March 2, 1926. 1,575,520

W. D. ARCHEA

WORK CARRYING DEVICE FOR GRINDING MACHINES

Filed Jan. 16, 1924 3 Sheets-Sheet 1

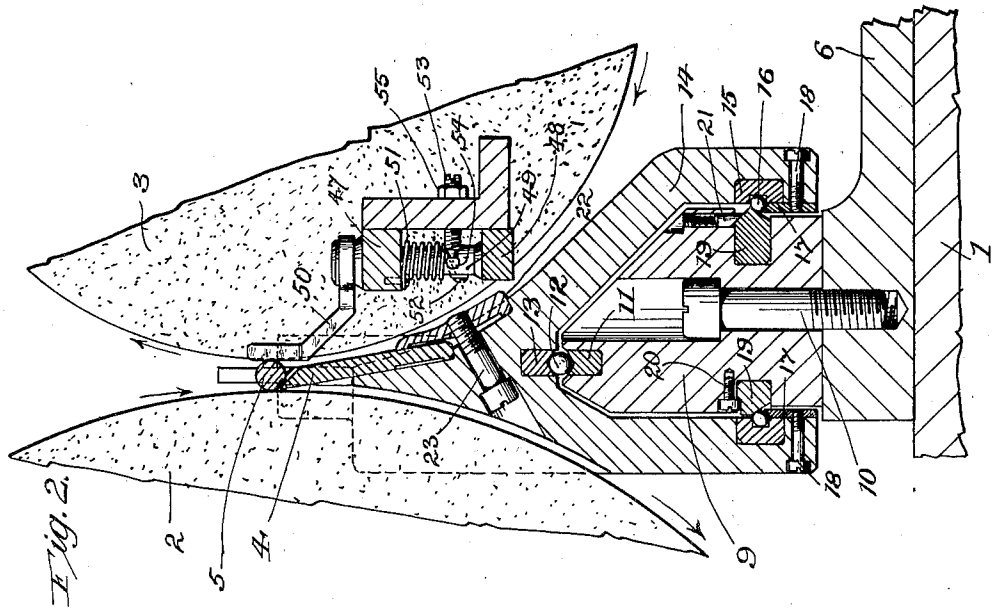


Fig. 2.

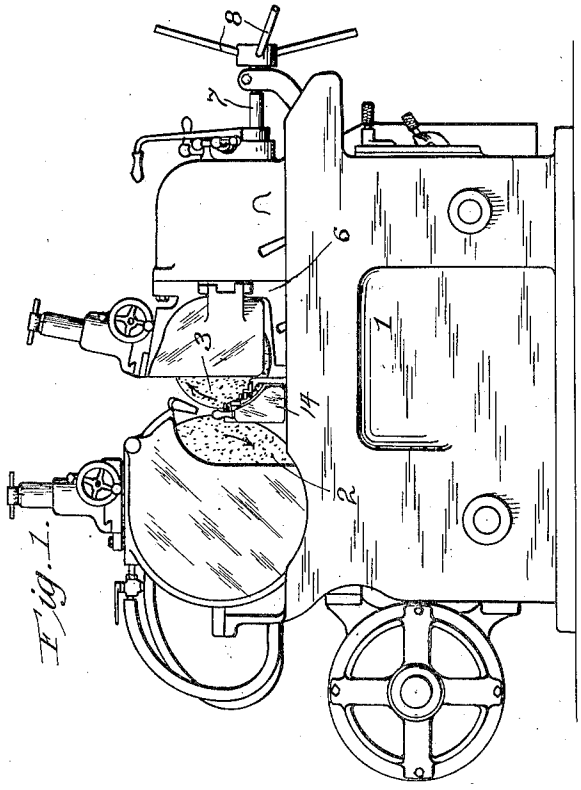


Fig. 1.

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Filed Jan. 16, 1924 3 Sheets-Sheet 2

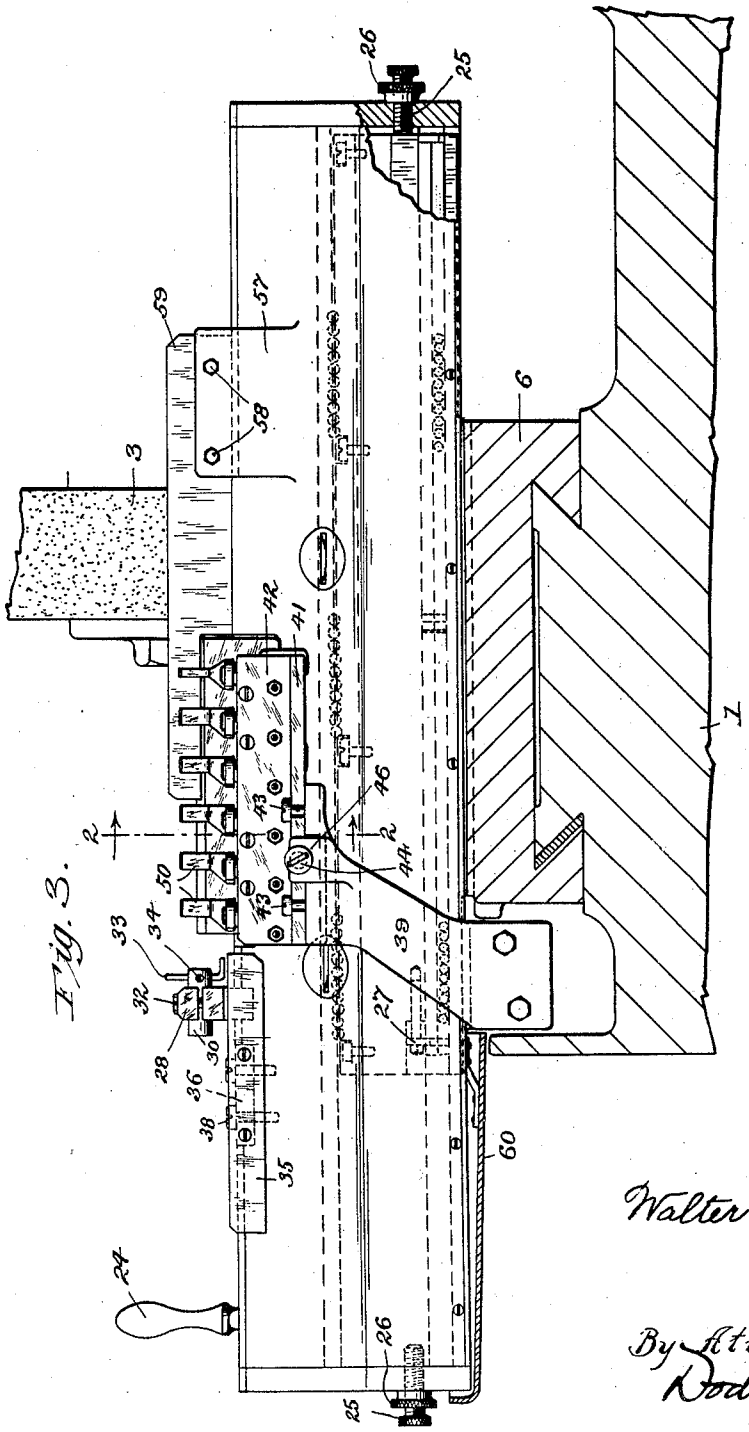


Fig. 3.

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Filed Jan. 16, 1924 3 Sheets-Sheet 3

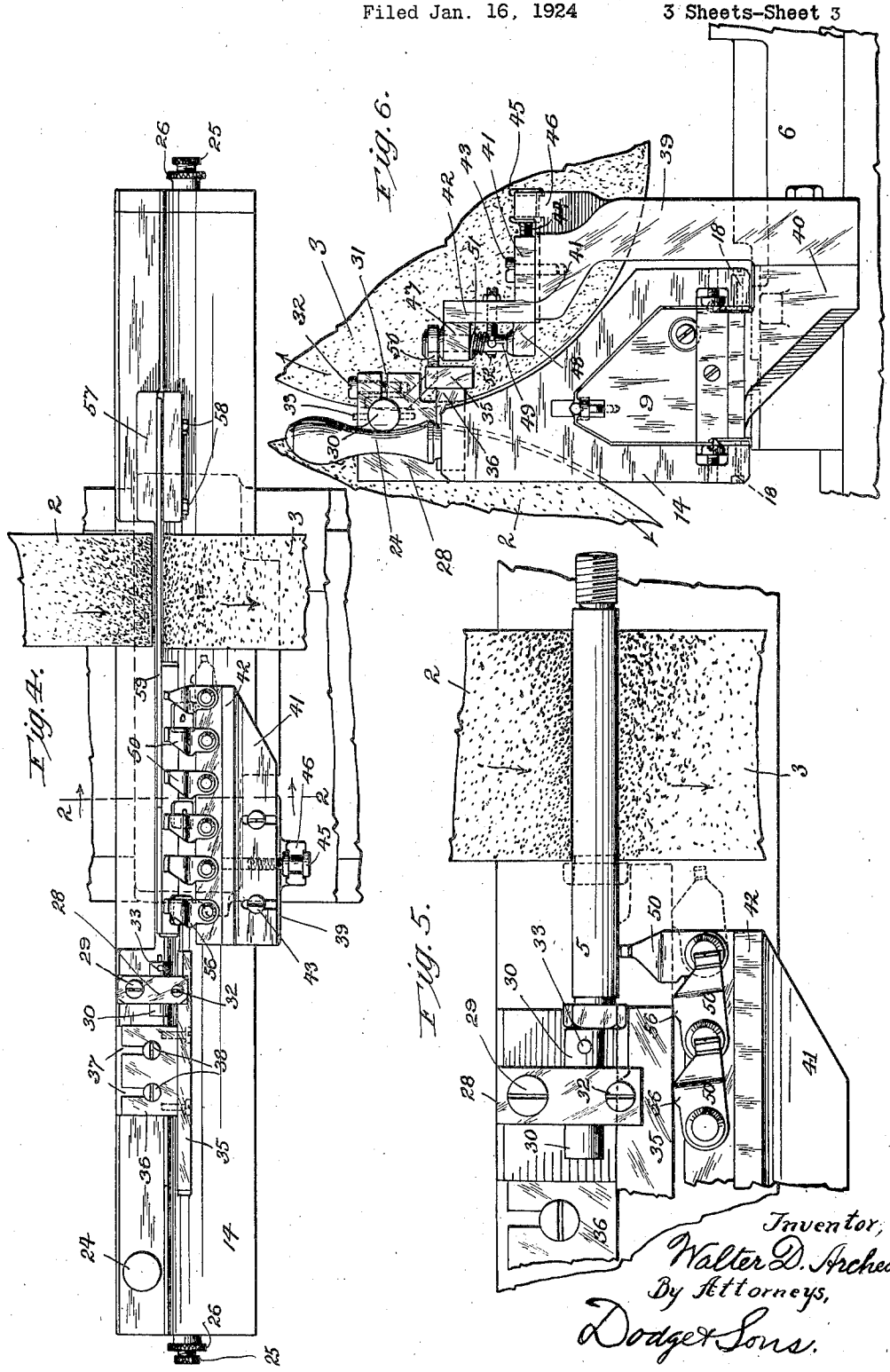


Fig. 4.

Fig. 5.

Fig. 6.

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Patented Mar. 2, 1926. 1,575,520

UNITED STATES PATENT OFFICE.

WALTER D. ARCHEA, OF NORWOOD, OHIO, ASSIGNOR TO THE CINCINNATI MILLING MACHINE COMPANY, OF CINCINNATI, OHIO, A CORPORATION OF OHIO.

WORK-CARRYING DEVICE FOR GRINDING MACHINES.

Application filed January 16, 1924. Serial No. 686,653.

To all whom it may concern:

Be it known that I, WALTER D. ARCHEA, a citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Work-Carrying Devices for Grinding Machines, of which the following is a specification.

This invention pertains to machines for grinding objects or portions of objects to circular form in cross section, either cylindrical or tapering, and has reference particularly to means for introducing such objects into and withdrawing them from grinding position between a grinding wheel or disk and a coacting wheel or disk which effects, or governs, or effects and governs, the rotation of the object ground.

A special feature of the invention resides in means for holding the work or object treated upon the rest or support which sustains it at proper level while being ground, such holding means being designed to permit the passage of an enlargement, head or shoulder of the work or object up to the grinding member.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of a grinding machine of one of the types in connection with which the present invention may be advantageously employed;

Figure 2 is a transverse sectional view on the line 2—2 of Figs. 3 and 4;

Figure 3 is a front elevation of the feeding device or attachment looking toward the grinding wheel, the bed or base of the machine and the slide which carries the governing wheel being shown in section:

Figure 4 is a top plan view of the device showing its relation to the grinding and the governing or regulating wheels;

Figure 5 is a plan view of parts of the device of Fig. 4, shown on an enlarged scale and with the work or blank in grinding position;

Figure 6 is an end elevation of the feeding device, sufficient of the grinding and governing wheels being shown to indicate the relation of said feeding device thereto.

The mechanism here illustrated and about to be described is designed for use with grinding machines employing a grinding wheel, disk or element; a governing wheel, disk or element; and an interposed work-rest or support upon which the object to be ground rests and by which it is supported in proper relation to the grinding and governing elements while being ground. Such machines are commonly designated as "centerless grinders" because the work piece is not mounted on centers. There are various types of centerless grinders differing from each other primarily in the forms of the grinding element and the governing element and in the way in which these elements are presented to the work piece. All centerless grinders have in common the characteristics that these two elements are opposed to each other, that the work rest extends between the opposed faces, and that the relative speeds of the grinding and governing elements are so chosen that the governing element regulates the rotation of the work piece and the grinding element grinds the work piece as the latter rotates. In the particular type of machine here illustrated, the grinding and governing wheels or elements are peripherally opposed, and the work-rest or support extending between them serves to support the work while being rotated through frictional contact with the relatively slow-turning governing wheel, and while being ground by the rapidly turning grinding wheel. To effect this action the two wheels rotate in the same direction about their respective axes, (clockwise as viewed in Figs. 2 and 6 of the accompanying drawings), so that the grinding wheel is caused to move downward relatively to the work-rest and work, and the governing or regulating wheel is caused to move upward relatively thereto.

Another known type of centerless grinder uses disks which grind on their side faces. The disks are usually made slightly conoidal or in frusto-conical form, and their shafts or arbors are set at a slight inclination one to the other, so that while the disks stand face to face throughout their area, said faces diverge at one side of their axes but are parallel at the opposite side thereof along a given line or plane, which is the plane of contact of said disks with opposite sides of the work or blank being ground. The work-rest in such cases extends between the opposed conoidal faces at that side of their axes on which said faces are parallel in the grinding plane, and the disks rotate in opposite directions about their respective axes

in order that the grinding disk shall move downward toward the work and work-rest, and that the governing or regulating member shall move upward relatively thereto.

In another known type of centerless grinder using face grinding disks, the grinding disk and the governing disk are carried by shafts or arbors whose axes are parallel, or substantially so, but offset so that the two disks overlap to approximately one-half their diameter. Under such arrangement the disks will rotate in the same direction about their axes to secure a downward movement of the grinding wheel and an upward movement of the governing or regulating wheel relatively to the work-rest and work. Here again the work rest extends between the opposed faces.

In still other forms of centerless grinding machines the two elements are set in angular relation one to the other, that is to say, their arbors or shafts stand in 90 degree, or substantially 90 degree, relation one to the other, and the periphery of one wheel is opposed to the side or radial face of the other. In such relation the grinding member or element moves downward toward the work-rest or support and the governing or regulating member moves upward, and in all these various relations of the grinding and governing elements this downward movement of the grinding and upward movement of the governing element is maintained, the grinding element being caused to move at high velocity, and the governing or regulating element at relatively low velocity or surface speed. In this case also the work rest extends between the opposed faces.

The present invention relates primarily to the work supporting means and is available for use in the form shown or with only minor modifications in centerless grinders of any of the types above enumerated. Generally stated, this work supporting means is available for use in any centerless grinding machine where the grinding and regulating members are so opposed as to offer a grinding passage through which the work carrier may extend and are so driven that one serves to regulate the rotation of the work piece on such carrier while the other abrades the rotating work piece. The type of centerless grinder making use of peripherally opposed wheels is generally regarded as the most satisfactory and for that reason has been chosen for illustrative purposes.

Referring again to the drawings and first to Fig. 1, the numeral 1 indicates the main frame or base of the machine which is preferably of hollow box construction. 2 indicates the grinding wheel and 3 the governing or regulating wheel which, acting in connection with the work-rest 4 and the grinding wheel 2, determines the speed of rotation of the blank or work 5. The grinding and governing elements 2 and 3 are mounted upon shafts or arbors, and rotated at suitable relative speeds by belts passing about pulleys on said arbors or shafts; by gearing; or in any other usual and convenient way of imparting motion to rotary bodies. The shafts or arbors of the wheels 2 and 3 are carried in suitable bearings of supports, either at one or at both sides of the respective wheels, but preferably in the form of a long sleeve bearing at one side to facilitate mounting the wheels upon their respective shafts or arbors and removing them therefrom without disturbing the bearings and shafts.

The bearing or bearings for the grinding wheel may be made adjustable if desired to permit movement of said wheel toward and from the governing or regulating wheel, but in practice I prefer that it or they be fixed in position, since it is of great importance that the grinding wheel mountings be as rigid as possible to the end that there shall be little or no vibration created by the high speed of rotation of said wheel. This is further ensured by perfect truing and centering of the wheel, best attainable with peripheral grinders.

In the machine as illustrated in Fig. 1 the shaft of the governing or regulating wheel 3 is carried in a bearing or bearings mounted upon and movable with a slide 6 capable of adjustment toward and from the grinding wheel 2 by a screw-shaft 7 provided with a hand-wheel or spoke-wheel 8 by which to turn it in one or the other direction as required.

Various parts and features of the machine indicated in outline in Fig. 1 are not of my invention and will not be here described, but the general features and principle of the machine have been thus outlined to give a better understanding of the relation of the feeding device here set forth to the other parts of the machine.

The device for supporting and guiding the work and introducing it into and withdrawing it from grinding position is preferably carried by the slide 6, which as stated carries the bearing or bearings of the governing or regulating wheel, but it may be mounted upon the main frame or bed 1 of the machine if desired. This supporting, guiding and feeding mechanism comprises a supporting or guiding member 9 in the form of a bar or block secured by bolts 10 to the slide 6 or to the bed-plate of main frame 1, with its length at right angles to the direction of movement of slide 6, or parallel with the axis of the grinding wheel 2. This support 9 is advisably of the form shown in Figs. 2 and 6 having vertical longitudinal walls beveled or cut away in their

upper portions as seen in said figures, leaving a relatively narrow top portion horizontal. This top portion is channeled to receive a hardened, grooved bar or runway 11 for anti-friction balls or rollers 12, upon which rests and travels a similar hardened bar or runway 13 seated in a groove in a carriage 14 which straddles or encompasses the supporting bar or block 9 and moves longitudinally thereon. The depending walls of the carriage 14, which are slightly set away from the parallel walls of the guide block or bar 9 to afford due clearance, are provided on their inner faces with channeled bars 15 to receive anti-friction balls or rollers 16 which are retained within the grooves or bars 15 by plates 17 secured in place by screws 18. Co-acting bars or runways 19 let into grooves or recesses in the longitudinal upright walls of the guide block or bar 9 complete the ball races or runways, and stops or retainers are provided to prevent escape of the balls at the ends of the bars 11 and 19, one of said stops 27 being shown in dotted lines in Fig. 3. The bars 19 may be held in their seats or grooves by screws 20, as shown in connection with the left-hand bar in Fig. 2, or by spring-pressed beveled plugs 21 as shown at the right-hand side, such holding devices permitting removal of the bars 19 in case they become worn and require renewal or dressing.

The sides of the carriage 14 are in their upper portions curved or fashioned to conform more or less closely to the curvature of the wheels 2 and 3 which they respectively face, thus giving to the upper portion of said carriage a narrowing or wedge-like form, permitting it to extend well up into the space between the grinding wheel 2 and the governing or regulating wheel 3. The face of said carriage opposed to the periphery of the governing wheel 3 is further cut away to afford a seat for the work-rest or support 4, here shown as a flat steel bar, the upper portion of which is beveled or chamfered to produce a thin edge nearest the periphery of the grinding wheel 2, from which point it slopes downward toward the periphery of the governing wheel 3. The work-rest 4 is held firmly to its seat on the carriage 14 by a clamping plate 22, fashioned as shown in Fig. 2 with a rounded bead or bearing edge at its lower boundary, which forms a fulcrum or swinging point for the plate, and with an overhanging lip or edge at its upper boundary to give a relatively narrow face where it bears against the work-rest. The clamping plate 22 is drawn toward and held firmly against the work-rest by screws 23, one of which is seen in Fig. 2.

By providing a plurality of work-rest plates or bars 4 of different width, thickness, and form of upper edge, the device may be readily adapted to support objects of different size, form and material, and of varying shape, as a cylinder of uniform diameter throughout, or of two or more diameters in different portions of its length, or of conical or taper form, all of which may be ground in machines such as here indicated, if the grinding and governing wheels be properly formed and adjusted. This is mentioned here for the purpose merely of indicating the range of use of the feeding and withdrawing device or mechanism described and claimed, but no claim is made in this application to such formation of wheels or such variant grinding per se.

The carriage 14 is made considerably longer than the support 9, and is designed to move upon and relatively to said support a distance somewhat in excess of the length of the objects to be presented by it to the grinding and regulating wheels. It is provided at its outer end with a handle 24 by which it may be manually moved longitudinally, and it is furnished at its ends with screws 25 and jam-nuts 26, forming stops to limit the travel of the carriage in both directions. The heads of screws 25 and the nuts 26 are preferably circular and knurled as indicated, to permit them to be adjusted without the use of tools or wrenches, and the threads are of slight pitch to afford delicate and accurate adjustment. The carriage 14 is further provided on its top and at a point at which it will always stand to the left of the wheels 2 and 3 as viewed in Figs. 3, 4 and 5, with an upstanding block 28 secured to the carriage by a screw 29 or other suitable fastening. This block 28 is provided with an opening to receive a stem 30 the axis of which, when the stem is in place, is parallel with the line of travel of the carriage. To enable said stem to be clamped in adjusted position in said block a slit 31 (see Fig. 6) extends from the stem-receiving opening to the side of the block, and a pinch-screw 32 passing through an opening in the upper arm thus formed and screwing into a tapped hole in the lower arm of block 28, serves to draw the arms together and to clamp or bind the stem 30 in place.

Through the end of the stem 30 toward the wheels 2 and 3 there is formed a hole to receive an L-shaped rest or support 33 which may be vertically adjusted, and when so adjusted is clamped by a set-screw 34. The office of this rest is to support the outer end of the object to be ground, whether that be a plain cylinder of a head or projection of any kind, a hexagon head being indicated in Fig. 5. The stem 30 may be turned in its seat preparatory to being clamped, so that the horizontal arm at its lower end may be caused to stand beneath the work or object to be ground in the vertical plane of the axis of such object.

35 indicates a bar provided with a horizontal wing or plate 36 furnished with slots 37 by which the plate and bar are made horizontally adjustable toward and from the upper portion of the carriage 14, screws 38 passing through said slots and into tapped holes in the top of the carriage 14 serving when turned down, to clamp and bind the plate 36 in its adjusted position. The bar 35 extends parallel with and preferably somewhat beyond the stem 30, as best shown in Figs. 4 and 5, and serves in addition to other offices, to form a second support for the outer end or head of the object ground, as indicated in Fig. 5. When the stem 30, rest 33, and bar 35 are suitably adjusted they hold or support the head or outer end of the work in proper position relatively to the work-rest 4 and to the grinding and regulating wheels, but until the leading end of the object enters the grinding space between the grinding wheel 2 and the governing or regulating wheel 3 it is necessary to furnish a lateral support to said work on the side next said governing wheel. While a suitably formed groove in the upper edge of the work-rest bar 4 might serve this purpose, the groove would be liable to receive and retain minute particles of metal ground from the object treated, or granules or crystals loosened from the grinding or the regulating wheel, and these would tend to cut or mar the surface of the object ground, and by making the support uneven would tend to prevent the grinding of the object to true and uniform shape and dimensions. On the other hand, it is difficult if not impracticable to provide a retaining guard or support for that side of the object next the regulating wheel, which shall at once give adequate support to the object, prevent its falling from the rest, and yet pass into the opening between the grinding and the regulating or governing wheel.

I therefore provide a support which is moved back automatically as the object treated moves inward to grinding position, or into the space between the grinding and governing wheels. This device consists essentially of one or more, usually several, swinging arms or supports, the bearing or supporting face of each of which stands normally in a vertical plane co-incident with the side of the object nearest the governing or regulating wheel, said arms being normally held in such position, but moved back on the inward or forward movement of the carriage by the bar 35 or other suitable means. This mechanism is shown in Figs. 2 to 6 inclusive. It is mounted upon and supported by a post or bracket 39 bolted or made fast to a depending lug or projection 40 extending downward and outward from the carriage-supporting member 9, as seen in Fig. 6. The top of bracket 39, which is horizontal, extends in the direction of the travel of the carriage and at right angles thereto, to an extent sufficient to afford an adequate bearing face for the bottom plate 41 of a substantially Z-shaped bracket 42, slotted as shown in Figs. 3, 4 and 6 to permit horizontal adjustment toward and from the body of carriage 14 when the clamping screws 43 are backed or loosened, such adjustment being effected preferably by a screw 44 entering a tapped hole in the bottom plate 41, and having a spool-shaped or circumferentially grooved head 45 seated in a forked arm 46 of the post 39. The flanges of the spool-like head 45 prevent axial movement of the screw 44, which consequently moves the plate 41 inward or outward when rotated in one or the other direction.

The Z-shaped bracket 42 has upper and lower bars or flanges 47, 48, on the side toward the carriage 14, in which are journaled or mounted to turn, vertical stems 49 of cylindrical form through the major portion of their length. Each stem 49 carries at its upper end an arm 50 preferably of the form shown in Fig. 2, terminating at its outer or free end in a substantially vertical section or member which bears against and gives support to the work lying on work-rest 4, as shown in Figs. 2 and 5 and by dotted lines in Fig. 6. In Fig. 5 but one arm 50 is shown in supporting position, the object treated being there shown with its outer or trailing end somewhat close to the in-feeding side of the grinding and governing wheels, and the need for such support being at such time slight.

Encircling each of the stems 49 is a helical spring 51, one end of which is made fast to a fixed support, preferably the flange or bar 47 of the Z-shaped bracket 42, while the other end is clamped or made fast to the stem in any convenient way, a binding screw 52 for this purpose being shown in Fig. 2. The springs 51 are arranged to swing the arms 50 toward the work-rest or bar 4, and the movement of each arm in that direction is limited by a stop-screw 53 with which engages a stud 54 projecting radially from the stem 49. The adjusting screw 53 is advisably provided with a jam-nut 55. The swinging arms 50, viewed from above, are preferably of the outline shown in Figs. 4 and 5; that is to say, they have between their carrying stems 49 and the upright terminal member, a rounded projection 56 with which the forward or inner end of the bar 35 makes contact as the carriage 14 moves toward the grinding and the governing wheels.

When the work is positioned on the work-rest or bar 4 and support 33 in contact with the upstanding ends of the swinging arms 50, all properly adjusted, the carriage 14 is moved inward and the leading end of the

work or object treated makes contact successively with the rounded projections of said arms 50, beginning with the one at the extreme left in Fig. 4, and moving them one after another to the right, or to the position indicated in Fig. 5, thus permitting the advance of the carriage while maintaining support for that side of the work away from the work-rest or bar 4 and next to the governing or regulating wheel. In this way the work is adequately and accurately supported during its entire inward travel, and until the work has been carried as far as the grinding is to be performed. On the backward movement of the carriage, which takes place when the grinding has been completed, or practically completed, the arms 50, freed by the bar 35, successively swing to their supporting position, or from the dotted line position to the full line position of the extreme right-hand arm, as seen in Fig. 5, thus again giving support to the object ground during its complete outward travel.

It is obvious that instead of swinging horizontally about a vertical pivot, the arms 50 may be arranged to swing vertically about a horizontal pivot, or may be pressed inward toward the work by springs and moved in a right-line outward against spring pressure, though the arrangement shown and described is found quite satisfactory.

It is found in the grinding of objects by wheels of emery, corundum, carborundum, and the like, which are made up of minute granules or crystals of very hard abrading substances, that some crystals of exceptional hardness will project a minute distance further from the body of the wheel than others, and that marks will be made thereby on the object ground. It is hence desirable to impart to the work a short axial reciprocation preparatory to or during withdrawal of the work. This is found to be quite effective in the removal of such marks, and to produce a better finished article. No material grinding or reduction of the object treated will be occasioned by such reciprocatory movement, because once the object is ground to the diameter determined by the relative adjustment of the grinding and the governing wheels, the object will merely rotate but is not subjected to sufficient pressure against the grinding wheel to do further grinding of any moment.

As seen in Figs. 3 and 4 the carriage 14 is provided with upstanding lugs 57, one of which is tapped to receive screws 58 to bear against and clamp between the lugs, a stop-plate 59, which may be adjusted to overhang the work-rest 4 to greater or less extent, and to form a stop against which the leading end of the work shall abut to prevent undue movement in an inward direction. In other words, the stop 59 prevents any head, shoulder or enlargement which the work may have from being moved into contact with the side face of either wheel, or if the radial face of such head or enlargement is to be dressed, it prevents such inward movement as would cause undue cutting away of the radial face.

It is to be understood that though the parts are here shown arranged to feed the material into the grinding space from the left-hand side of the machine as viewed in the drawings, it may be entered and withdrawn from the opposite side. In other words, parts of the device may be reversed as to their positions and directions of movement throughout, the invention consisting essentially in means for supporting the work preparatory to its introduction into the grinding space, during the grinding operation, and while being withdrawn from grinding position.

60 indicates a pan or guard secured to the under side of the carriage, to catch any oil that may fall from the moving parts of the device.

It will be noted that the runways for the carriage are all within the carriage body, and thus housed or protected from grit, cuttings, and other matter that might tend to wear the runways and balls, or make the carriage support uneven or irregular.

While I have shown and described ball bearings, and prefer to use them because of the reduced friction and consequent free movement of the carriage, and further because of the close adjustment and the maintenance of true running of the carriage with a minimum of friction which such construction assures, the anti-friction rolls may be omitted. Again, cylindrical, double-cone, or other well known types of rolls may be employed if desired.

In the drawings parts such as the Z-shaped bracket 42 with its upper and lower flanges 47, 48, are shown as made up of separate pieces but may of course be a single piece produced by casting, machining from the solid metal, or in other well-known way. The construction shown is found to work quite satisfactorily in practice, but is illustrative of the features and principles involved which may, however, be given variant embodiment so long as the general principles and mode of operation be retained.

The device here described may be employed in connection with a grinding wheel, and a rest or backing-up device facing the effective grinding surface and adjustable relatively thereto, but which has no rotary movement; in other words, with a support such as is employed with single wheel or disk grinders.

What I claim is:—

1. In combination with a grinding machine, a work-feeding device comprising a

fixed supporting guide; a carriage mounted and movable upon said guide toward and from the grinding space; a work-rest or support secured to and movable with said carriage; means for supporting the outer or trailing end of the work; and supports at the side of the work opposite that which is in contact with the work-rest, extending normally into guiding and supporting position relatively to the work but adapted to be forced aside as the carriage and work advance, to carry the work into grinding position.

2. In combination with a grinding machine, a work-supporting carriage movable toward and from the grinding wheel in a plane parallel with the grinding face thereof; a support for the trailing or outer end of the work, and a work-rest or support adapted to contact with one side of the work or object, both mounted upon and movable with the carriage; and a yielding support for the opposite side of the work, carried by a fixed support and adapted to be pressed back by the advancing carriage out of contact with the work as the latter enters and passes through the grinding field.

3. In combination with a rotary grinding member, a guiding base or block in substantial alinement with the active grinding surface; a carriage movable upon said base in the direction of the length thereof; a work-supporting bar upon which the work may lie, fixed upon and movable with the carriage; and a yielding support in the path of the carriage for retaining the work upon said work-supporting bar while moving to, while in, and while moving from the grinding position, said yielding support adapted to be forced out of the path of the carriage as the latter advances.

4. In combination with a rotary grinding member, a guiding base or block in substantial alinement with the active grinding surface; a carriage movable upon said base in the direction of the length thereof; a work-supporting bar upon which the work may lie, fixed upon and movable with the carriage; and a yielding support in the path of the carriage for retaining the work upon said work-supporting bar while moving to, while in, and while moving from the grinding position, said yielding support adapted to be forced out of the path of the carriage as the latter advances, and to return automatically into said path as the carriage moves away from the grinding member.

5. A device for supporting work to be ground and delivering the same into and removing it from grinding position, comprising a base or support normally fixed in position and extending in the direction of or parallel with the effective face of the grinding member; a carriage movable upon and in alinement with said base; a work-rest or bar upon and movable with said carriage and serving to support the side of the work toward the grinding member; a second support also mounted upon and movable with the carriage, to support the outer or trailing end of the work; and a series of yielding arms carried by a support independent of the carriage, extending into the path of the carriage or a part movable therewith and into position to support the side of the work opposite the rest or bar during the travel of the work from a position outside the grinding area, but adapted to be forced from such position by the carriage as it carries the work to and across the grinding area, and to return automatically to supporting position as the carriage retraces its movement.

6. In combination with a grinding member, a carriage movable across the effective grinding face thereof and provided with supports for one side and for the outer end of work to be ground, said supports being capable of adjustment to suit varying sizes and forms of work and of being fixed in such adjustment; and a yielding support for the opposite side of the work, extending normally into the path of the carriage, but adapted to be moved out of said path as the carriage advances, and to return automatically to normal position as the carriage recedes.

7. In combination with a grinding member, a guiding block or bar adapted to be fixed in position and extending across and parallel with the effective working face of the grinding member; a carriage mounted upon and movable lengthwise of said guiding block; a work-rest mounted upon and movable with said carriage, and extending upward above the lower line of the work on the side toward the grinding surface; a supporting post or bracket fixed in relation to the carriage and provided with movable arms arranged to bear against the side of the work away from the grinding surface but capable of being forced from such position by the advancing carriage; means for restoring said arms to their normal position during recession of the carriage; and stops to limit the return movement of said arms and to hold them in proper relation to the work.

8. In combination with a grinding member 2, a fixed guiding and supporting block or member 9; a carriage 14 mounted upon and encompassing said guiding member and movable longitudinally thereon; a work-supporting bar 4 carried by said carriage and removably attached thereto; a bar 35 secured upon and movable with the carriage; an end support 33—34 for the work, also mounted upon and movable with the carriage; a series of movable arms 50 extending normally into the path of the bar 35, and serving to support the side of the

work furthest from the effective face of the grinding member; means for adjusting said arms toward and from the work-supporting bar 4; and means for adjusting the bar 35 and the end support 33—34 to suit objects of different diameters.

9. In a device for supporting objects during grinding and while moving to and from the grinding position, the combination of a guiding block or base capable of being rigidly fixed in position; a carriage overlying said guiding block and movable longitudinally upon and relatively to said block; adjustable stop screws for limiting and determining the range of movement of said carriage; adjustable work-supports mounted upon and movable with said carriage for supporting the outer end and one side of the work; and a yielding support for the opposite side of said work, fixed relatively to the carriage, normally extending into the path of the carriage or a part thereof and occupying a position to support the second or opposite side of the work, said support being yieldingly held in its normal position but adapted to be forced from and to return automatically to such normal position during the advance and the recession of the carriage.

10. In a work-supporting device of the character described, a fixed base or support, a carriage encompassing said base, supported and movable thereon, the carriage and the base being provided with raceways and with balls or rollers intermediate said raceways; work-supports for one end and side of the work, mounted upon and movable with said carriage; and a yielding support for the opposite side of the work, independent of the carriage and automatically movable from and to supporting position as the carriage advances and recedes.

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

WALTER D. ARCHEA.