March 24, 1925. 1,530,488

F. E. GARDNER

GRINDING MACHINE

Filed June 20, 1921 5 Sheets-Sheet 1

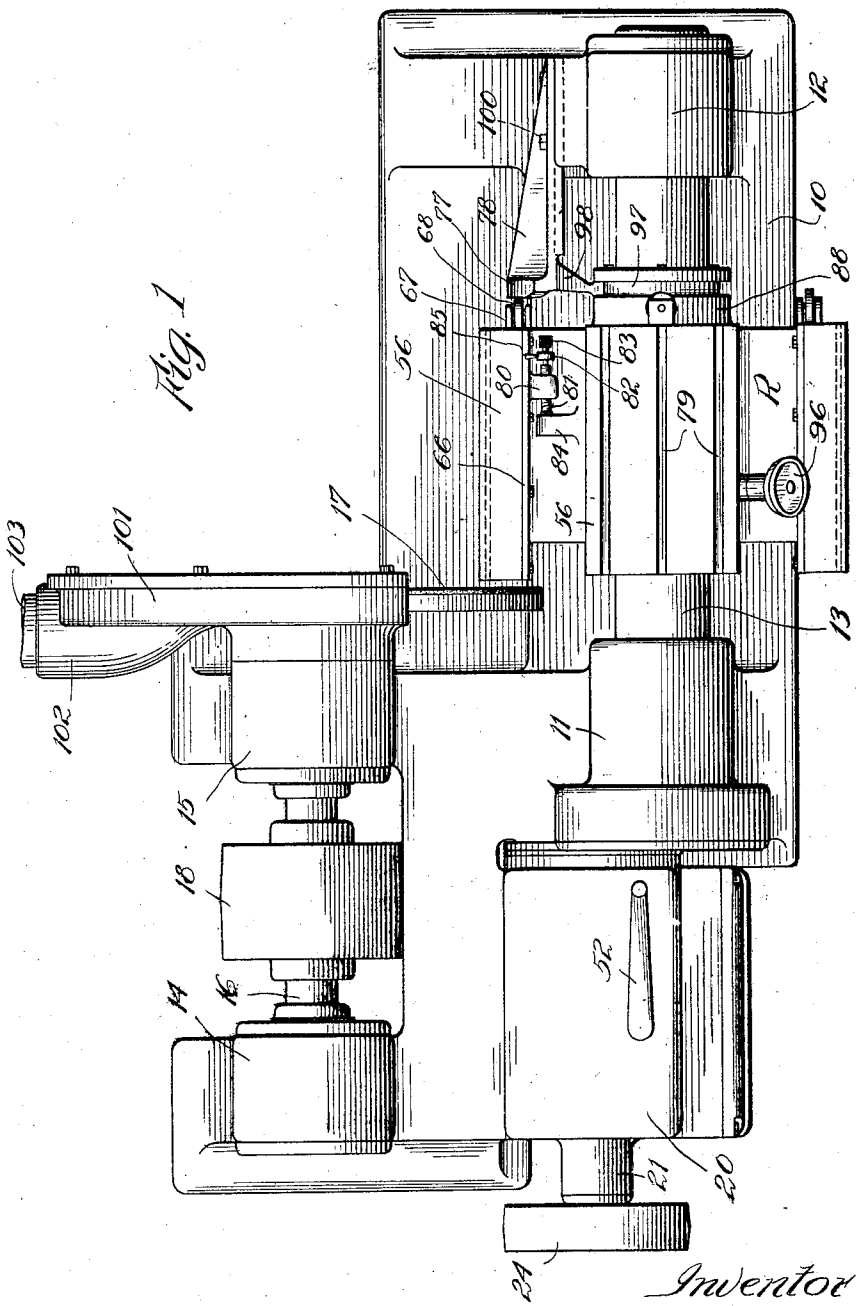


Fig. 1

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Fig. 2

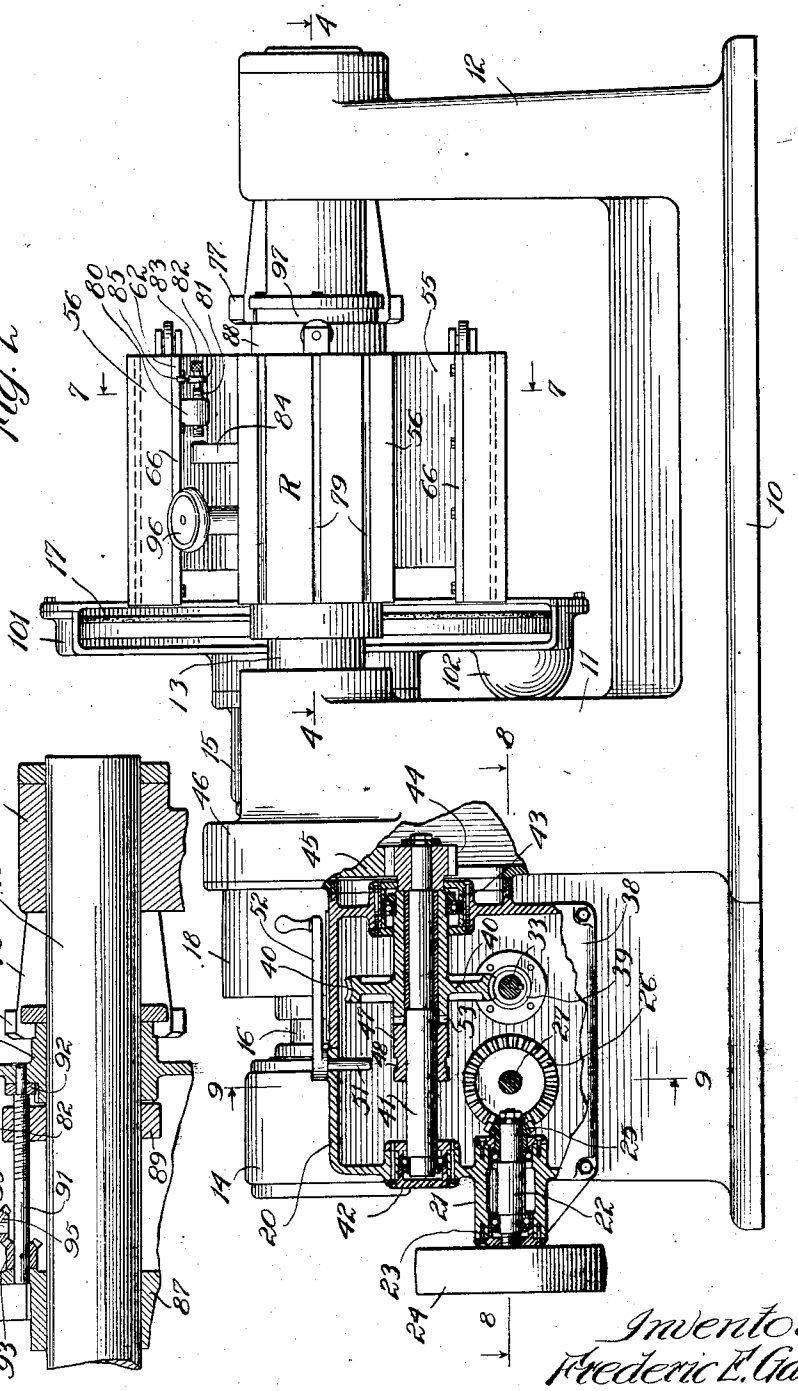


Fig. 3

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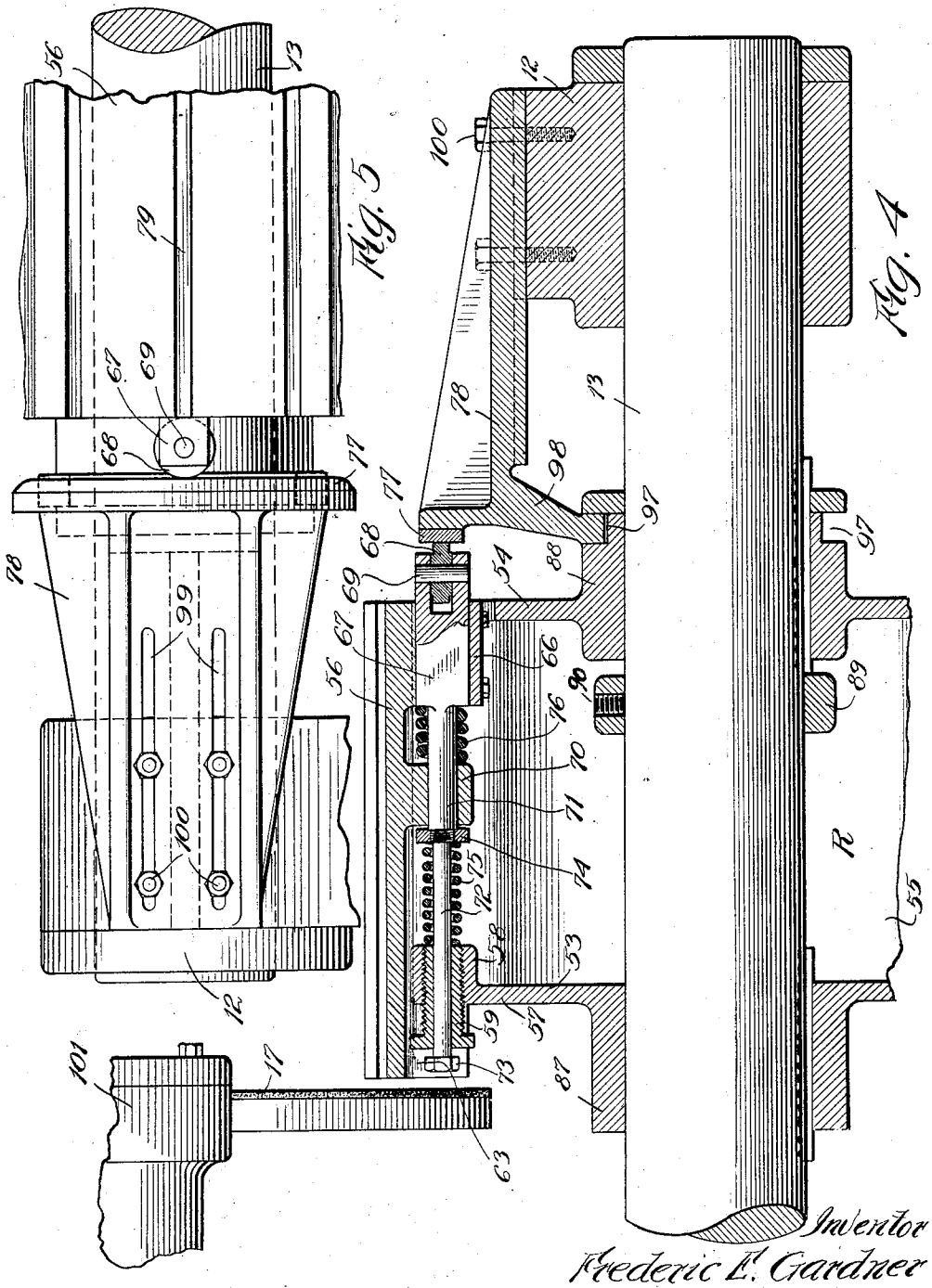


Fig. 5

Fig. 4

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GRINDING MACHINE

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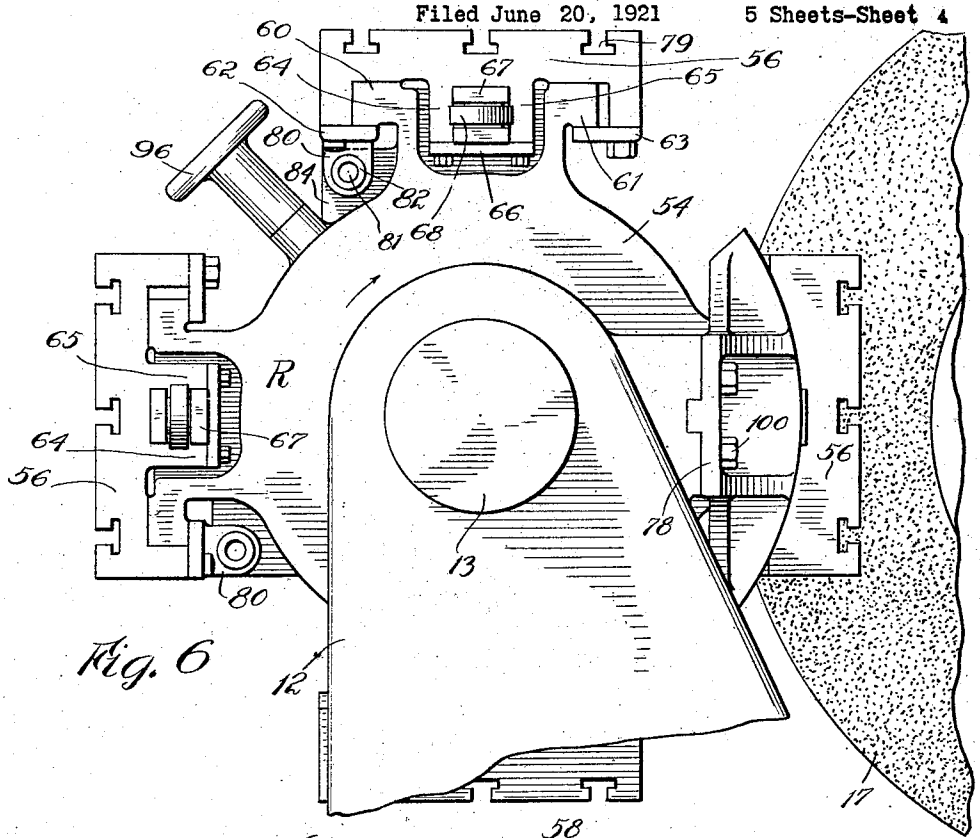


Fig. 6

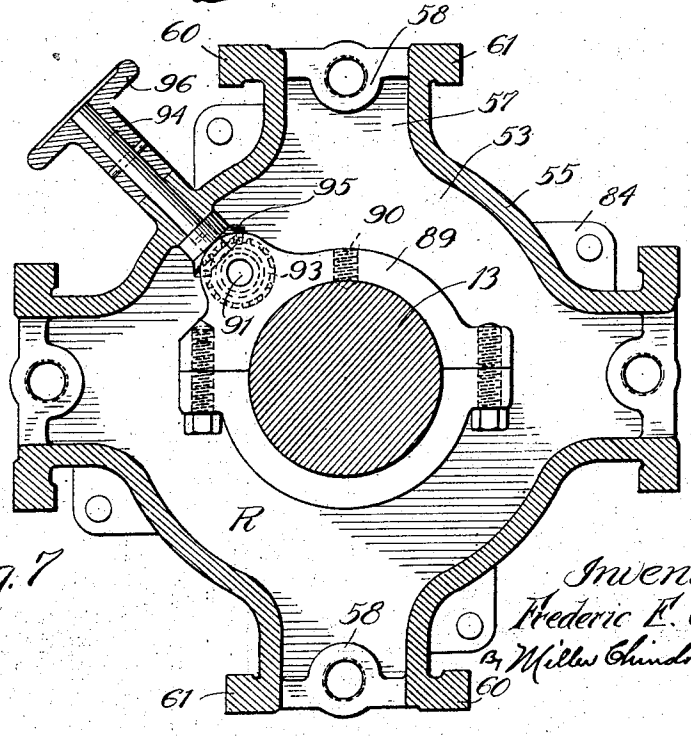


Fig. 7

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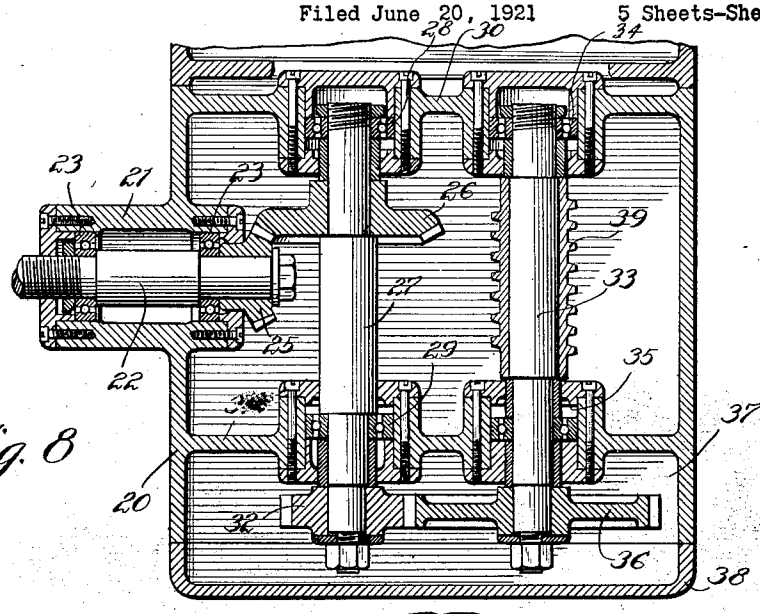


Fig. 8

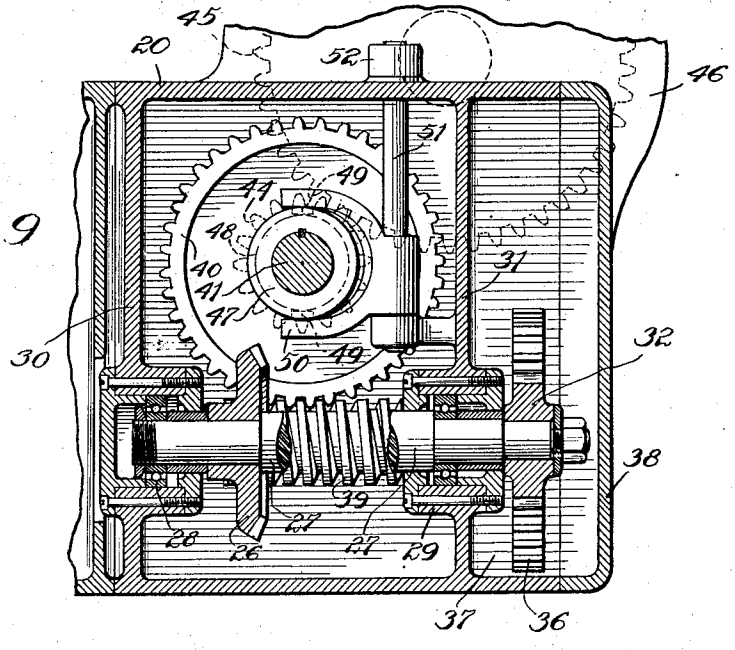


Fig. 9

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Patented Mar. 24, 1925. 1,530,488

UNITED STATES PATENT OFFICE.

FREDERIC E. GARDNER, OF BELOIT, WISCONSIN.

GRINDING MACHINE.

Application filed June 20, 1921. Serial No. 478,829.

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.

My invention relates to grinding machines of the type in which a revolvable work holder is associated with a rapidly revolving grinding disk to successively present to the grinding wheel objects to be ground.

One of the important objects of the invention is to provide improved arrangement in which a grinding disk is mounted to revolve about a horizontal axis, and the work holder in the form of a reel is also mounted to rotate about a horizontal axis, the axes being offset so that the holder will successively carry objects across a portion of the grinding wheel.

Another important object is to provide transversely shiftable tables on the work carrier and improved means for successively shifting said tables to present to the grinding wheel objects which have been secured on the table.

Another important object of the invention is to provide improved cam and spring mechanism for controlling shifting of the tables. A further object is to provide yielding means for exerting the required pressure on the tables to cause work thereon to be powerfully applied against the grinding wheel, together with means for positively limiting the travel of the tables to insure the proper degree of grinding.

Another important feature of the invention resides in means for bodily adjusting the work holder structure on its supporting shaft and without destroying the adjustment of the table shifting mechanism.

The above and other features of my invention are incorporated in a machine disclosed on the accompanying drawing, it being understood that changes and modifications could readily be made which would still come within the scope of my invention.

On the drawings,

Figure 1 is a plan view,

Fig. 2 is a side elevational view partly in section to disclose the gearing train,

Fig. 3 is a diametrical sectional view through the work carrier reel showing the micrometer top adjustment and the means for bodily adjusting the reel,

Fig. 4 is an enlarged sectional view on plane 4—4, Fig. 2,

Fig. 5 is a plan view of the parts shown in Fig. 4,

Fig. 6 is an enlarged end view from the right of Fig. 2,

Fig. 7 is an enlarged sectional view on plane 7—7, Fig. 2,

Fig. 8 is an enlarged sectional view on plane 8—8, Fig. 2, and

Fig. 9 is an enlarged sectional view on plane 9—9, Fig. 2.

Generally speaking, the machine comprises a grinding disk mounted on a horizontal axis, and a work carrier structure rotatable on a horizontal axis which is parallel with but offset from the axis of the grinding disk. The work carrier has a plurality of guideways for work supporting tables and cam mechanism is provided for shifting these tables at the proper time to carry work thereon into engagement with the grinding disk, the work carriers being carried with the work carrier structure to be swept across the disk while the disk is rotated. Means are provided for forcibly though yieldably shifting the work holder tables to apply the work thereon to the grinding disk and micrometer setting mechanism is provided for determining the amount of grinding that is to be performed on the object so that accurate grinding will result.

Referring to the drawings, on the bed plate 10 are the bearing pedestals 11 and 12 which at their upper ends journal the shaft 13 on which is supported the work supporting drum or reel structure designated as a whole R. At the other end of the machine are the bearing pedestals 14 and 15 which journal at their upper ends the shaft 16 which supports the grinding disk 17. The shafts 13 and 16 are horizontal and parallel but are offset laterally a distance as clearly shown in Fig. 1. On the shaft 16 is provided the pulley 18 by which the shaft may be rapidly rotated as by means of a belt.

The driving means for the reel R are clearly shown in Figs. 2, 8 and 9. The transmission trains controlling the rotation of the reel are within the protecting housing 20 which forms part of the machine supporting framework. On one of the side walls of the housing is the cylindrical part 21

through which extends the drive shaft 22 to be suitably journaled at its end preferably on anti-friction bearing mechanism 23. At the outer end of the shaft is the driving pulley 24 and at the inner end of the shaft is the bevel pinion 25. The pinion meshes with the bevel gear 26 secured on the rear end of the shaft 27 which is journaled in suitable bearing boxes 28 and 29 supported on the intermediate walls 30 and 31 of the housing structure 20. The shaft 27 is horizontal and extends at right angles to the shaft 22 and at its front end carries the gear pinion 32. A countershaft 33 extends parallel alongside of the shaft 27 and is journaled in suitable bearing structures 34 and 35 supported on the intermediate walls 30 and 31. At its front end the shaft 33 carries the spur gear 36 which meshes with the gear pinion 32. The gear and pinion are within the compartment 37 in front of the wall 31 which compartment is accessible by virtue of the removable cover 38 so that the gear and pinion may be readily changed to adjust the transmission relation between the shafts 27 and 33.

Between the bearing structures 34 and 35 the shaft 33 carries the worm 39 which meshes with the worm wheel 40 rotatable on the shaft 41. This shaft is above the shafts 27 and 33 and extends horizontally at right angles to such shafts and is suitably journaled in bearing structures 42 and 43 in the side walls of the housing frame 20. At its outer end the shaft 41 supports the gear pinion 44 which meshes with the gear wheel 45 secured to the reel shaft 13 and protected within the housing 46. Through the gearing train just described the reel shaft is slowly but powerfully driven.

Clutch mechanism is provided for controlling the rotation of the reel. On the shaft 41 is splined the clutch collar 47 which has the annular groove 48 for receiving the pins 49 extending from the fork frame 50 which is secured to the shaft 51 to swing when the shaft is rotated by means of its lever 52. The adjacent ends of the clutch collar and gear have clutch projections 53. When the lever 52 is swung in one direction the clutch fork will shift the collar to carry the clutch projection into engagement so that the shaft 41 will be connected to be rotated with the worm wheel 40. When the lever 52 is swung in the opposite direction the parts are unclutched and the worm wheel rotates idly on the shaft 41 and the carrier is at rest.

The work carrier R is in the form of a cylindrical shell comprising the end walls 53 and 54 and the cylindrical wall 55. The reel frame has a number of radial extensions forming seats for the work holding tables 56. The details of these extensions are clearly shown in Figs. 6 and 7. The inner wall 57 of each extension is a continuation of the reel side wall 53 and has the threaded sleeve 58 formed thereon parallel with the reel axis for receiving a threaded abutment bushing 59. The sides of each extension are formed by continuations of the cylindrical wall 55 of the reel. The ends of the side walls have flanges 60 and 61 whose upper faces form the seats for the respective work holding tables 56. Strips 62 and 63 are secured to the under sides of each table 56 and engage against the under sides of the flanges 60 and 61 to thus hold the table on the extension, the table being free to slide on the extension in a direction parallel with the reel axis. At its outer end each table 56 has the walls 64 and 65 depending between the side walls of the extension and connected together at their lower ends by a plate 66, the walls and plate forming a rectangular passageway for a slider block 67 whose outer end is bifurcated for the reception of a cam roller 68 pivoted on the pin 69 which extends radially (Fig. 4). A distance inwardly of the cam block passageway each table has a lug 70 through which extends the stem section 71 of the cam head, the stem section 72 being a continuation of the section 71 but of reduced diameter and extending through the threaded bushing 59 and engaged at its outer end by the abutment nut 73. At the base of the reduced stem section 72 is the nut 74 between which and the inner end of the bushing 59 is the compression spring 75. On the stem section 71 between the cam block 67 and the lug 70 is the spring 76. The spring 75 is thus interposed between the reel frame and the slidable table and the spring 76 travels with the table. The spring 75 is lighter than the spring 76 and resists inward travel of the table and tends to shift the table and the cam block outwardly so that the cam rollers 68 may engage successively with the cam rail 77 supported on the inner end of the bracket 78 which is adjustably mounted on the side of the bearing pedestal 12.

The tables 56 have grooves 79 therein for receiving clamping bolts by means of which work or work holder fixtures may be secured on the tables. In the arrangement shown the shafts 16 and 13 are horizontal with the reel shaft in front of the grinder shaft, the reel overlapping the grinding wheel a sufficient distance so that the work carried on the tables 56 will be swept across the wheel between its periphery and axis. As the reel rotates the cam rollers will successively encounter the cam rail 77, the result of such engagement being inward shift of the tables to apply the work thereon against the grinding wheel, the spring 75 being free to shift the tables outwardly after they have passed across the grinding field.

The objects to be ground are applied at

the front of the machine and are accurately positioned on the tables in correspondence with the amount of grinding desired. Before a roller reaches the cam rail the spring 75 shifts the cam block with its stem outwardly with the abutment head 73 against the bushing 59. When a roller encounters the rail its cam block will be shifted inwardly but resisted by the spring 75 primarily. Inward shift of the cam block will be transmitted through the heavy spring 76 to the lug 70 and to the work holding table. The rollers do not engage the cam rail until the work on the tables has been brought into the grinding field in front of the grinding disk. Then when the cam rollers engage the rail the tables will be urged powerfully though yieldably toward the grinding disk through the spring 76 and the work on the table will be ground. The spring 76 projects the machine against injury which might result from irregularities during grinding if the cam roller were directly mounted on the work holding table. After a cam roller leaves the cam rail the corresponding spring 75 will be free to shift the table outwardly to its normal position. The force of the spring 75 can be readily adjusted by means of the threaded abutment bushing 59.

In order to accurately limit the travel of the work holding tables to insure accurate grinding, I provide micrometer setting mechanism in connection with each table. Such mechanism is clearly shown in Figs. 1, 2 and 3. Each table has a lug 80 depending therefrom for supporting a micrometer screw 81, which screw carries a micrometer dial 82 and has the knurled head 83. For each micrometer screw 82 an abutment wall 84 is provided on the reel framework. Upon turning of the micrometer screw the pointer 35 will indicate on the dial the width of the gap 86 between the screw and its abutment 84, the width of gap determining the amount of grind on the work supported on the respective table. In Fig. 3 the gap shows. In Fig. 1 the cam roller for the rear table is in engagement with the cam rail and the gap is closed, the micrometer screw abutting against its lug to prevent further movement of the table toward the grinding wheel. The cam rail is so positioned that the cam block 67 will be shifted inwardly a greater distance than the adjusted distance between the micrometer screws and abutments. With this arrangement the compression springs 76 will always exert pressure against the tables until the work thereon has been fully ground, that is, until the micrometer screws engage with the abutments to positively stop further movement of the tables. In other words the throw of the cam blocks by the cam rails is sufficient to cause enough compression energy to be stored in the spring 76 that they may exert sufficient grinding pressure until the tables are positively stopped by the micrometer screws and their abutments.

By suitable gauge blocks or by first securing work holding fixtures on the tables objects can be quickly and accurately mounted on the tables for accurate grinding. Sometimes, in view of the nature of the work, or on account of its irregular shape, parts to be ground may have to extend radially inwardly across the inner end of the table. To provide for this I make the reel adjustable as a whole on its supporting shaft. Accordingly the hubs 87 and 88 of the reel frame are splined on the shaft 13 as shown in Fig. 4, and between the hubs a split collar 89 is clamped and rigidly secured by a set screw 90. Journaled in the side walls 53 and 54 of the reel frame is the shaft 91 which threads through the collar 89 and is held against longitudinal movement by the collar 92 and bevel gear 93 secured thereto (Fig. 3). Journaled in the cylindrical wall 55 of the reel structure and extending at right angles to the shaft 91 is the shaft 94 which at its inner end carries the bevel gear 95 and at its outer end has the head 96, the gear 95 meshing with the gear 93. Upon turning of the head 96 the shaft 91 will be turned and the reel frame will be adjusted on its shaft 13 toward or away from the grinding wheel. The reel frame can thus be readily moved away from the grinding wheel to allow for overhanging or projecting parts on castings, or the adjustment can also serve for accurately shifting the reel frame inwardly to compensate for grinding wear on the grinding wheel.

In order to maintain the proper relationship between the cam rollers and the cam rail, the rail supporting bracket 78 is shifted with the reel frame during adjustment thereof. The hub 88 is provided with the annular groove 97 into which extends the arm 98 on the bracket 78, and the bracket has the slots 99 for its bolts 100. Before adjustment of the reel frame is made the bolts 100 are loosened so that the bracket 78 may shift, and after adjustment the bolts are again tightened. The camming adjustment between the bracket 78 and the respective work holding tables will therefore be maintained during any adjustment of the reel frame.

It will be noted that the gearing and all the operating and adjusting parts of the machine are well protected against grinding dust and also to make operation of the machine safe. The grinding wheel 17 except for the section with which the reel co-operates is surrounded by a housing 101 and an outlet 102 on this housing may be connected by pipe 103 with a suction device for conveying away the grinding dust.

The operator stands in front of the ma-

chine and applies the work to the supporting tables. Usually, work supporting fixtures are permanently attached on the tables into which the objects to be ground can be quickly and accurately clamped in proper position with reference to the grinding wheel. If necessary the operator can quickly stop the work supporting reel by swinging the lever 52 which controls the clutch mechanism already described. As the reel revolves comparatively slowly the micrometer screws 81 can be set while the reel is revolving, and the bodily adjustment of the reel structure toward or away from the grinding wheel can also be readily made while the reel is revolving by turning the head 96 of the adjusting mechanism. The machine as a whole is of simple and economical construction and is very efficient.

I claim as my invention:

1. A grinding machine having, in combination, a grinding element rotatable on a horizontal axis, a cylindrical drum having a plurality of longitudinal ways on its peripheral surface, said drum being rotatable on a horizontal axis offset from the axis of said grinding element whereby said drum and said element will partially overlap, fixtures on said ways for supporting a plurality of work blanks at various stations about the periphery of said drum, means including a cam for effecting a relative movement of said grinding element and one of said fixtures toward each other when said fixture is carried across the face of said element, and resilient means for opposing said movement.

2. In a grinding machine, the combination of a grinding wheel, a work supporting structure, a work holding table shiftable on said structure, means for moving said structure to position the table in front of said wheel with an object thereon against said wheel ready to be ground, a stationary lug on said table, a shiftable block thereon, an elastic member between said lug and block, and means engaging with said shiftable block during movement of said structure whereby energy is stored in said elastic member and said energy expended in forcing said table toward the grinding wheel whereby work thereon is ground.

3. In a grinding machine, the combination of a grinding wheel, a work supporting structure, a work holding table shiftable on said structure, means for moving said structure to position the table in front of said wheel with an object thereon against said wheel ready to be ground, a stationary lug on said table, a shiftable block thereon, an elastic member between said lug and block, means engaging with said shiftable block during movement of said structure whereby energy is stored in said elastic member and said energy expended in forcing said table toward the grinding wheel whereby work thereon is ground, and adjustable means for limiting the movement of said table toward said wheel.

4. A grinding machine having, in combination, a grinding element, a work supporting drum mounted in overlapping relation with said element, said drum having a plurality of ways on its periphery for supporting a series of work blanks at different stations around said drum, means for automatically and selectively effecting a relative movement of each work blank and the grinding element toward each other when said work blank is carried opposite said element, means for limiting the extent of said movement and means for separating said grinding element and said work blank after the grinding operation is completed.

5. In a grinding machine, the combination of a grinding wheel, a work supporting structure, a work holding table shiftable on said structure, means for moving said structure to position said table in front of the grinding wheel to present work thereon to said wheel, a light spring tending to shift said table out, a lug on said table, a block on said table, a compression spring between said lug and block, and a cam means in the path of said cam block when said structure is moved to position said table, engagement of said shiftable abutment with said cam means causing said compression spring to be compressed and said table shifted inwardly against the force of said light spring to yieldingly press work on the table against the grinding wheel.

6. In a grinding machine, the combination of a grinding wheel, a work supporting structure, a work holding table shiftable on said structure, means for moving said structure to position said table in front of the grinding wheel to present work thereon to said wheel, a light spring tending to shift said table out, a lug on said table, a shiftable block on said table, a compression spring between said lug and shiftable block, a stationary rail in the path of said shiftable block when said structure is moved to position said table, engagement of said shiftable block with said stationary rail causing said compression spring to be compressed and said table shifted inwardly against the force of said light spring to yieldingly press work on the table against the grinding wheel, and adjustable means for limiting the inward movement of said table.

7. In a grinding machine, the combination of a grinding wheel, a work supporting structure movable in a direction parallel with the grinding face of said wheel, a work holding table shiftable on said structure in a direction at right angles to the grinding face, movement of said structure serving to position said table in front of the

grinding face to bring work thereon into grinding position, a cam block traveling with said structure, a compression spring between said block and said table, a cam in the path of said block when said structure is moved to position said table, engagement of said cam and block causing compression of said spring and yieldable inward movement of said table to press work thereon against the grinding wheel, and means for bodily adjusting said structure in a direction at right angles to the grinding face of said grinding wheel.

8. In a grinding machine, the combination of a grinding wheel, a work supporting structure movable in a direction parallel with the grinding face of said wheel, a work holding table shiftable on the periphery of said structure in a direction at right angles to the grinding face, movement of said structure serving to position said table in front of the grinding face, means tending to hold said table out whereby work supported thereon may be brought into grinding position in front of the grinding wheel, adjustable stop mechanism for limiting the inward movement of said table and thereby determining the depth of grinding, a compression spring for said table, and means for compressing said spring during movement of said structure and to an extent greater than the grinding depth whereby said table will be yieldably forced by the relaxation of said spring to press the work against the grinding wheel until the table is stopped and the work has been fully ground.

9. In a grinding machine, the combination of a grinding wheel, a shaft, a work supporting structure on said shaft adapted to rotate therewith in a plane parallel with the grinding face of said wheel, work holding tables shiftable transversely on said structure in a direction at right angles to the grinding face, revolving of said structure serving to successively position said tables in front of the grinding face to bring work thereon into grinding position, cam mechanism effective during revolving of said structure to shift the tables inwardly after positioning thereof to thereby apply the work to the wheel to be ground, said supporting structure being longitudinally shiftable on said shaft, an abutment fixed on said shaft against longitudinal movement thereon, and an adjusting train between said abutment and said structure operable to shift said structure longitudinally on said shaft.

10. In a grinding machine, the combination of a grinding wheel, a work supporting frame, work holding tables reciprocable on said frame, said frame being revolvable to successively position said tables in front of the grinding wheel, said tables being reciprocable toward and away from the grinding wheel to present work thereon to the grinding face, cam-engaging means for each table, a cam rail supported in the path of said cam-engaging means when said supporting frame revolves whereby said tables are successively shifted inwardly to cause work thereon to be applied to the grinding wheel, means for bodily adjusting said supporting frame toward and away from the grinding face, and a connection between said cam rail and said frame for causing said rail to be shifted with said frame during bodily adjustment thereof whereby the camming relation between said rail and the table cam-engaging means is maintained.

11. In a grinding machine of the class described, the combination of a grinding wheel, a work supporting frame, work holding tables having work retaining grooves and being shiftable on the periphery of said frame, said frame being revolvable to successively position said tables in front of the grinding wheel and said tables being shiftable toward and away from the grinding face to present work thereto, a movable block for each table, a compression spring between each table and its movable block, a cam positioned in the path of said movable blocks when said supporting frame revolves whereby said springs are successively compressed to have energy stored therein to be expended in yieldably forcing the tables toward the grinding face to cause work thereon to be ground, and adjustable stop mechanism for each table for limiting the inward movement thereof by the associated spring.

12. A grinding machine having, in combination, a grinding disk rotatable on a horizontal axis, a work supporting frame revolvable on a horizontal axis offset from the axis of the grinding disk whereby said frame and disk will only partially overlap, radial extensions on said frame, seats formed on said extensions, transversely shiftable tables mounted on said seats, and means for shifting said tables when in overlapping position with reference to said grinding disk whereby work on said tables will be presented to said disk to be ground.

13. A grinding machine having, in combination, a revolving grinding wheel, a cylindrical work supporting frame, radial extensions on said frame formed by continuations of the cylindrical wall of said frame, flanges on said extensions, work supporting tables mounted on said flanges and adapted to be successively carried by said frame into grinding position with reference to said wheel, and means for shifting said tables when in such grinding position whereby work thereon is presented to the grinding wheel.

14. A grinding machine having, in combination, a rotatable grinding wheel, a work supporting structure, a work holding table

slidable on said structure toward and away from said wheel, a stationary lug on said table, a second lug having a passageway therethrough on said table, a cam block slidable within said passageway and having a stem passing through said first mentioned lug, spring means on said stem and between said lugs, and cam means for compressing said spring means to force said table against said wheel.

15. A grinding machine having, in combination, a grinding wheel, a revolvable supporting frame having ways on its periphery, a plurality of transversely shiftable work supporting tables on said ways and having grooves for securing work thereto, said tables being adapted to be carried into grinding position with reference to said wheel, and means for shifting said tables along said ways when in such grinding position whereby work thereon is presented to the grinding wheels.

16. A grinding machine having, in combination, a grinding wheel, a movable work supporting structure, a work holding table shiftable on said structure, resilient means tending to hold said table outward with respect to the grinding wheel, resilient means for pressing said table against the grinding wheel, means for limiting the movement of said table toward the grinding wheel, and means for limiting the effectiveness of said first-mentioned resilient means in moving the table outwardly.

17. A grinding machine having, in combination, a grinding wheel, a shaft, a work supporting frame slidably mounted on said shaft, a collar within said frame secured to said shaft, a shaft journaled in the side walls of said frame and having threaded engagement with said collar, and means for rotating said last mentioned shaft to bodily adjust said frame along said first-mentioned shaft.

In testimony whereof, I have hereunto set my hand.

FREDERIC E. GARDNER.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,530,488, granted March 24, 1925, upon the application of Frederic E. Gardner, of Beloit, Wisconsin, for an improvement in "Grinding Machines," errors appear in the printed specification requiring correction as follows: Page 3, line 20, for the word "projects" read *protects;* page 4, line 95, claim 5, strike out the word "cam," and line 97, for "shiftable abutment" read *block;* same page, line 127, claim 7, after the word "on" insert the words *the outer periphery of;* page 5, line 2, claim 7, after the article "a" strike out the word "cam"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of May, A. D. 1925.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.