

In the embodiment of my invention selected for illustration, a suitable base 10 carries on its opposite ends two carriages 11 and 12 having bearings in which two spindles 13 and 14 are mounted, said spindles
 75 having fixed to their adjacent ends two grinding wheels which are indicated as a whole by numerals 15 and 16. Each of the grinding wheels preferably comprises an annular grinding element *a* mounted in a chuck *b* which is fixed on the spindle and
 80 is provided with peripheral means for gripping or locking the element *a* in the chuck. The spindles have pulleys 17 and 18 fixed thereon by which they may be driven from
 85 any suitable source of power. The axes of the two spindles 13 and 14 are parallel but are offset or arranged out of alinement with each other, both axes being in the present
 90 instance in the same horizontal plane, although that is not an essential arrangement. The two spindles are mounted at such distance apart that the grinding faces of the
 95 two wheels overlap only the radial dimension or width of their grinding faces at one side of their respective axes.

Between the wheels 15 and 16 there is mounted a rotatable work-carrier 19 which in the form herein shown consists of a circular disk adapted to receive small flat objects in suitable holes 20 uniformly spaced
 100 adjacent its periphery and carry them down between the grinding wheels, where they are ground. The pieces are fed in, by hand or automatically, at 20' opposite the wheel
 105 16 and are restrained from falling out of the hole by a suitable guide plate 24 mounted on the hood 24' and a circular plate or shield 25 located within the central recess of the grinding element *a* of wheel
 110 16. As the piece of work is carried down between the opposed faces of the grinding elements by the rotation of the carrier, the carriage 11 is automatically drawn back to let the piece of work enter freely. After
 115 the work is between the opposed portions of the faces of the grinding wheels, the carriage 11 is automatically fed in and the piece is ground to an exact thickness. The carriage is then drawn back again and the
 120 finished piece is carried up across the central recess of the grinding element *a* of wheel 15, being restrained from falling out of its hole by a suitable shield 26 mounted on the hood 26' and a circular plate 27 located
 125 in the central recess of the grinding element of wheel 15. The finished piece is moved out of the work-carrier by an ejector 27^a on the plate 27, and a new piece is inserted at the point 20' at each retraction of the
 130 carriage 11.

The automatic means for rotating the carrier 19 and reciprocating the carriage 11 will next be described. A drive shaft 28 carries a cone of pulleys 29 to be driven by a belt from any suitable source of power (not shown). A worm 30 (Fig. 3) on the drive shaft 28 engages a worm wheel 31 on a short horizontal shaft 32 mounted in stationary bearings in the base and carrying at one end a cam or eccentric 33. The carriage 11 is slidably mounted on ways 34 on a sub-base 35 which is arranged to be reciprocated toward and away from the work carrier by means of a lever 36 fulcrumed at 37 on the base, the upper end of said lever being pivotally attached to said sub-base while the lower end carries a roller 36' to engage the periphery of the cam 33. A powerful compression spring 38 (Fig. 1) is positioned to exert its force between the lower end of the lever and the adjacent portion of the base 10 so that the spring tends to swing the lever in a direction to force the sub-base 35 and therefore the grinding wheel 15, toward the work carrier. The lever 36 carries an adjusting screw and lock nut device 39 by which the tension of the spring 38 may be adjusted. A pair of stop brackets 40 fixed on the outer end of the sub-base 35 abut against the end of the base 10 and are arranged to limit or determine the extent of inward travel of the sub-base under the influence of the spring 38.

For operating the work carrier 19 in synchronism with the reciprocation of the carriage 11 so that the carriage will be moved outward each time a piece of work is to be fed between the opposed portions of the faces of the grinding elements, I provide a horizontal shaft 45 (Fig. 1) mounted in bearings in the base 10 and having fixed on its inner end a gear disk 46 which is positioned in the same plane as and beneath the work carrying disk 19. The gear disk has teeth on its periphery to intermesh with the teeth on the disk 19 to drive it. Said disk 19 is provided with trunnions 44 which are mounted in bearings 47 on the top of the hoods or housings 24' and 26' surrounding the respective grinding wheels.

The outer end of the shaft 45 is connected by suitable gearing to the shaft 32 previously described, said gearing in the present instance comprising a spur gear 48 (Fig. 3) fixed on the shaft 45 and meshing with a spur pinion 49 which is rigid with a large spur gear 50 that meshes with a small spur pinion 51 on a shaft 52, the latter shaft being connected by a pair of bevel pinions 52^a to the shaft 32.

In order to accommodate pieces of work of different sizes in the work carrier 19, the said carrier is mounted so that it may be readily removed from the machine and an-

other carrier substituted therefor having work recesses of different size and spacing. By removing the screws which support the bearings 47 on the grinding wheel housings the whole work carrier may be lifted from the machine and another quickly substituted therefor. To conform to the different spacing of the work openings in the substituted carrier it is necessary to drive the latter at a different speed and therefore to enable the operator to change the speed at will, the gears 48, 49, 50 and 51 are made readily removable so that other gears properly related to the substituted carrier may be placed in the train.

The movement of the reciprocating sub-base 35 and carriage 11 is guided by the ways 34 and 43, and their alinement on the base 10 cannot be changed after the machine has been assembled. Means are provided for securing perfect alinement of the axes of the two grinding wheels by adjustment of the second carriage 12. A knee 53 (see Figs. 6 to 9) is journaled on a horizontal axis at 54 on the base 10 of the machine. This knee is supported at its outer end by a pair of jack screws 55 secured by lock nuts, and the knee is clamped by a bolt 55^a which passes through upstanding lugs 55^b on the base 10 and through elongated holes 55^c in the overlapping sides of the knee. A sub-base 56 is supported upon the knee 53 to swing about a pivot 57 located at one end of the knee and sub-base, and the sub-base is adapted to be clamped in position on the knee by four bolts 58 passing through enlarged or elongated openings 59 in the sub-base 56 and threaded into the knee 53. When these bolts are loosened, the sub-base may be swung on the vertical axis of the pivot 57 and by tightening the bolts the sub-base may be locked in its set position. Suitable upstanding lugs 60 at opposite sides of the knee 53 carry adjusting bolts 61 by means of which the sub-base may be conveniently and accurately adjusted. It will thus be seen that the two adjustments about the pivotal axes 54 and 57 provide for perfect alinement or parallelism of the faces of the two grinding elements 15 and 16.

For adjusting one or both of the grinding elements with respect to the work, each carriage 11 and 12 is slidably mounted with respect to its sub-base 35 or 56 respectively by means of ways 34 and 62. The means herein shown for making this adjustment comprises in each instance a combined nut and worm wheel 63 the periphery of which meshes with a worm 64, the nut being positioned between opposed walls or lugs on the carriage and receiving a screw shaft 65. This shaft is rotatably mounted in a lug 66 on the sub-bases 35 and 56 and the shaft has collars 67 engaging said lug to prevent endwise movement of the shaft.

For quick adjustment of the grinding elements toward and away from the work in order to space the two grinding elements at different distances apart to accommodate work of different thicknesses, the shaft 65 is rotated within the worm wheel nut 63 by means of a suitable crank handle (not shown) which may be applied to the outer squared end of said shaft. A slower and more accurate adjustment is obtainable by clamping the shaft by means of the split bearing 66* (Fig. 1) in the lug 66 and by rotating the worm wheel nut 63 by means of the transverse worm 64. This worm is rigid with a shaft which is mounted in a lug 68 on the carriage 11 or 12 and is held against longitudinal movement in the lug, said shaft being provided with a hand wheel 69 by means of which the worm 64 may be rotated. In changing from one size of work to another it is convenient to use the quick adjustment for an approximate setting of the grinding elements after which the fine adjustment may be used for exactly positioning the elements, and the fine adjustment may also be used to adjust the elements in compensating for the wear thereon.

The dressing attachments are shown in Figures 1, 3 and 10. The supporting fittings 70 and 71 are secured respectively on the hoods or housings 24' and 26' of the respective grinding wheel structures. These hoods are mounted upon the sub-bases 33 and 56 respectively. Each fitting 70, 71 comprises a split sleeve 72 for clamping a pivot bar 73 which extends horizontally and receives on its reduced end 74 the frame or arm 76 in which is mounted the dressing tool holder 77 (Fig. 10). A nut 78 engaging the threaded end of the rod 73 holds the arm 76 on the pivot bar. The dressing tool holder is pivoted intermediate its ends on the pin 79 so that the holder may swing in the plane of the axis of the rod 73. Front and rear set screws 80 and 81 extend through the arm 76 and engage respectively against the front and rear ends of the holder. A suitable dressing tool 82 is supported in the holder and the frame may normally hang down as shown at the right of Fig. 3. However, when it is desired to dress a grinding element the associated frame is swung inwardly by means of a handle 76' to sweep the dressing tool across the face of the grinding element. As clearly shown in Fig. 3, the outer sections of the grinding elements are entirely free for such engagement therewith of the dressing tools. By means of the split clamping sleeves 72 rough adjustment can be made for the dressing tools and by means of the set screws 80 and 81 final adjustment can be made so that after sweep of the dressing tools across the grinding surfaces the proper amount of dressing will have been accomplished. The dressing

mechanisms form permanent attachments on the machine and are always ready for instant use, and from the arrangement described and shown they may be operated at any time during running of the machine and even while the base 35 is being reciprocated, the dressing attachment for the grinding wheel structure 16 being secured on the housing for such structure so that the proper dressing relationship between the attachment and the grinding element is always maintained. The dressing operations therefore never interfere with the operation of the machine and furthermore it being possible to make frequent light dressings, more efficient and accurate dressing can be accomplished than where heavier dressing is necessary after a period of operation of the machine.

Reference has already been made to the plates or shields 25 and 27 which close the apertures of the annular grinding elements against the objects ground by the machine. These plates are adjustably supported and preferably held a small distance within the grinding spaces of the grinding elements in order to be clear of the grinding tools and also that adjustment can be made as the grinding elements are reduced in thickness after dressing operation. As best shown in Figs. 3, 4 and 5, both plates are supported from the hood 26' of the grinding wheel structure on the stationary carriage 12. The stud 83 extends horizontally from the base of the hood and carries an arm 85 which by means of a set screw 84 is rotationally and longitudinally adjustable on the stud. The upper end of the arm receives the stem 86 extending from the fitting 87 on which the plate 25 is secured, a set screw 88 locking the stem in adjusted position. The bracket 89 secured on the hood 26' receives the stem 90 of the fitting 91 on which the plate 27 is secured, the set screw 92 locking the pin after adjustment of the plate. By means of the various set screws accurate adjustment of the plates with reference to the grinding elements can readily be made, even while the machine is running.

I have shown a water circulatory system for feeding water to the grinding elements when desired. The water is contained in the tank 93 formed in the machine bed and a pump 94 draws the water and the pipes 95 and 96 direct the water to the respective grinding fields.

I also show means for retracting the base 35 a sufficient distance to permit renewal of worn out grinding elements or to give adequate access for inspection, repairs, etc. As shown in Figs. 1 and 3, the base 35 has the rack 97 thereon to be engaged by the gear 98 turned by means of the wheel 99. When it is desired to retract the base the pin 100 is released from the lever 36 and the lug 66.

Briefly summing up the operation, the pieces to be ground are fed to the disk 19 at the point 20' in front of the plate 25. The cam 33 then operates on the lever 36 to cause retraction of the base 35 and the grinding wheel structure 15 so that the inserted piece can be carried into position between the opposed sections of the grinding elements. The grinding structure is then permitted to be yieldingly pressed inwardly by the spring 38 during which period the inserted piece is ground. As the piece just ground is carried along farther by the carrier 19, it encounters the ejecting tongue 27^a on the plate 27 and is thereby pushed out of its pocket and deposited onto a chute or conveyor (not shown). By virtue of the gearing and transmission train the reciprocating of the grinding element carrier is in timed relation with respect to the rotation of the work carrier. Owing to the offset relation between the grinding elements and the clear spaces thereby afforded, the dressing mechanisms which are conveniently located can be at any time readily operated to keep the grinding surfaces true and accurate. By virtue of the various adjustments provided for the carriage 12 supporting the grinding wheel structure, the faces of the two grinding elements can be accurately kept in parallel planes so that accurate grinding will result. The preliminary and final adjustment mechanism provided for the carriage 11 permits accurate adjustment of the gap between the grinding faces, and after the grinding elements are worn out, new ones can readily be inserted by withdrawing the base 35 by means of the rack and pinion mechanism described. By removing the bearing blocks for the work holder 19 such holder can be lifted out of the machine and a new one readily substituted. The work to be ground is preferably fed in automatically and after the machine has been once set it is automatic in its operation thus effecting a great saving in labor.

I claim as my invention:

1. In a grinding machine, in combination, a slidable grinder carriage, a rotatable nut mounted between opposed bearing surfaces on said slidable carriage in abutting relation therewith, a threaded element passing through said nut, and two separate means for producing relative motion between said nut and said threaded member at different rates of speed.

2. In a grinding machine, in combination, a slidable carriage, a nut rotatable between opposed bearing surfaces on said carriage in abutting engagement therewith, a threaded member passing through said nut, a worm wheel carried by said nut, a manually operated worm adapted to rotate said nut and locking said nut against rotation when not

in operation to rotate said nut, and independent means for rotating said threaded member and for locking said threaded member against rotation.

3. In a grinding machine, in combination, a base, an upstanding lug on said base, a carriage slidable on said base, a nut rotatably mounted in said carriage, said nut having a worm wheel, a worm meshing with said worm wheel for rotating said nut, a threaded member journaled in said lug and passing through said nut, and means for locking said threaded member against rotation, said worm serving to lock said nut against rotation when said member is actuated.

4. In a machine of the class described, the combination of a grinding element and means for driving it, said element being annular and presenting a grinding face in a plane at right angles to its axis of rotation, a work carrier arranged to successively carry pieces of work across the face of said grinding element to be ground thereby, and a plate supported in the annulus of said grinding element between said grinding element and substantially parallel to said work carrier for preventing escape of the work pieces when travelling past the hollow of said grinding element.

5. In a grinding machine of the class described, a support, a carriage slidable on said support, an annular grinding element rotatable on said carriage, a work carrier for carrying work to be ground across the grinding face of said grinding element, a guard plate mounted on said support by means of an arm and positioned to close the annulus of said grinding element to prevent work from falling therein from said carrier, said plate being unaffected in position relative to said carrier upon adjustment of said grinding wheel to compensate for wear.

6. In a machine of the class described, the combination of a pair of opposed annular grinding elements having parallel laterally offset axes and arranged with their grinding faces parallel, a work holder between said elements, two shields, one mounted to close the annulus of each grinding element, and two guide plates, one mounted opposite each of said shields, and the exposed portions of the associated grinding elements, said shields and guards serving to prevent the escape of work from said holder.

7. In a grinding machine of the class described, the combination of two opposed annular grinding disks arranged with their grinding faces parallel, a work carrier having work holding pockets adapted to carry work between the opposed grinding faces, guard plates inserted in the apertures of said grinding disks to prevent escape of work from the holder when traveling past such apertures, and means on one of said

plates for ejecting ground work from the carrier.

8 In a grinding machine of the class described, the combination of two opposed grinding disks, a work carrier adapted to travel through a fixed path between said disks to support work for grinding, shields within the adjacent ends of the disk apertures to guide work across such apertures, 10 said disks being fixed with relation to the work holder during operation of the machine, and means for adjusting said disks with reference to the work holder and shields to compensate for grinding wear thereon.

15 9. In a grinding machine of the class described, the combination of two annular grinding disks arranged with their grinding faces parallel and overlapping the distance of their radial depth, means for rotating said disks, a work carrier movable in a fixed 20 path between said disks to carry work through the grinding field, shields supported in the apertures of said disks at the adjacent ends thereof, guide plates mounted opposite said shields, said shields and guide plates 25 defining a fixed path through which the work to be ground is guided, and means for axially adjusting said grinding disks with reference to said path to compensate for the grinding wear thereon.

30 10. In a grinding machine of the class described, the combination of two annular grinding disks disposed with their faces parallel and positioned to overlap to the extent of their radial depth, a work holder positioned to travel between the overlapping 35 sections to carry work therebetween and means supported at the annulus of one of said disks for ejecting ground work from said carrier.

40 11. In a grinding machine of the class described, the combination of two parallel annular grinding disks overlapped to the extent of their radial depth, a work carrier 45 movable between said disks and having a

work supporting pocket, said pocket being arranged to receive work in front of the aperture of one disk and to carry it through the grinding area, and means in the aperture of the other disk for discharging the ground 50 work from the carrier.

12. In a grinding machine of the class described the combination of two parallel annular grinding disks partially overlapped, 55 a work carrier movable between said disks, guard shields in the adjacent ends of the apertures of said disks, said carrier being adapted to receive work in front of the shield of one disk, and a discharge tongue on the shield of the other disk for discharg- 60 ing finished work from said carrier.

13. In a grinding machine, the combination of two opposed grinding disks having parallel laterally offset axes, a housing for each disk, and a rotatable work carrier po- 65 sitioned between said disks and journaled on said housing, said carrier being adapted to carry work pieces between said disks to be ground.

14. In a machine of the class described 70 the combination of a grinding element, a removable rotatable work carrier having a plurality of work pockets and a toothed periphery traveling in a fixed path in front of said element, means for automatically re- 75 ciprocating said element toward and away from said carrier at regular intervals, a gear disk meshing with said toothed carrier, and means for operating said gear disk in synchronism with the reciprocation of 80 said grinding element, whereby each piece of work is moved into grinding relation with said grinding element before grinding commences, said means including gears permitting a variation of the synchronous re- 85 lationship.

In testimony whereof, I have hereunto set my hand.

FREDERIC E. GARDNER.

Certificate of Correction.

29

It is hereby certified that in Letters Patent No. 1,576,820, granted March 16, 1926, upon the application of Frederic E. Gardner, of Beloit, Wisconsin, for an improvement in "Grinding Machines," an error appears in the printed specification requiring correction as follows: Page 5, lines 91 and 92, claim 4, strike out the words "between said grinding element and"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of April, A. D. 1926.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.