

**July 12, 1927.**

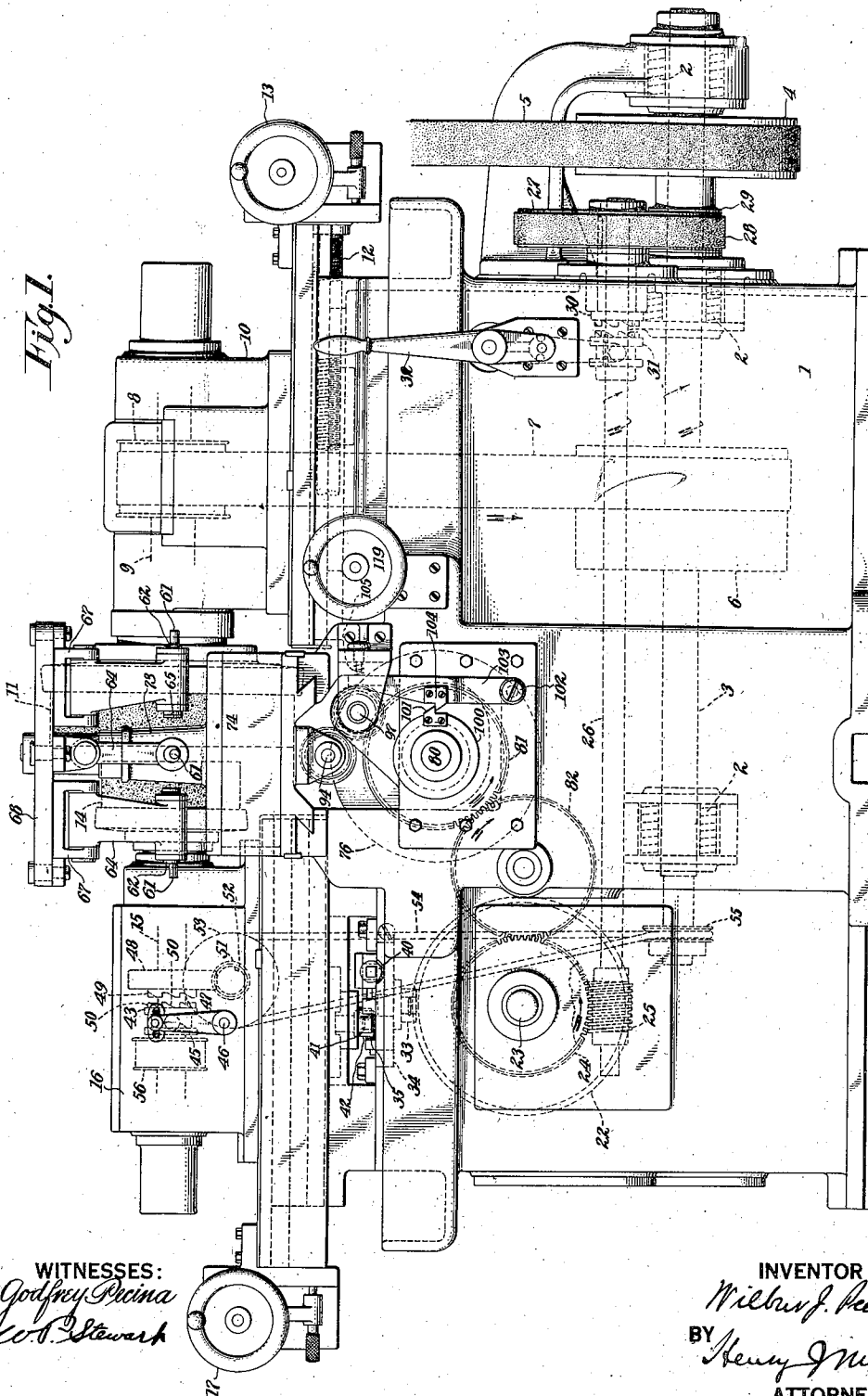
**W. J. PEETS**

1,635,339

## CENTERLESS GRINDING MACHINE

Filed June 28, 1922

4 Sheets-Sheet 1



**WITNESSES:**

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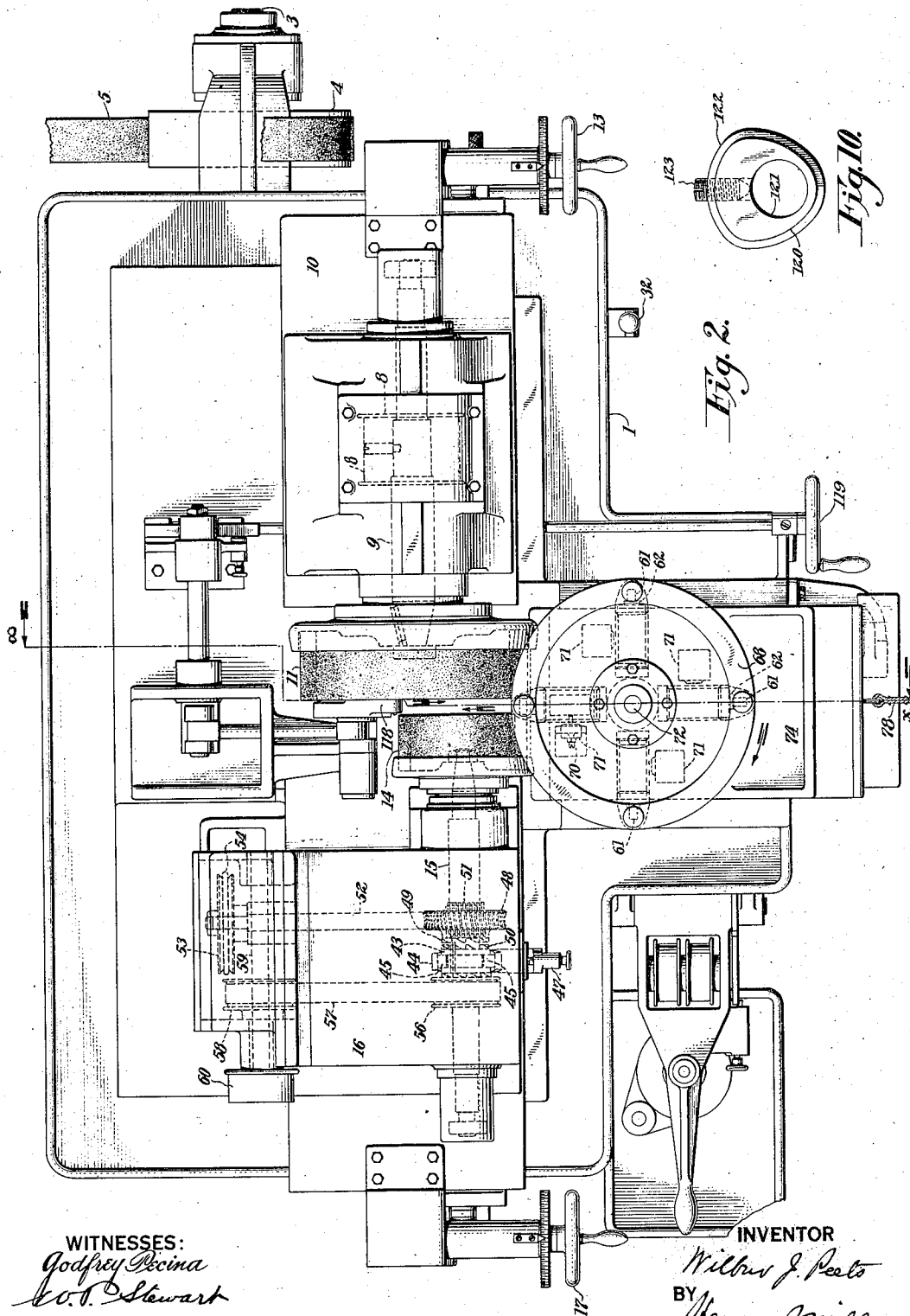
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# CENTERLESS GRINDING MACHINE

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**July 12, 1927.**

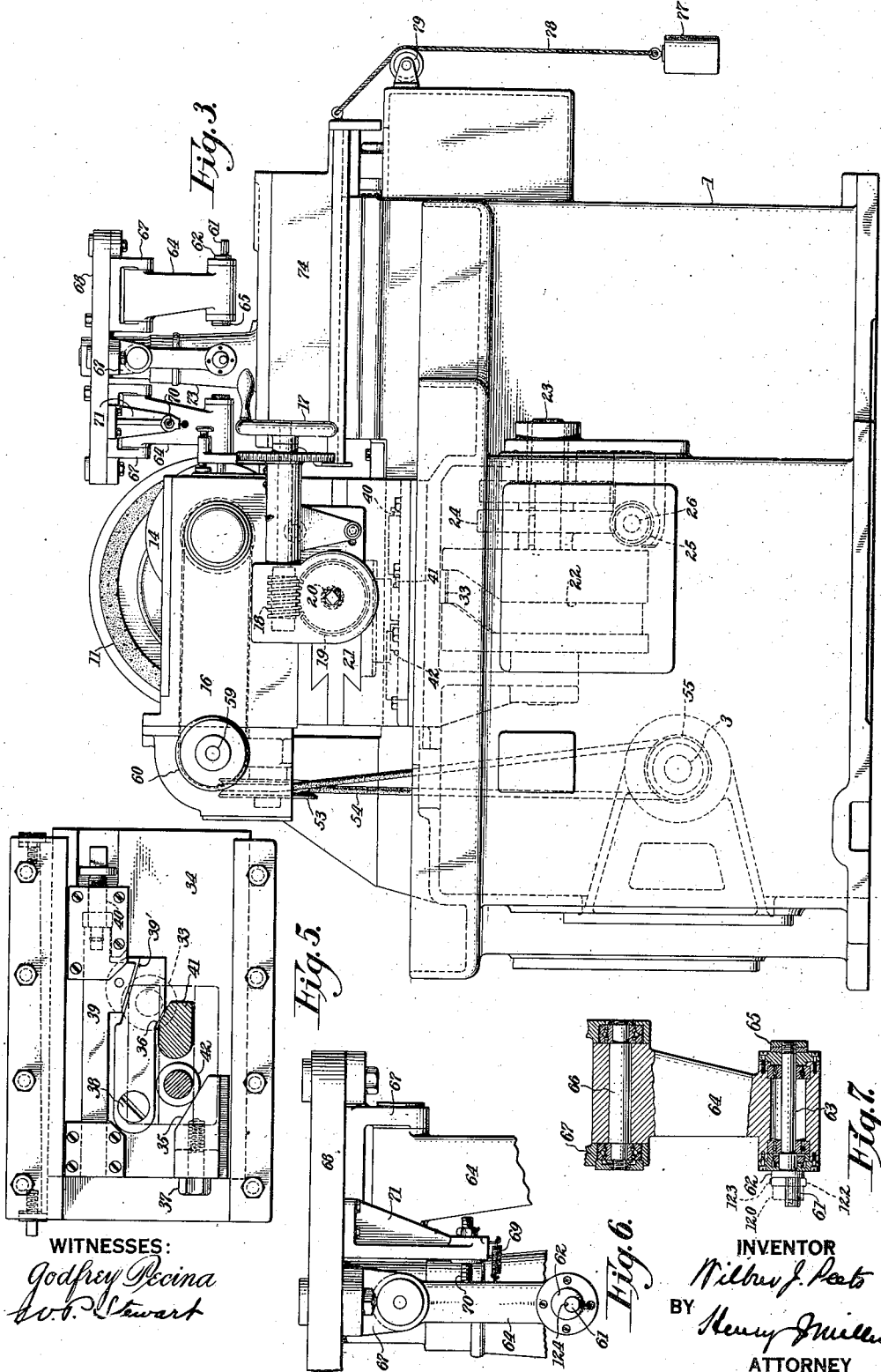
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Fig. 4.

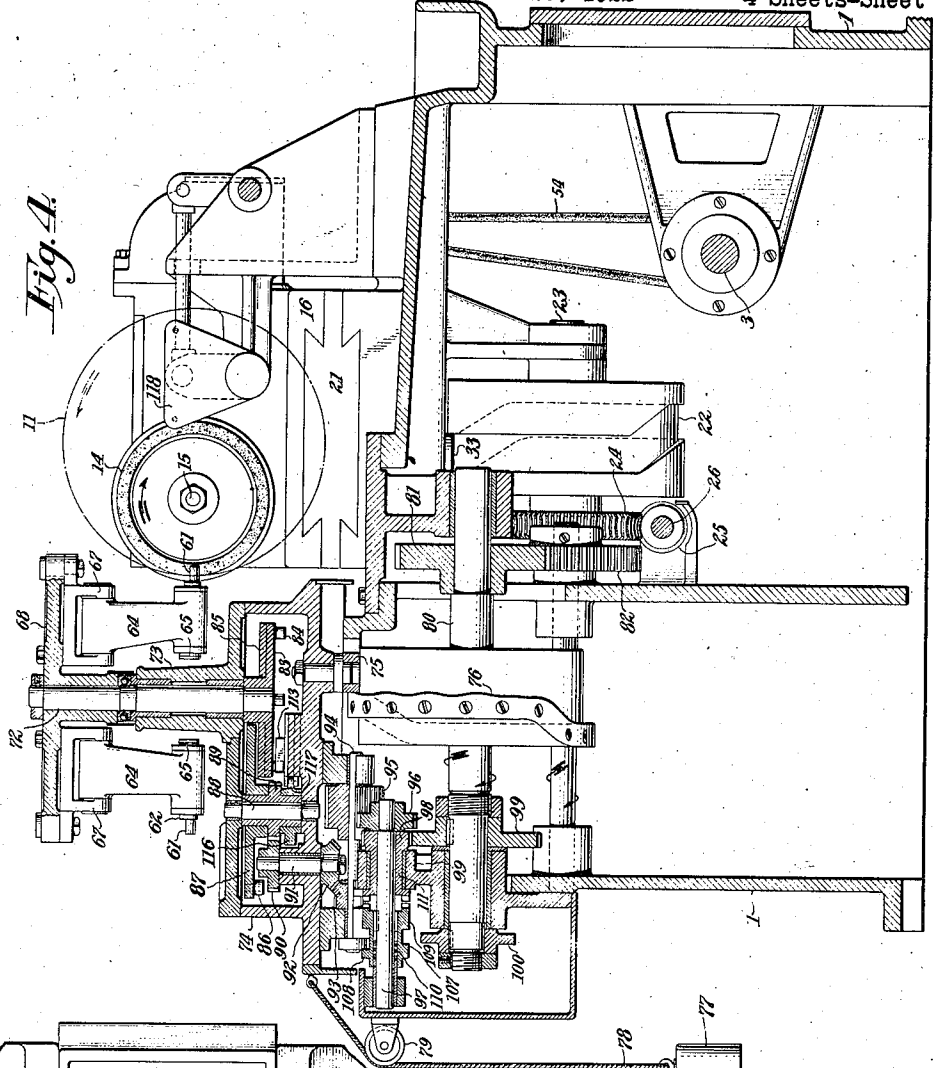
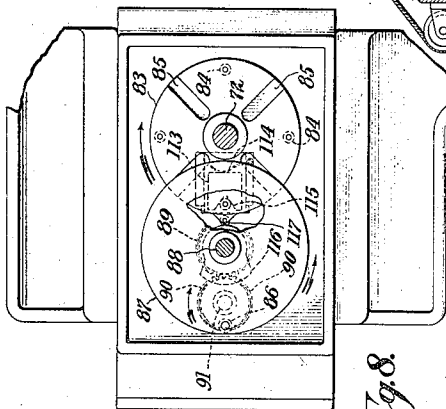


Fig. 8.

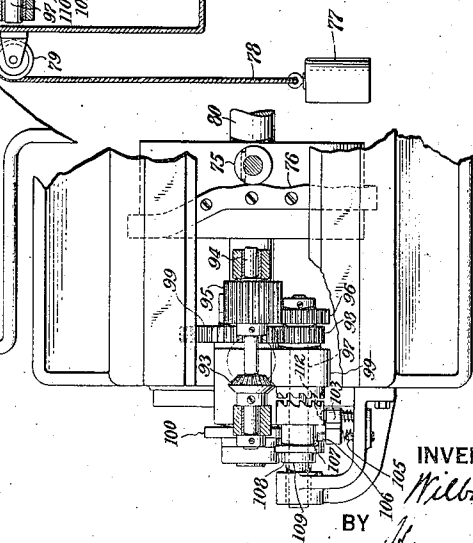


Fig. 9.

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# UNITED STATES PATENT OFFICE.

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## CENTERLESS GRINDING MACHINE.

Application filed June 28, 1922. Serial No. 571,457.

This invention relates to improvements in centerless grinding machines and has for an object to provide in machines of this character a rotary work-holder upon which the work is secured during the grinding operation.

The invention has also for its object to provide in a centerless grinding machine a work-holder capable of floating movements toward and from the work-engaging face of a grinding wheel.

The present invention has also for its object to provide a centerless grinding machine in which the floating work-holder referred to is automatically actuated to present the work to the action of the grinding-wheel; to reciprocate the work during the grinding operation and to retract the work from operative position.

A further object of this invention is to provide a centerless grinding machine embodying therein a floating work-holder and a work-controlling wheel operative in conjunction with a grinding wheel whereby the work-controlling wheel automatically acts to control the rotation of the work during the grinding operation.

Other objects of the invention will be apparent from the following description and claims.

In centerless grinding machines it has been the common practice to gravitationally support the work upon a rest between a work-controlling wheel and a grinding-wheel. In accordance with the present invention, the work is not merely supported upon a work-rest but on the contrary is carried by a work-holder and the latter term is herein employed in this sense as distinguishing from work-rests of prior constructions.

The preferred embodiment of the invention, as herein disclosed, is particularly adapted for finishing to size work that has been rough-formed to shape and approximate size, such as triangular cams having a uniform length of diameter. During the grinding operation the work is rotated with one side of its periphery engaging a work-controlling wheel and its opposite side a grinding wheel. It is therefore evident when the intersections of the consecutive diameters of the work do not define a point, i. e., when they describe a curve, the axis of rotation of the work must of necessity be

free to float or vibrate in order to maintain the desired form of the work.

To this end the work-holder, in its preferred embodiment, comprises an eccentric spindle-extension journaled in the free end of an arm pivotally supported upon a rotary turret and yieldingly held against an adjustable stop by a suitable spring. The turret carries a plurality of these work-holder sustaining arms and is intermittently rotated by suitable mechanism to successively present the work-articles, which are secured upon the spindle-extensions, to the action of a work-controlling wheel which latter advances the work to the action of a grinding-wheel. The grinding-wheel is preferably of the cylinder or cup-type of which the end-face acts upon the work and is rotated by operative connections with the main-shaft of the machine at a uniform and comparatively high speed. The work-controlling wheel is rotated at a comparatively low speed and in a direction whereby the direction of rotation of the work under the action of the work-controlling wheel corresponds to the direction of rotation of the grinding-wheel at the point of contact. The rotating work-controlling wheel is in retracted or inoperative position during the work-presenting movement of the turret and is then advanced to engage the work, thereby swinging the work-holding arm away from its stop against the action of its holding spring. The work and its carrying-spindle are by this frictional engagement rotated at a surface speed corresponding with that of the work controlling wheel and while rotating in this fashion the work continues its advance under the feeding action of the work-controlling wheel into engagement with the end face of the grinding wheel, the work maintaining however its surface speed during the grinding operation. Before retracting the work-controlling wheel, its feeding action is preferably suspended for a short period to allow for reaction of the parts. During the grinding operation the work-holder carrying turret is rapidly reciprocated to uniformly wear down the grinding surface and to obtain a polished finish, after which the turret is retracted sufficiently to permit the intermittent work-positioning movements thereof.

In the accompanying drawings, Fig. 1 is

a front elevation of a centerless grinding machine embodying the present improvements. Fig. 2 is a top-plan view of the same. Fig. 3 is an end elevation of the machine as viewed from the left in Fig. 1. Fig. 4 is a sectional view substantially on the line  $x-x$  of Fig. 2. Fig. 5 is a plan view of the work-controlling wheel feed-slide. Fig. 6 is a fragmentary view in elevation of the work-holder carrying turret. Fig. 7 is a view partly in section of a work-holder carrying arm. Figs. 8 and 9 are detail plan views of portions of the turret indexing mechanism. Fig. 10 is a view in elevation of a cam to grind which the present machine is particularly designed.

Referring to the drawings, the machine frame 1 is provided with suitable bearings as 2 in which is journaled the main actuating shaft 3, carrying at one end a belt-pulley 4. The belt-pulley 4 is connected by means of a belt 5 with a suitable driving pulley (not shown).

Secured upon the main shaft 3 is a wide-face belt-pulley 6 connected by means of a belt 7 with a pulley 8. The pulley 8 is carried by a shaft 9, suitably journaled in a carriage 10 and carrying at one end a cup or cylindrical grinding wheel 11. The carriage 10 is slidably supported upon the machine frame for movements in the direction of the axis of the shaft 9 to adjust the position of the grinding wheel 11. This adjustment may be effected in a well known manner by means of a screw-shaft 12 having the usual worm and worm-gear connections with a hand-wheel 13. It is to be understood that upon adjustment of the carriage 10, the belt 7 travels along the wide face of pulley 6.

Facing the grinding wheel 11 is a cylindrical work-controlling wheel 14 carried by a shaft 15, substantially parallel to the shaft 9 and sufficiently offset therefrom whereby vertical tangents to the front faces of the wheels 11 and 14 lie in substantially the same vertical plane. It is apparent that shafts 9 and 15 may be in alinement by constructing the wheels 11 and 14 of equal size. The shaft 15 is journaled in a sliding carriage 16 confined to movements in the direction of the axis of the shaft 15. There is however a double movement of the carriage 16 in this direction. One of these movements is a work-controlling wheel positioning or adjusting movement effected manually by actuation of the hand-wheel 17 which rotates a worm 18 geared with a worm-wheel 19. The worm-wheel 19 is carried by a screw-shaft 20 suitably journaled against endwise movement in the carriage 16 and threaded into a block 21 dove-tailed into the base of the carriage 16. The block 21 being immovable during this adjustment, it is apparent that by rotation of the hand-wheel 17, the carriage 16 is slidably moved

upon the block 21 to effect a minute adjustment of the position of the work-controlling wheel 14.

The other movement of the carriage 16 in the same line is effected automatically for a purpose which will be apparent. After the described manual adjustment of the carriage 16, it is clear that the worm 18, worm-wheel 19 and screw-shaft 20 securely lock said carriage upon the block 21 all of which may thereafter be reciprocated as a unit. This is accomplished automatically from a grooved cam 22 carried by a cross-shaft 23 suitably journaled in the machine frame. The shaft 23 carries a worm-wheel 24 geared with a worm 25 secured upon a counter-shaft 26. Loosely journaled upon the opposite end of the counter-shaft 26 is a belt-pulley 27 connected by means of a belt 28 with a pulley 29 secured upon the main shaft. The belt-pulley 27 carries one element 30 of a clutch of which the coacting element 31 is keyed upon the counter-shaft 26 and is longitudinally slidable thereupon under the action of a manually operated clutch-shifting lever 32 which may be held in clutching and unclutching positions in any suitable or well known manner.

The grooved cam 22 is entered by a roller 33 depending from a slide-plate 34 which is thereafter reciprocated from the cam in a direction transverse to the axis of the shaft 15. The slide-plate 34 is guided in suitable ways provided for the purpose and upon its upper side carries two cams 35 and 36. The cam 35 is secured in position by means of a bolt 37 while the cam 36 is supported for pivotal adjustment upon the slide-plate by means of a screw 38. The effective position of the cam 36 is determined by a slide-bar 39, longitudinally adjustable upon the slide-plate by means of a screw-bolt 40 and having a swiveled wedge-surface 39' bearing against the cam 36. The cam 36 engages an abutment 41 depending from the block 21 and acts to slowly feed said block together with the carriage secured thereupon in the direction of the axis of shaft 15. Return movements are effected by the action of the cam 35 upon a roller 42 also depending from the block 21. It is to be understood from the foregoing that the work-controlling wheel 14 may be manually adjusted and is automatically fed axially of shaft 15.

Rotation is imparted to the shaft 15 and the work-controlling wheel 14 carried thereby from either one of two driving devices selective at will. To this end a clutch-element is slidably keyed upon the shaft 15. This clutch-element comprises a peripheral grooved collar 43 straddled by a fork 44 carrying studs, as 45, engaging the peripheral groove in the collar. The fork 44 may be rocked upon a fulcrum-pin 46 to laterally shift the clutch-element by means of a man-

ually manipulated arm 47 which may be suitably maintained during the operation of the machine in any one of three positions, i. e. neutral, right, or left-hand clutching positions. 5 Journalled loosely upon the shaft 15 but held against endwise movement thereupon is a worm-wheel 48 carrying clutch-teeth 49 at one side thereof complementary with the teeth 50 of the collar 43. The worm-wheel 48 is 10 geared with a worm 51 upon a cross-shaft 52 carrying at one end a pulley 53 connected by means of a belt 54 with a pulley 55 carried by the main-shaft 3 of the machine. These driving connections effect comparatively 15 slow rotations of the work-controlling wheel 14 during the grinding operation. The speed of rotation of the wheel 14 may be increased materially, when dressing the work-engaging face of the wheel, by the 20 provision of separate driving means. To this end, the collar 43 may be shifted to the left (Fig. 1 of the drawings) by manual manipulation of the arm 47 thereby causing an interengagement of clutch-elements between the collar 43 and a pulley 56 loosely 25 journalled upon the shaft 15. The pulley 56 is connected by means of a belt 57 with a pulley 58 carried by a shaft 59, suitably journalled in the slide 16 and carrying at its outer end a pulley 60 which may be belted to any suitable source of power.

The work to be operated upon by the grinding-wheels mentioned is placed upon a work-holder comprising a spindle-extension 35 or crank-pin 61 projecting eccentrically from a flange 62 of a spindle 63. The spindle 63 is journalled in suitable ball-bearings provided in the free end of a depending arm 64 and is held against endwise movement in its 40 bearings by means of the flange 62 and lock-collars 65 threaded upon the opposite end of the spindle. The arm 64 is pivotally carried at its upper end by a pintle 66 journalled to permit oscillatory movements of the arm, i. e., floating movements of the work-holder, 45 in suitable ball-bearings provided in a bearing-bracket 67 bolted upon or otherwise carried by a turret head 68. The turret head 68 carries four work-holder sustaining 50 arms 64 such as that described and which are equally spaced on the turret-head. Each of these arms 64 is acted upon by a spring 69 to yieldingly hold the arms against an adjustable stop 70 provided on a bracket 71 depending from the turret-head. The turret-head is carried by a vertical shaft 72 55 suitably journalled in bearings provided in a vertical boss 73 of a horizontal turret-slide 74, which is reciprocated in suitable ways 60 in a direction at right angles to the axes of the wheels 11 and 14. To this end the turret-slide 74 carries a cam-roll 75 acted upon by a cam 76 and which cam-roll is indicated as held against the cam by a weight 77 suspended by a cord 78 passing over an idler

79 and connected with the slide. The cam 76 is carried by a shaft 80 upon which is secured a gear 81 in mesh with an intermediate gear 82 in turn meshing with a suitable gear upon the worm-wheel carrying 70 shaft 23.

The turret head is rotated 90° at the finish of each grinding operation to successively present the work-holding arms 64 in operative position with respect to the wheels 11 75 and 14. To this end the turret fulcrum-shaft 72 is coupled with an indexing mechanism which may be of any suitable construction, there being illustrated in the accompanying drawings a form of Geneva 80 movement for effecting this result. As illustrated, the turret-shaft 72 carries at its lower end a pin-wheel 83 of which the pins 84 project from the lower surface thereof, while its upper surface is provided with a series 85 of diametrical grooves 85 spaced 90° and located intermediate the pins 84. Positioned to successively engage the grooves 85 to rotate the wheel 83 a quarter revolution is a roller 86 carried by a disk 87 suitably 90 secured upon a vertical shaft 88 journalled in the slide 74. That is, for each complete revolution of the disk 87, the roller 86 engages one of the grooves 85 and advances the wheel 83 a quarter revolution, whereupon the roller disengages said wheel. 95 The disk 87 is intermittently revolved through the intermediary of a spur-gear 89 carried by the shaft 88 and meshing with a similar gear 90 carried by the upper end of a vertical shaft 91 journalled in the turret-slide 100 74. At its lower end, the shaft 91 carries a bevel-gear 92 meshing with a similar gear 93 carried by horizontal shaft 94 journalled in suitable bearings provided on the slide 105 74. The shaft 94 carries a comparatively wide spur-gear 95 driven from a gear 96 secured upon a shaft 97 slidingly mounted for endwise movements in suitable bearings provided for the purpose. The shaft 97 110 passes freely through a gear 98 journalled in a bearing 98' provided in the machine frame suitable to prevent endwise movement of said gear 98 with the shaft 97.

The gear 98 is rotated by engagement 115 therewith of a gear 99 secured upon the cam-shaft 80. While the gears 99 and 98 are rotated continuously during the operation of the machine, the gear 96 is only intermittently rotated. To this end there is secured 120 upon the outer end of the cam shaft 80 a disk 100 carrying a trip-element 101. Fulcrumed upon the machine frame by means of a pivot-screw 102 is a lever 103 carrying a complementary trip-element 104 in the path 125 of movement of the element 101. During each rotation of the cam-shaft 80, an inclined face on the trip-element 101 engages a similar face on the element 104 and thereby rocks the lever 103 against the action of 130

the springs 105 suitably disposed to bear against the upper end of said lever 103. This rocking movement of the lever 103 withdraws a stud 106 carried thereby out of the path of movement of a cam portion 107 of a flange 108 provided on a clutch-sleeve 109 secured upon the shaft 97. This withdrawal movement of the stud 106 permits a coil spring 110 surrounding the shaft 97 and bearing upon the clutch sleeve to shift the latter together with the shaft 97 lengthwise, whereby the teeth of the clutch-sleeve 109 operatively engage complementary clutch teeth provided on a laterally projecting sleeve 111 of the gear 98. When the trip-element 101 clears the trip-element 104, the lever 103 is again advanced by the action of the springs 105, but the partial rotation imparted to the clutch-sleeve 109 by its engagement with the sleeve 111 has now carried the cam-portion 107 out of the path of the stud 106, whereupon the latter engages the straight portion of the flange 108, permitting the complementary clutch-elements 109, 111 to remain in engagement to rotate the disk 87 until the cam-portion 107 again engages the stud 106, thereby disconnecting said clutch-elements. At this time a second stud 112 carried by the lever 103 enters an aperture in the sleeve 109 to retain the latter, together with the shaft 97 in stationary ineffective position until again permitted to advance by the action of the trip-elements 101, 104.

Locking means is provided to hold the turret-shaft 72 stationary during the action of the grinding wheel upon the work. Mounted upon the slide 74 is a slide-block 113 guided in suitable ways and urged to advance by means of a spring 114. This slide-block 113 is provided with a V-shaped notch 115 positioned to successively engage the pins 84 and thereby lock the pin-wheel in operative work-presenting position. A cam 116 is secured upon the shaft 88 and acts upon a roller 117 carried by the slide-block 113 to displace the latter against the action of the spring 114. The action of the cam 116 is timed to release the roller 117 at the time the roller 86 disengages each of the grooves 85, whereby the pin-wheel is promptly locked in operative position.

When it is desired to dress the operative faces of the grinding wheel 11 and the work-controlling wheel 14, there may be employed the usual device 118 designed for this purpose. In order to throw the device 118 into effective dressing position, it has suitable operative connections with a hand-wheel 119. As hereinbefore stated it is preferred to increase the speed of rotation of the work-controlling wheel during the dressing operation and it is at this time that the belt 57 is employed to drive the shaft 15.

While the present machine is equally

adapted for use in grinding a variety of classes of articles in accordance with the principles of centerless grinding machines, it has been more particularly designed to finish to size triangular cams of which consecutive diameters are of equal lengths. 70 A cam of this character is illustrated in Fig. 10 and comprises an irregular periphery 120 having an eccentric cam-shaft aperture 121 and an end-flange 122 into which is threaded 75 a set-screw 123 for securing the cam upon its cam-shaft. In use, the cam usually operates in the fork of a lever or pitman and for smooth operation it is essential that the cam constantly contacts with opposite sides of the 80 fork without binding or lost-motion; i. e., consecutive diameters should be of equal lengths. This result is obtained in the present machine to a substantially accurate degree in spite of the fact that the periphery 85 of the cam is an irregular surface to an extent that the intersections of the diameters do not define a point but a locus of points resembling a hypocycloid.

In effecting this grinding to size of these 90 cams, they are successively placed upon the work-holders with the spindle-extension or crank-pin 61 within the cam-shaft aperture 121, being secured by seating the set-screw 123 within a V-shaped groove 124 in the pin 95 61. Owing to the eccentricity of the cam-aperture 121, the pin 61 is preferably constructed as equally eccentric with respect to the axis of the spindle 63, whereby less swinging movement of the arm 64 is occasioned. 100 By means of the mechanism described the work-holder carrying turret is intermittently indexed and advanced to present the work to the action of the work-controlling wheel 14, it being understood that 105 the latter wheel is at this time in retracted position and the particular work-carrying arm 64 is yieldingly held against the stop 70 by means of the spring 69. The cam 22 now acts to slowly feed the rotating work- 110 controlling wheel toward the rotating grinding wheel 11, thereby engaging the periphery of the work, first moving it away from the stop 70 and then rotating it by frictional engagement, about the axis of the 115 spindle 63. As before stated, the consecutive diameters of the work do not intersect at a common point and a median point of said intersection locus is therefore selected to correspond substantially with the axis of 120 the spindle 63, whereby while the work will rotate substantially upon said axis, the latter is permitted to float or vibrate toward and from the opposed work-engaging faces of the grinding and work-controlling wheels a 125 distance equivalent to the distance of the median point selected from the locus of the diameter-intersections. This vibration of the work-holder spindle is permitted by the pivotal support for the arm 64, the spindle 130

comprising an element axially sustaining the work for rotation between the grinding and work-controlling wheels, as distinguished from the peripheral work-rests and guides heretofore employed in this class of machines. The provision of means for engaging the work within the periphery thereof, having free floating movements in directions toward and from the operative faces of the grinding and work-controlling wheels comprises an important and novel characteristic of the present improvement in this class of machines.

The axial feed of the rotating controlling wheel 14 continues while the rotating grinding wheel 11 is acting upon the periphery of the work to grind the latter to size. During the grinding operation the turret 68, together with the work-holders carried thereby, is reciprocated or jogged in a direction transverse to the axis of the grinding-wheel 11 under the action of the cam 76 and weight 77 as before explained. A neutral point in the axial feed of the work-controlling wheel 14 is now reached to allow for reaction in the parts, whereafter said wheel and turret are retracted and the turret indexed a quarter revolution and advanced to operatively position the next work-holder, at which time the grinding operation is repeated.

Having thus set forth the nature of the invention, what I claim herein is:—

1. In a centerless grinding machine, the combination with work controlling and grinding wheels having opposed work-engaging faces, of a work-holder including an element sustaining the work between said wheels during the grinding operation for rotation about an axis coincident with the axis of said element.

2. In a centerless grinding machine, the combination with a grinding wheel having a work-engaging face, a work-controlling wheel having a work-engaging face, and operative connections for rotating said wheels, of a work-holder for sustaining the work between said wheels during the grinding operation, including a work-supporting element having bodily floating movements toward and from the work-engaging faces of said wheels.

3. In a centerless grinding machine, in combination, a grinding wheel, means for rotating said grinding wheel, a work-supporting holder upon which the work is secured, a floating carrier, a journal in said carrier for said work-holder permitting rotating movements of the work, a work-controlling wheel adapted to rotate said work, and means for rotating said work-controlling wheel during the grinding operation.

4. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections

for rotating said wheels, of a work-supporting holder upon which the work is secured for axial rotation therewith, and supporting means for said work-holder permitting floating movements thereof toward and from said grinding wheel during the grinding operation.

5. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections for rotating said wheels, of a work-holder upon which the work is secured for axial rotation therewith between said wheels under the controlling action of the rotating work-controlling wheel, and a work-holder support, said work-holder being journaled eccentrically in said support.

6. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections for rotating said wheels, of a swinging arm, a journal support for said arm, and a work-holder carried by the free end of said arm sustaining the work between said wheels during the grinding operation.

7. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections for rotating said wheels, of a swinging arm, a rotary turret pivotally supporting said arm, means for intermittently rotating said turret, and a work holder carried by said arm sustaining the work between said wheels during the grinding operation.

8. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel and operative connections for rotating said wheels, of a swinging arm, a rotary turret pivotally supporting said arm, means for intermittently rotating said turret, a work-holder carried by said arm sustaining the work between said wheels during the grinding operation, and means for reciprocating said work-holder in a direction transverse to the swinging movements of said arm.

9. In a centerless grinding machine, in combination, a grinding wheel, means for rotating said wheel, a bodily floating work-holder, a work-controlling wheel adapted to frictionally engage the periphery of and thereby rotate the work carried by said work-holder, means for rotating said work-controlling wheel, and means for yieldingly holding the work against said work-controlling wheel during the grinding operation.

10. In a centerless grinding machine, in combination, a grinding wheel, means for rotating said wheel, a bodily floating work-holder, a stop, a spring acting to yieldingly hold said work-holder in a position determined by said stop, a work-controlling wheel, means for rotating said wheel, and operative connections for feeding said wheel

in a direction to rotatably advance the work against the action of said spring into contact with said grinding wheel.

11. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections for rotating said wheels, of a bodily floating work-holder, and means for automatically shifting said work-holder and the work carried thereby from an inoperative position into operative position between said wheels.

12. In a centerless grinding machine, in combination, a grinding wheel, means for rotating said wheel, a bodily floating work-holder rotatably supporting the work, means for automatically shifting said work-holder from an inoperative position into operative position, a work-controlling wheel adapted to rotate the work and advance it into effective engagement with said grinding wheel, and means for actuating said work-controlling wheel.

13. In a centerless grinding machine, in combination, a grinding wheel, means for rotating said wheel, a bodily floating work-holder rotatably supporting the work, means for automatically presenting said work-holder in operative position, a work-controlling wheel adapted to rotate the work and advance it into effective engagement with said grinding wheel, means for actuating said work-controlling wheel, and means for reciprocating said work-holder during the grinding operation.

14. In a centerless grinding machine, the combination with a grinding wheel having an operative work-engaging face, a work-controlling wheel, and operative connections for rotating said wheels, of a work-holder having floating movements toward and from the work-engaging face of said grinding wheel, and means for relatively shifting said work-holder and said grinding wheel during the grinding operation in a direction substantially parallel with the work-engaging face of the grinding wheel.

15. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections

for rotating said wheels, of a floating work-holder, and means for relatively shifting said grinding wheel and work-controlling wheel to operatively engage the work carried by said work-holder.

16. In a centerless grinding machine, the combination with a grinding wheel, a work-controlling wheel, and operative connections for rotating said wheels, of a floating work-holder, and means for relatively shifting said work-controlling wheel and work-holder to rotatably engage the work carried by said work-holder.

17. In a centerless grinding machine, the combination with a grinding wheel having an active work-engaging face, means for rotating said grinding wheel, and a work-controlling wheel having a work-engaging face opposed to said grinding wheel face and disposed to control rotation of the work, of a work-holder including a work-supporting element rotatable with the work upon an axis substantially parallel with the work-engaging faces of said wheels.

18. In a centerless grinding machine, the combination with a rotary grinding wheel having an operative work-engaging face, means for rotating said wheel, and a work-controlling wheel having a work-engaging face opposed to that of the grinding wheel for controlling rotation of the work, of a work-holder including an element axially sustaining the work for rotation between said wheels, and means for reciprocating said work-holder in a direction substantially parallel with the work-engaging face of the grinding wheel during the grinding operation.

19. In a centerless grinding machine, the combination with work-controlling and grinding wheels having opposed work-contacting faces, of work-supporting means having free floating movements in directions toward and from the operative faces of said wheels.

In testimony whereof, I have signed my name to this specification.

WILBUR J. PEETS.