April 29, 1924. 1,491,922

H. M. ROCKWELL

GRINDING MACHINE

Original Filed Jan. 10, 1917 5 Sheets-Sheet 1

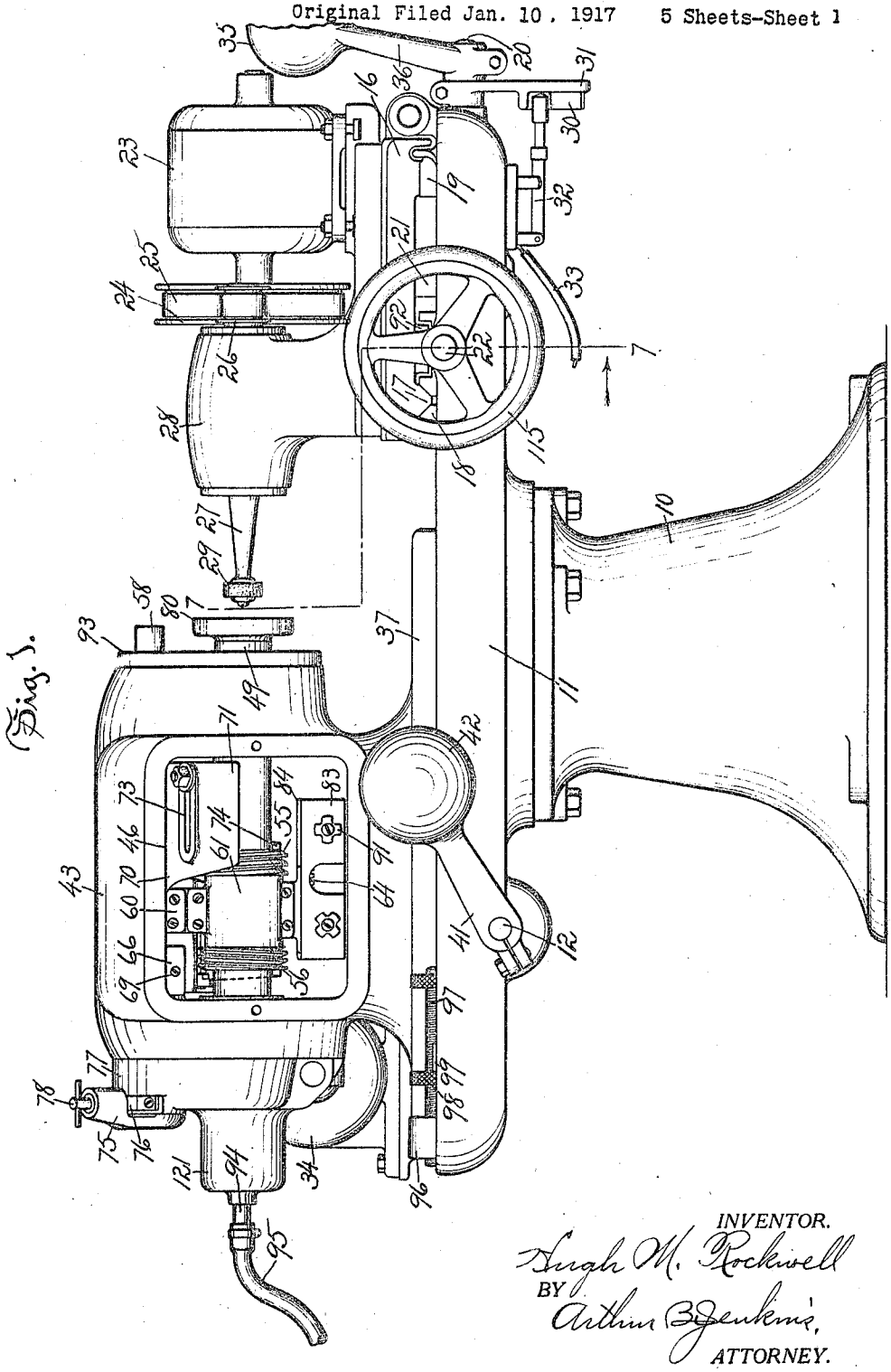

Fig. 1.

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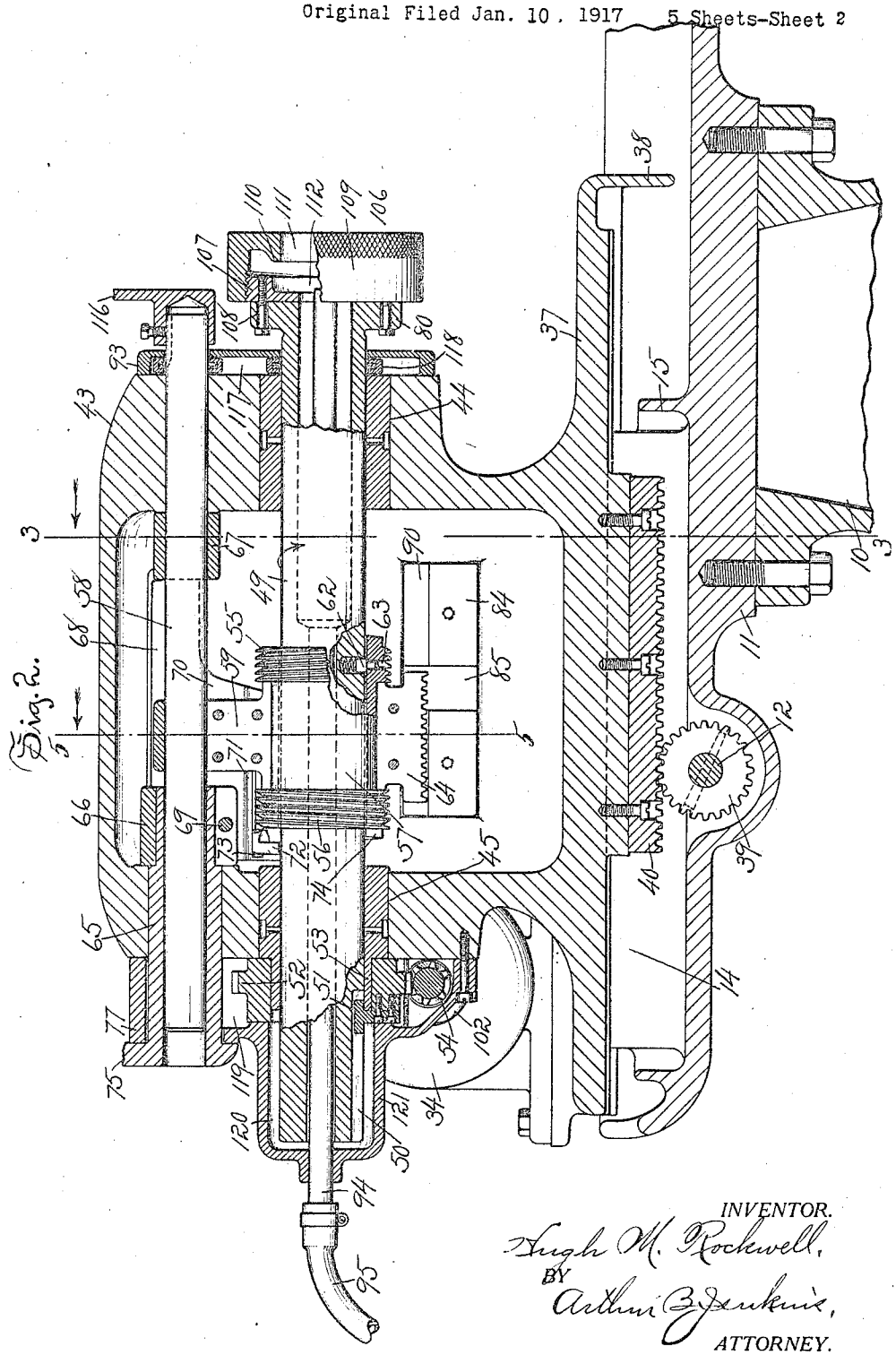

Fig. 2.

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Original Filed Jan. 10, 1917 5 Sheets-Sheet 3

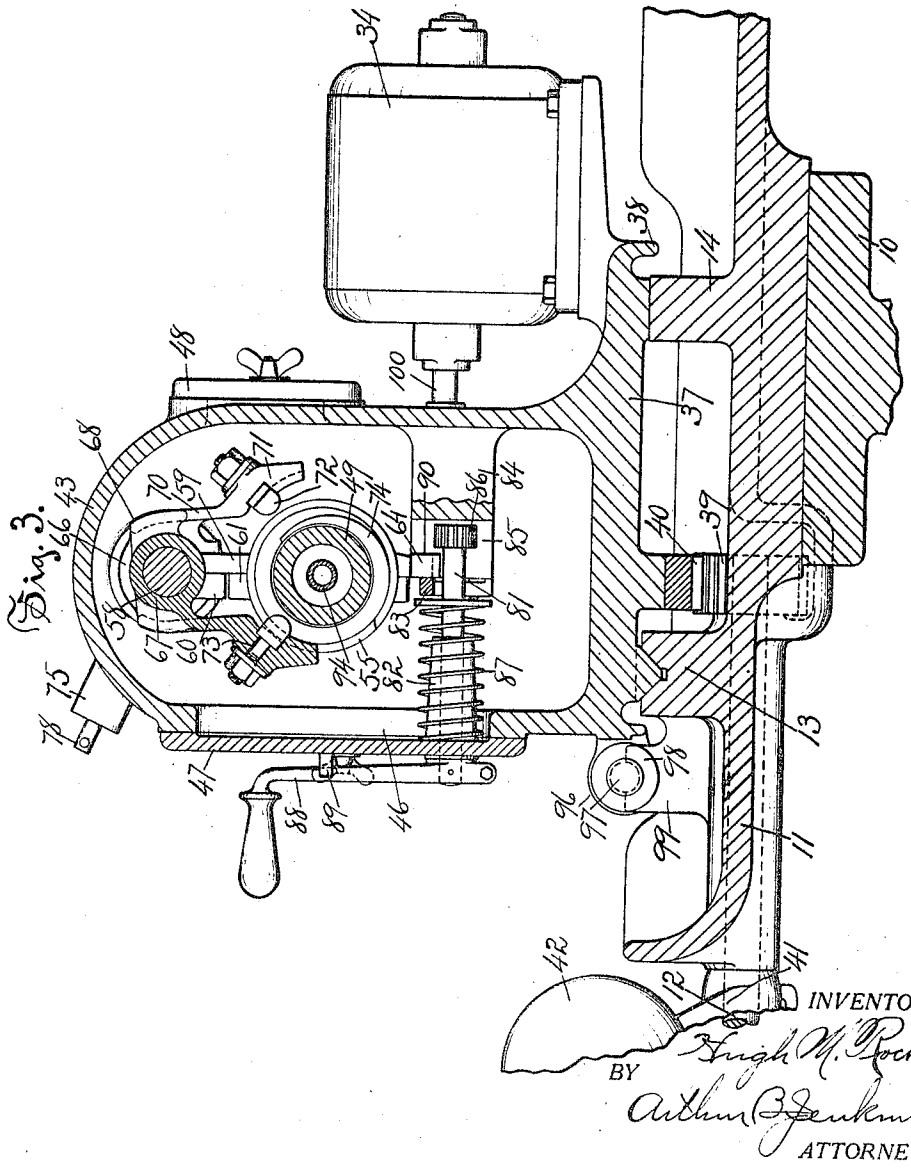

Fig. 3.

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GRINDING MACHINE

Original Filed Jan. 10, 1917 5 Sheets-Sheet 4

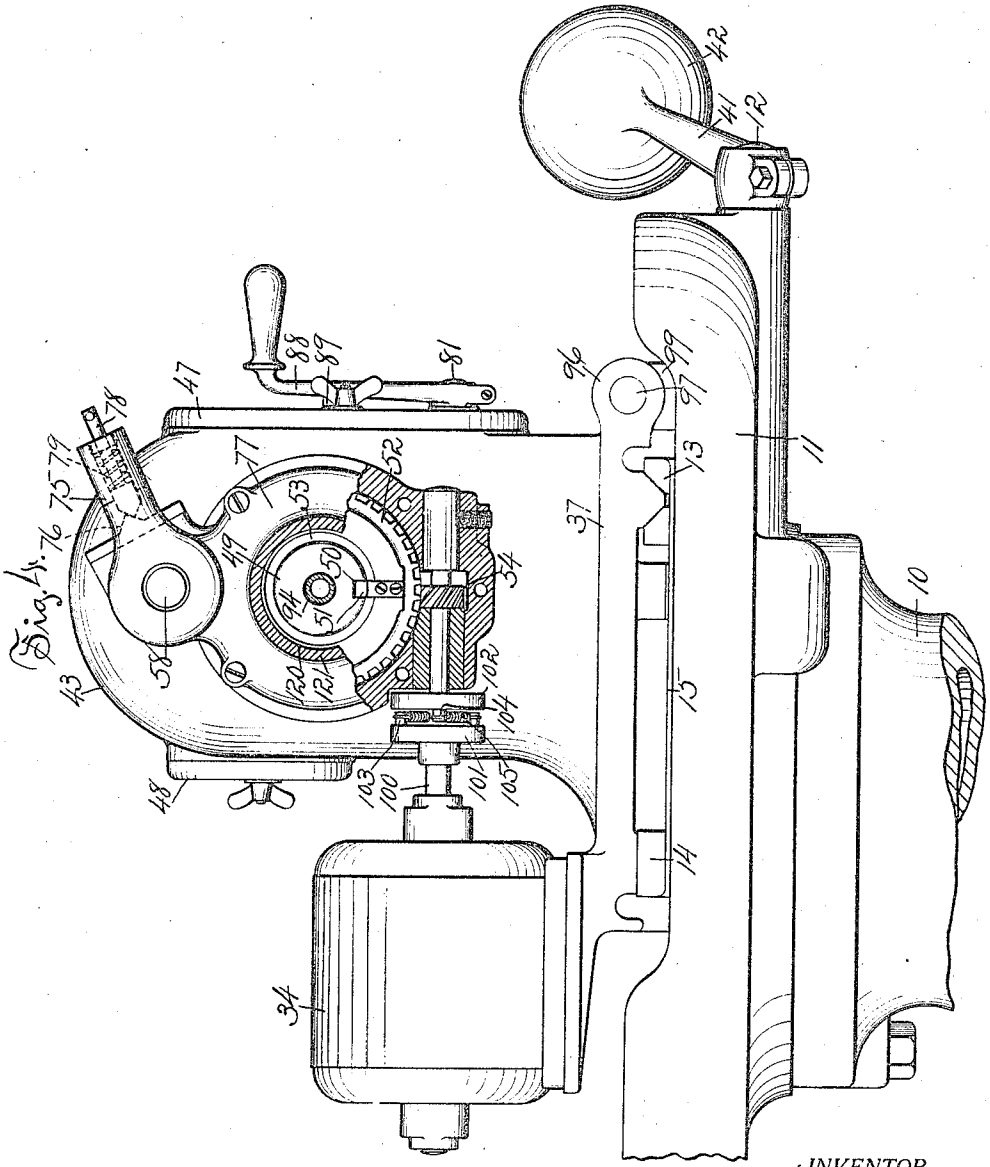

Fig. 4.

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GRINDING MACHINE

Original Filed Jan. 10, 1917 5 Sheets-Sheet 5

Fig. 7.

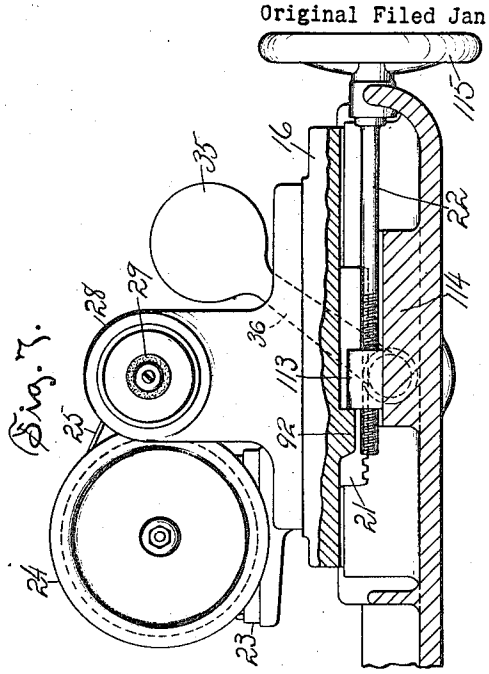


Fig. 5.

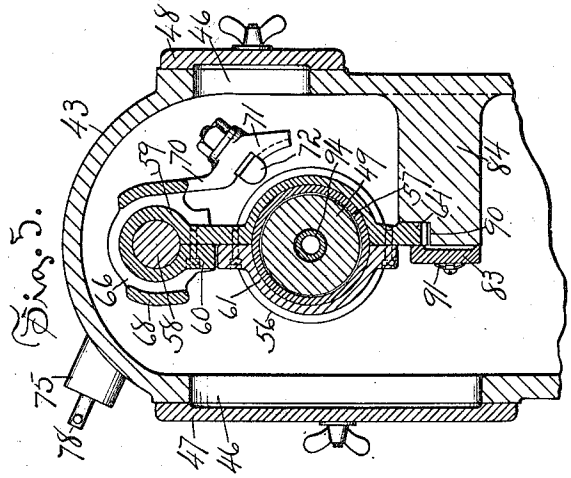
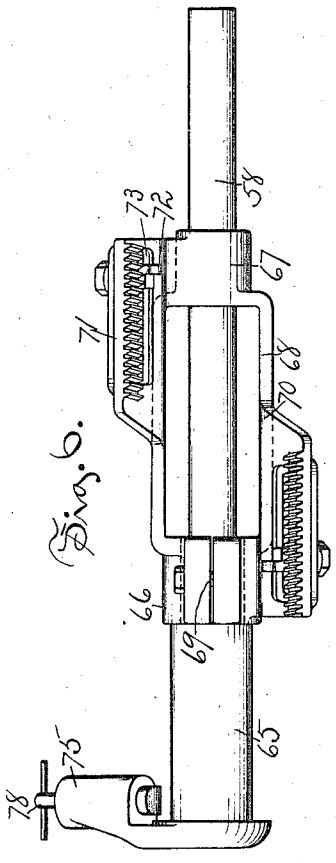


Fig. 6.



INVENTOR.
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Patented Apr. 29, 1924. 1,491,922

UNITED STATES PATENT OFFICE.

HUGH M. ROCKWELL, OF BRISTOL, CONNECTICUT, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STANDARD STEEL AND BEARINGS INCORPORATED, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

GRINDING MACHINE.

Application filed January 10, 1917, Serial No. 141,607. Renewed September 21, 1923.

To all whom it may concern:

Be it known that I, HUGH M. ROCKWELL, a citizen of the United States, and a resident of Bristol, in the county of Hartford and State of Connecticut, have invented a new and Improved Grinding Machine, of which the following is a specification.

My invention relates to the class of machines that are used to give articles the proper shape as to size, form, dimensions, &c., and an object of my invention, among others, is to provide a simple and durable machine that shall be extremely accurate in the character of work produced by it.

A form of machine in the construction and use of which the objects herein set out, as well as others, may be attained, is illustrated in the accompanying drawings, in which—

Figure 1 is a view in front elevation of a machine embodying my invention, with the closing plate of the casing removed.

Figure 2 is a view, scale enlarged, in central vertical section through the upper part of my improved machine, and with parts broken away to show construction.

Figure 3 is a view in cross section through the machine on plane denoted by dotted line 3—3 of Figure 2.

Figure 4 is a view in end elevation, looking from the left with respect to the plane of view of Figure 1, and with parts broken away to show construction.

The scale of Figures 3 and 4 is the same as that of Figure 2.

Figure 5 is a detail view in cross section through the upper portion of the case on plane denoted by dotted line 5—5 of Figure 2.

Figure 6 is a detail bottom view illustrating the reversing frame and its support.

Figure 7 is a detail view in cross section through a portion of the bed of the machine on plane denoted by dotted line 7—7 of Figure 1.

My improved machine is especially adapted for cutting away a portion of metallic articles for the purpose of giving them correct size, shape, &c., a grinder or grinding tool being made use of for the purpose of effecting the cutting operation, and as my improved machine is especially adapted for operating upon metallic articles of annular form, the machine is illustrated and described herein as arranged to operate upon the casing forming a part of ball bearings.

In the accompanying drawings the numeral 10 indicates a standard, of any suitable construction, supporting a table 11, preferably of pan shape and within or upon which the operative parts of the machine are located. The table or pan 11 may be bolted to the standard or otherwise secured thereto in any suitable manner. It has a bearing in the lower side thereof for a rock shaft 12, and a guide 13 and a rest 14 rise from the bottom of the pan in position to guide and support the work supporting frame in its sliding movement. A flange 15 also rises from the bottom of the pan to form an inclosure and prevent entrance of objectionable matter to working parts of the device.

The work supporting frame is located at one end of the pan and will be specifically hereinafter described. The tool supporting frame is located at the opposite end of the pan and comprises a base 16 having a guide rib 17 extending into a guide 18 rising from the pan, said base also being supported on a rest 19 also rising from the bottom of the pan. A rock shaft 20 has a pinion engaging a rack 21 projecting from the under side of said base and by means of which rock shaft, pinion and rack the base is moved laterally of the machine. A threaded stop shaft 22 mounted in the sides of the pan has a nut to engage a stop 92 on the base 16 and limit its lateral movement in one direction. This nut is adjustably mounted on the shaft in any manner that will readily suggest itself to the skilled mechanic. The base 16 supports a motor 23, herein shown as an electric motor, the shaft of which has a driving pulley 24 secured thereto with a belt 25 extending therefrom to a pulley 26 on the grinder spindle 27 mounted in a bearing 28 rising from the base and having a grinder 29 secured to its outer end. A cut-out cam 30 on a cam plate 31 secured to the shaft 20 engages the end of a cut-out or switch bar 32 and by which the flow of electricity through a wire 33 to a motor 34 located at the other end of the pan is controlled. A ball 35 is located at the end of an arm 36 secured to the rock shaft 20, this weight being so located that it will normally press the lug 92 on the base 16 against the nut,

the latter being manually moved by a wheel 115 to effect the feeding of the grinder laterally up to a piece of "work", and by the term "work" as employed herein is meant the article that is being reduced by the grinder to proper shape, size or otherwise formed by the grinder.

The work supporting frame comprises a base 37 located within the pan and having a lip 38 projecting downwardly below the plane of the upper edge of the flange 15 to assist in preventing objectionable matter from entering the inclosure within said flange. A pinion 39 on the shaft 12 engages a rack 40 on the base 37, and the shaft 12 has an arm 41 secured to it and bearing a ball or weight 42 by means of which the shaft is operated to impart a reciprocating movement to the work supporting frame longitudinally with respect to the work supporting spindle and toward and from the grinder, the weight yieldingly holding said frame at the limits of such reciprocating movement. A casing 43 rises from the base 37 and has openings 44—45 in its end walls and holes in its front and rear walls, the hole 46 in the front wall being closed by a plate 47 and the hole in the rear wall being closed by a plate 48.

A work supporting spindle 49 is mounted for longitudinal and rotary movement in bushings in the openings 44—45 in the end walls, this spindle having a groove 50 at one end to receive a spline 51 secured to and projecting from the face of a driving worm wheel 52 mounted on a worm support 53 comprising an extension from the bushing in the hole 45 in the rear wall of the casing. This worm wheel 52 meshes with a driving worm 54 connected with the shaft of the motor 34. The work supporting spindle is rotated by means of the mechanism just described. Said spindle receives a longitudinal reciprocating movement by means of threads alternately meshing with threaded blocks. In the construction herein shown the spindle 49 turns to the left and the thread 55 operates to move the spindle toward the grinder and the thread 56 operates to move the spindle in the reverse direction and by means that will presently be described, said threads being forward and backward feed threads.

In order to obtain the greatest accuracy in operation of the machine, the parts are constructed to insure a minimum amount of vibration being transmitted to the work supporting spindle. The threads 55 and 56 are, therefore, supported independently from and clear of said spindle, so that the shocks incident to alternate engagement of threaded blocks with said threads are not transmitted to the spindle. A sleeve 57 having an opening therethrough larger than the spindle 49 is supported in an opening through a bracket secured to and depending from a bar 58, mounted in the casing. In the construction shown this bracket comprises two branches 59—60, the branch 60 being shorter than the branch 59 and being formed by a part bent backwardly with respect to the branch 59 and encircling the bar 58, as shown in Figure 5 of the drawings. The branch 59 envelops the sleeve 57 on one side and a cap plate 61, a counterpart of a portion of the branch 59 envelops the side of the sleeve on the side opposite the branch 59, this cap plate being secured to said branch as by means of screws, the branch 60 of the bracket also being secured to the branch 59 as by means of screws that tightly clamp the bracket in place on the bar 58 so that the sleeve 57 will not touch the spindle 49 at any point, but may freely rotate within said bracket. This sleeve is connected to rotate with the work supporting spindle as by means of a plunger 62 seated upon a spring in a recess in the spindle as shown in Figure 2 of the drawings, the reduced end of this plunger engaging an opening 63 in the threaded sleeve. It will thus be seen that the connection between the spindle and the sleeve is so small as to impart but little vibration from one to the other. A rack 64 is formed on the lower edge of one member of said bracket, preferably the member 59.

One end of the bar 58 extends into a rocking sleeve 65 mounted for rocking movement in a hole above the opening 45 in the rear wall of the casing. A hub at one end of a reversing frame is mounted upon the end of this sleeve that projects into the casing, and a hub at the opposite end of the frame is mounted upon the bar, said frame being located at the upper end of the chamber in the casing. This frame consists of the hubs 66—67 and cross bars 68 connecting the hubs, the hub 66 being split on one side and having a clamp screw 69 extending through the split portion as a means of securing the reversing frame to the sleeve 65. Arms 70 extend downwardly from the cross bars and have at their lower ends threaded blocks 71 each of which blocks is provided with a thread to engage one of the threads 55 or 56 on the sleeve 57. The members of this frame, in the construction herein shown, are integral each with the other, and reversing frame actuating lugs 72 are adjustably secured to the blocks 71 as by means of studs passing through slots 73 in the blocks and secured in place as by means of nuts, as shown in Figure 1 of the drawings. These lugs are located in position to encounter reversing cams 74 formed at opposite ends of the sleeve 57 and by means of which the reversing frame is tipped or rocked from one side to the other to bring the threads on the blocks 71 alternately into engagement with

the threads 55 and 56. An actuating arm 75 extends from the sleeve 65 and projects over an actuating cam 76 mounted on a cover 77 secured to the casing at one end, this cam comprising a plate removably secured to the casing. An actuating plunger 78 is mounted in a recess in the overhanging part of the arm 75, an actuating spring 79 within the plunger forcing it into engagement with the actuating cam. In operation, one of the cams 74 engages one of the lugs 72 and rocks the reversing frame to disengage one of the threaded blocks from one of the driving threads. This action forces the plunger over the points of the cam 76, the reversing cam moving the reversing frame just sufficient to carry the plunger beyond the point of this cam. The beveled end of the plunger engaging the cam on the opposite side of its point and the spring 79 forcing the plunger downward causes movement of the reversing frame and completes such movement, a lug 72 in this completion of the movement being carried away from a cam 74.

The spindle 49 is provided with a plate 80 to which a work holding chuck 110 or other desirable tool may be attached, a general description of which hereinafter appears. In some cases it is desirable to move the spindle by manual operation, and for this purpose an operating shaft 81 is mounted at one end in and extends through the plate 47 and bearing hub 82 thereon and through an opening in the lower edge of a guide plate 83 secured to a guide 84 projecting from the rear wall of the casing, said guide having an opening 85 to receive a pinion 86 on the end of the shaft 81. A spring 87, thrusting at one end against the plate 47 and at its other end against a shoulder on the shaft, forces the pinion 86 normally from engagement with the rack 64, and as shown in Figure 3 of the drawings. When it is desired to manually move the spindle 49 longitudinally the reversing frame will be placed in its central or neutral position, as by moving the arm 75 to its central position and turning the plunger 78 into a position at right angles from that shown in Figure 4 and causing the ridge of the plunger, which is of some length, to rest upon the ridge of the cam, but extending across it so that the plunger will remain in this position. The handle 88 being pulled outwardly the pinion 86 will be engaged with the rack 64 and the spindle may then be moved longitudinally by turning the handle that is pulled outward to retain the pinion in engagement with the rack during this operation. Upon releasing the force applied to the handle the spring 87 will return the parts to their normal position shown in Figure 3 and the handle will be engaged with a locking lug 89 on the plate 47. It will be noted that the plates 47 and 48 are removably held in place as by means of thumb nuts and threaded lugs. In one operation this manual movement of the spindle 49 is made use of to dress the grinding wheel, a suitable tool being held in the chuck or attached to the plate 80 and the grinding wheel being rotated, the shaft 49 is moved longitudinally to carry the dressing tool across the face of the grinding wheel. The guide 84 is cut-away at its upper front edge as at 90 to form with the plate 83 a guide groove to receive the rack 64. This guide plate is yieldingly held in place as by means of spring washers 91, these washers having arms that press yieldingly against the plate, and screws or other suitable means for securing the washers in place are employed. This construction causes the guide plate 83 to exert a slight yielding pressure against the rack 64. The rack 64 in addition to its function in the operation of moving the sleeve 57 and spindle 49 lengthwise, also performs a very important feature in its function as a guide. In this latter case it so guides the sleeve 57 in its movement with the spindle 49 that the sleeve and spindle are always held from contact one with the other. The covers 77 and 93 are secured to the ends of the casing and are provided with recesses and with suitable washers to receive the ends of the bars and shafts and to prevent the entry of injurious matter, as dust, dirt, and the like, into the bearings and into the case. A tube 94 extends through this spindle 49 to supply lubricating material to the work being performed on the machine, this tube being fed from a pipe 95 extending to any suitable source of supply.

A stop screw support 96 projects outwardly from the front of the casing at its lower end (see Figure 1) and this support receives a stop screw 97 that is provided with stops 98 that may be adjusted along the screw as by means of interengaging screw thread upon said parts. In operation these stops are positioned on opposite sides of a stop lug 99 extending upwardly from the bottom of the pan 11, as shown in Figure 3, and the position of these stops will, by contact with the lug 99, determine the extent of movement and the zone of such movement in the operation of placing the work held by the spindle 49 in position for operation of the cutting or grinding tool and in removing it from such position.

The connection between the motor shaft 100 and the shaft of the driving worm 54 is a yielding connection and consists of discs 101—102 secured to said shafts respectively and having posts 103—104 respectively connected by springs 105. This construction will compensate for any slight difference in alinement of the worm and motor shafts, and also provides for a yielding driving connection.

The chuck 106 as herein illustrated comprises a back plate 107 that is secured to the chuck plate 80 as by means of bolts so arranged that the chuck may be adjustably placed in different positions upon said plate. As herein shown these bolts are threaded into the back plate 107 and pass through enlarged holes 108 in the chuck plate that enables the chuck to be shifted into any desired position. The heads of the bolts rest against the back of the chuck plate and they are threaded into the back plate 107 and any suitable number of bolts and holes may be employed. A face or clamp plate 109 is secured to the back plate as by means of interengaging screw threads, this plate having on its inner surface an annular lip 110 to engage the work and hold it against the back plate, an opening 111 in the face plate permitting access of the tool for operation on the work held within the chuck. The back plate 107 is recessed as at 112 to permit free access of the grinder tool to the work being operated upon.

The shaft 22 hereinbefore referred to as a stop shaft, is also a feed shaft and the nut hereinbefore mentioned is threaded upon this shaft. This feed nut 113 is prevented from turning movement as by means of one of its sides resting in sliding contact with a nut holding lug 114 rising from the bottom of the pan 11. After a piece of work has been finished the base 16 is manually shifted by the operation of the weight 35, arm 36, and shaft 20 to position the grinder free from interference with the placing of a new piece of work in the chuck. After such piece of work has been so placed the weight 35 is shifted to the position shown in Figure 7 of the drawings, the stop 92 striking the nut 113. The weight 42 is now operated to move the base 37 toward the grinder and position the work held in the chuck in closer proximity to said grinder. The hand wheel 115 secured to the shaft 22 is now mannually operated to cause the base 16 to move laterally in a direction to feed the grinder 29 toward the work and effect cutting operation thereon, a gage (not shown) that may be of any common construction and supported upon an arm 116 secured to the end of the bar 58, denoting when the work has been cut away to the desired extent. When this cutting operation is completed the wheel 115 is operated to move the nut in a direction to carry the grinder 29 clear of the piece of work, the weight 42 being now operated to move the chuck away from the piece of work and the weight 35 being thrown to move the grinder back out of the way, as hereinbefore described. The grinder 29 may be fed against the work, after the grinder and work have been placed in approximate cutting relation, by operating the wheel 115 to draw the nut 113 toward said wheel, thereby allowing the force exerted by the ball 35 on the base 16 through the medium of the shaft 20, its pinion and the rack 21, to press the grinder against the work, or by turning the wheel 115 in the opposite direction to move the base 16 against the force exerted by the weight 35 and thus bring the grinder into contact with the work.

From this it will be seen that all parts are quickly moved to their final positions after a piece of work has been completed and are also quickly moved into approximate cutting relation, and the accurate feed movement is manually given to the tool by means of the wheel 115, the weight 35 holding the work carriage against the feed nut 113 and the movement of the latter by the wheel 115 being effective to feed the base with the grinder thereon up to the work. This construction also avoids any special adjustment to take up any lost motion due to wear between the parts, as such adjustment will be gradually effected in the regular operation of the machine just above described.

The covers 77 and 93 may be secured to the casing in any desired manner as by means of screws and each is formed to provide a chamber that will act to intercept dust and dirt and collect the same, thus preventing a large portion thereof from entering the case 43. As an additional means of preventing this entry of dust and dirt into the case 43 the dirt intercepting chamber 117 in the cover 93 contains dust washers 118 surrounding the bar 58 and the spindle 49, these washers being of any desired form and construction. The cover 77 containing the dust intercepting chamber 119 also acts as a shield or housing for the worm wheel 52, the worm 54, and the projecting end of the spindle 49 that is located in a chamber 120 in a projection 121 from the face of said cover.

In the operation of the machine herein specifically shown and described the cutting grinder 29 is rotated by the motor 23 and is moved into contact with and out of contact from the work by means of the base 16, as hereinbefore described. The motor 34 through the worm 54 and worm wheel 52 imparts rotation to the spindle 49, the rate or direction of rotation being such as to cause a relative rotative movement between the work and the grinder. This rotation of the spindle, through the connecting plunger 62, imparts rotation to the reversing sleeve 57, the threaded ends of which, by engagement with one or the other of the threaded feed blocks 71, gives to the spindle 49 a reciprocating movement endwise to traverse the work across the face of the grinder.

The rocking movement of the reversing frame is caused by contact of one of the reversing cams 74 with one of the lugs 72, said

lugs being positioned and the cams being so located and shaped as to effect the rocking movement of the reversing frame to impart the desired traversed movement of the work across the grinder, and, as hereinbefore described, the shocks incident to the sudden stopping of the reversing frame at the end of each forward and backward movement thereof in its rocking movement, are reduced to a minimum.

In accordance with the provisions of the patent statutes, I have described the principles of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

It will be noted that the spindle 49 has both a rotative and a longitudinal movement in its bearings and this is particularly effective in preventing the tool from giving a tapered shape to a piece of work being operated upon. In order to produce accurate work it is essential that the supporting members, both for the tools and the work, and especially the latter, shall be as free as possible from vibration and shall, therefore, have an extremely steady action. To effect this purpose, in addition to the mechanism hereinbefore described, I connect the driving means for the spindle 49 and said spindle by means of a worm and worm wheel which impart a very steady movement to the spindle and reduces the vibration to a minimum.

I claim—

1. A work holder and a reducing tool supported in cooperative relation, means for positioning said members in closer relation by a movement in one direction, means for placing them in cooperative cutting relation by a movement in another direction, a stop to limit said last mentioned movement, means for forcing said members toward each other from the last named position, and means for moving said stop relative to said last named means to permit said force to act and cause cutting operation of said tool.

2. A work holder and a reducing tool supported in cooperative relation, means for placing said members in closer relation, means for moving said tool toward the holder, a stop to limit such movement, means exerting force upon the tool to move it from said last named position toward the holder, and means for moving said stop relative to said last-named means to permit said force to act to cause cutting operation of said tool.

3. A work holder and a reducing tool supported in cooperative relation, means for moving the tool and holder in different directions to place them in approximate cutting relation, means exerting force on one of said members to move it toward the other, a stop to limit such movement, and means for moving said stop to permit the tool to engage a piece of work carried by said holder.

4. A work holder and a reducing tool supported in cooperative relation, means for moving the tool to bring the tool and holder into closer relation, means for moving the holder to bring said members into approximate cutting relation, means exerting force on one of said members to move it toward the other, a stop to limit such movement, and means for moving said stop to permit the tool to engage a piece of work carried by said holder.

5. A work holder and a reducing tool supported in cooperative relation, means for moving the tool and holder in different directions to place them in approximate cutting relation, means exerting force on the tool to move it toward the holder, a stop to limit such movement, and means for moving said stop to permit the tool to engage a piece of work carried by said holder.

6. A work holder and a reducing tool supported in cooperative relation, means for moving the tool to bring the tool and holder into closer relation, means for moving the holder to bring said members into approximate cutting relation, means exerting force on the tool to move it toward the holder, a stop to limit such movement, and means for moving said stop to permit the tool to engage a piece of work carried by said holder.

7. A work holder and a reducing tool supported in cooperative relation, a base movably mounted and supporting one of said members, a rock shaft engaging said base to move it, means to exert force upon said shaft to rock it, a stop to limit movement of said base, and means to move said stop to permit said force to act to move the base.

8. A work holder and a reducing tool supported in cooperative relation, a base supporting each of said members, means for moving one of said bases to bring said members into closer relation, means for moving one of said bases to position said members in approximate cutting relation, gravity actuated means exerting force upon one of said bases to force said members into closer relation, and means to permit action of said force to effect cutting operation of said tool.

9. A work holder and a reducing tool supported in cooperative relation, bases supporting each of said members, means for moving one of said bases to position said members in closer relation, means for positioning said members in approximate cutting relation, a stop to limit the last named movement, means exerting force upon one

of said bases to move said parts toward each other, and means for moving said stop to permit said force to act to effect cutting operation of said tool.

10. A work holder and a reducing tool supported in cooperative relation, a base supporting each of said members, means for moving the holder base toward the tool base to bring the holder and tool into closer relation, means for moving the tool base to bring said parts into approximate cutting relation, a stop to limit said movement of the tool base, and means for moving said stop to bring the tool into cutting action.

11. A work holder and a reducing tool supported in cooperative relation, bases supporting each of said tools, means for moving the holder base toward the tool base, a rock shaft operatively connected with the tool base to move the tool toward the holder, means exerting force upon said shaft to force the tool toward the holder, a stop to limit the movement of the tool toward the holder, and means for moving said stop to permit action of said force to cause operation of said tool.

12. A work holder and a reducing tool supported in cooperative relation, a support for said tool, means for positioning said parts in closer relation, a rack rigidly connected with the tool support, a rock shaft having a pinion engaging said rack, a weighted arm secured to said shaft, a stop to engage the tool support and limit its movement, and means for moving the stop to permit cutting action of the tool.

13. A work holder and a reducing tool supported in cooperative relation, a motor to drive each of said members, means for moving one of said members with respect to the other member, and means connected to be operated by the movement of said member to control the operation of the motor for driving the other member.

14. A work holder and a reducing tool supported in cooperative relation, a motor to drive each of said members, means for moving the tool with respect to said holder, and means connected to be operated by the movement of the cutting tool to control the operation of the motor for driving said holder.

15. A work holder and a reducing tool supported in cooperative relation, a motor for driving each of said members, a rock shaft for moving the tool in closer engagement with said holder, a cam connected with said rock shaft, a switch connected to be operated by said cam, and an electrical connection between said switch and the motor appurtenant to said holder.

16. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating one of said members, and means supported out of contact with said member but operatively connected therewith to effect its longitudinal movement.

17. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said support, and means supported out of contact with said member but operatively connected therewith to effect a reciprocating movement thereof in a longitudinal direction.

18. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said member, and means supported out of contact with said member but operatively connected therewith to effect its longitudinal movement.

19. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said member, a reversing sleeve supported out of contact with said member but in driving engagement therewith, said sleeve having means to cause longitudinal reciprocating movement of said member, and means to engage said sleeve to effect said longitudinal movement.

20. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said support, a reversing sleeve and a reversing member having a reversing connection including screw threads of different character, and said sleeve being out of engagement with said member but operatively connected therewith, and means for operating the reversing member.

21. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said support, a reversing sleeve surrounding said member out of contact therewith but operatively connected thereto, said sleeve having threads of different character, a reversing member arranged to engage said threads, and means for operating the reversing member to cause reciprocating movement of said sleeve.

22. A support, a member rotatably and reciprocatively mounted and bearing said support, a sleeve and a rocking reversing member having a reversing connection including threads of different character, and said sleeve surrounding said member out of contact therewith but operatively connected thereto, and means for rocking said member to cause longitudinal movement of said sleeve by alternate action of said threads.

23. A support, a member rotatably and reciprocatively mounted and bearing said support, means for rotating said support, a supporting bar, a sleeve and a reversing frame having a reversing connection including threads of different character, said sleeve being slidably supported on said bar and surrounding said member out of contact therewith but operatively connected thereto and said frame being secured to said bar, and

means for rocking said bar to cause alternate action of said threads to cause longitudinal movement of said sleeve.

24. A shaft rotatably and reciprocatively mounted, a sleeve surrounding said shaft out of contact therewith but connected for simultaneous longitudinal and rotatable movement therewith, means for rotating the shaft, and means to engage said sleeve to cause longitudinal movement thereof.

25. A shaft rotatably and reciprocatively mounted, a sleeve surrounding said shaft out of contact therewith, and a vibration-absorbing connection between said shaft and said sleeve.

26. A shaft rotatably and reciprocatively mounted, a sleeve surrounding said shaft out of contact therewith, and yielding means carried by said shaft engaging said sleeve.

27. A shaft rotatably and reciprocatively mounted, a sleeve surrounding said shaft out of contact therewith, and a spring-pressed pin carried by said shaft engaging said sleeve.

28. A shaft, a bearing for said shaft, said bearing having a projection, a worm wheel mounted on said projection to rotate thereon, a spline secured to the worm wheel and projecting into a groove in said shaft, means for rotating the worm wheel to impart rotation to said shaft, and means for moving the shaft longitudinally.

29. A shaft, a bearing for said shaft, said bearing having a projection, a worm wheel mounted on said projection, a spline secured to the face of said wheel and projecting into a groove in said shaft, means for rotating said wheel, a sleeve surrounding said shaft out of contact therewith but connected thereto for rotatable and longitudinal movement therewith, and means for causing longitudinal movement of said sleeve.

30. A shaft rotatably and longitudinally mounted, a sleeve surrounding said shaft and having screw threads of different character thereon, said sleeve being operatively connected with said shaft, a rocking frame bearing members to engage said threads to impart reciprocating movement to said sleeve, reversing members carried by said frame, and cams on said sleeve arranged to engage said rocking members to impart rocking movement to said frame.

31. A shaft rotatably and longitudinally mounted, a sleeve surrounding said shaft and having threads thereon extending in different directions, said sleeve being operatively connected with said shaft, a cam at each end of the sleeve, a rocking frame, screw threaded blocks upon said frame arranged to alternately engage the threads upon the sleeve, and rocking members secured to said blocks in position to alternately engage the threads on said sleeve.

32. A shaft rotatably and longitudinally mounted, a supporting bar, a bracket suspended from said bar and slidable thereon, a sleeve supported by said bracket and having threads running in different directions thereon, said sleeve being operatively connected with said shaft, a rocking frame mounted on said bar and held against longitudinal movement thereon, means for rocking the bar, and means upon the frame to alternately engage the different threads upon said shaft.

33. A shaft rotatably and longitudinally mounted, a supporting bar, a bracket suspended from said bar, a reversing sleeve surrounding said shaft and supported by said bracket, said sleeve having threads running in different directions thereon and being operatively connected with said shaft, a rocking sleeve forming a bearing for said bar, a reversing frame rotatably mounted on said sleeve and having reversing members to alternately engage the different threads, and means for operating the rocking sleeve.

34. A shaft rotatably and longitudinally mounted, a bracket support, a bracket longitudinally mounted on said support, a sleeve surrounding said shaft and supported by said bracket and having threads running in different directions thereon, said sleeve being operatively connected with said shaft, a rocking sleeve, a rocking frame secured to said sleeve and having means to alternately engage said threads, an actuating cam, an arm extending from said sleeve, a plunger mounted in said arm normally forced into contact with said cam, and means for imparting initial movement to said frame.

35. A casing, a shaft rotatably and longitudinally movable therein and projecting thereout of, means for rotating said shaft, a threaded sleeve located within the casing and operatively connected with said shaft, a slidably mounted bracket supporting said sleeve, a rocking sleeve projecting into said casing, a rocking frame located within the casing and secured to said sleeve and having means to alternately engage the threads on said threaded sleeve, and means located outside of the casing for operating said rocking sleeve.

36. A casing having a chamber therein, a shaft rotatably and longitudinally mounted in said casing and extending through said chamber, means for rotating said shaft, a sleeve surrounding said shaft within said chamber and having threads extending in different directions thereon, a bracket located in said chamber and supporting said sleeve, a rocking frame located in said chamber, means upon said frame to alternately engage the threads on said sleeve to impart reciprocating movement to said shaft, a rocking sleeve projecting into said

chamber and secured to said frame, and means located outside of the casing for operating said rocking sleeve.

37. A casing having a chamber therein, a shaft mounted in the casing and projecting through said chamber, means for operating said shaft, a bar extending into said chamber and outside of said casing, means supported on the bar within said chamber to act in the operation of said shaft, a work holder secured to said shaft, and a support secured to said bar to relatively locate a device to cooperate with said holder in the operation thereof.

38. A casing having a chamber therein, a shaft extending into said casing and projecting to the outside thereof, a holder located on the end of said shaft outside of the casing, means for rotating the shaft, a sleeve surrounding the shaft within said chamber and having threads extending in different directions thereon, a bar projecting from the chamber within the casing to the outside thereof, a support for said sleeve, said support being slidably mounted upon said bar, a reversing frame mounted on the bar within the casing, and a support for a device to cooperate with said work holder, said support being secured to the end of the bar outside of the casing.

39. A casing having a chamber therein, a shaft rotatably mounted within said casing and extending through said chamber, a work holder secured to the shaft outside of the casing at one end thereof, driving means secured to said shaft outside of the casing at the opposite end thereof, a cover secured to the end of the casing and inclosing said driving means, reversing mechanism operatively connected with the shaft within the casing, and means for operating said reversing mechanism.

40. A casing having a chamber therein, a shaft projecting through said chamber outside of the casing at opposite ends thereof, a work holder secured to the projecting end of the shaft at one end of the casing, driving means secured to the shaft outside of the casing at the opposite end from said work holder, a cover secured to the end of the casing and inclosing said driving means, reversing means located within said chamber and operatively connected with said shaft, and means projecting through said casing and cover from said chamber to the outside of the structure and constituting a part of said reversing means.

41. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a sleeve having means thereon for causing reciprocating movement of said shaft, a member to cooperate with said sleeve to effect said reciprocating movement, means for connecting said member with and disconnecting it from said sleeve, and means for manually operating said sleeve when said member is disconnected therefrom.

42. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a sleeve having means thereon for causing reciprocating movement of said shaft, a member to cooperate with said sleeve to effect said reciprocating movement, means for connecting said member with and disconnecting it from said sleeve, a rack secured to said sleeve, and manually operated means engaging said rack to effect longitudinal movement of said sleeve.

43. A casing having a chamber therein, a shaft rotatably and reciprocatively mounted within the casing and projecting into said chamber, means for rotating the shaft, a sleeve located within said chamber and having means thereon for causing reciprocating movement of said shaft, a member located within the chamber and cooperating with said sleeve to effect said reciprocating movement, means connecting said member with and disconnecting it from said sleeve, a rack secured to said sleeve, and a manually operated member mounted in the casing and extending from the outside thereof into said chamber where it is operatively connected with said rack.

44. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a reversing sleeve surrounding said shaft and having means thereon for causing reciprocating movement of said shaft, a support, a two part bracket slidably mounted on said support and having its members located on opposite sides of said sleeve to support it, and means secured to said bracket to cause movement thereof by the operation of a manually operated member.

45. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a sleeve surrounding the shaft and having means thereon to cause reciprocating movement of said shaft, a support, a bracket slidably mounted on the support and including two parts located on opposite sides of the sleeve and surrounding it, means for securing the two parts of the bracket together, a rack secured between the two parts of the bracket, and manually operated means connected with said rack to effect movement of said sleeve.

46. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a sleeve surrounding said shaft and having means thereon for causing reciprocating movement of said shaft, a support, a frame mounted to rock on said shaft and having blocks depending from the frame and located on opposite sides of said shaft to alternately engage said reversing means on the sleeve, and means for rocking said frame to cause reciprocating movement of said sleeve.

47. A shaft rotatably and reciprocatively mounted, means for rotating the shaft, a sleeve surrounding the shaft and having threads thereon extending in opposite directions, a support, a rocking frame mounted on the support, threaded blocks supported by said frame on opposite sides of said sleeve to engage the threads thereon, cams located on said sleeve, reversing lugs adjustably mounted in said blocks to engage said cams, and means for rocking said frame.

48. A shaft rotatably and reciprocatively mounted, means for rotating the shaft, a sleeve surrounding said shaft and having threads at each end thereof formed to provide a groove between each set of threads, a support, a bracket slidably mounted on the support and surrounding said sleeve within said groove, a rocking frame mounted on said support and having threaded members to engage the threads on said sleeve, and means for rocking said frame.

49. A shaft rotatably and reciprocatively mounted, means for rotating said shaft, a sleeve surrounding said shaft and having threads at opposite ends thereof forming a groove between the sets of threads, said threads extending in different directions, a support, a two part bracket slidably mounted on the support and engaging said sleeve on opposite sides thereof and within said groove to support it, a rocking sleeve surrounding said support, a rocking frame mounted on said support and on said rocking sleeve, said frame having members to engage the threads on the threaded sleeve to effect reciprocating movement of the latter, and means secured to said rocking sleeve to operate it.

50. In combination with a cutting tool, a work supporting shaft, bearings for said shaft, means for rotating the shaft in said bearings, and means for moving the shaft longitudinally in said bearings, one of said means being for positioning purposes and the other for cutting feed purposes.

51. In combination with a spindle supporting a grinding cutter, a work holder shaft supported in cooperative relation with respect to said spindle, bearings for said shaft, means for rotating said shaft in said bearings, means for moving said shaft longitudinally in said bearings, means for driving said shaft, and a connection between said driving means and shaft, said connection including a worm and worm wheel intermeshing one with the other.

52. A work holder and a reducing tool supported in cooperative relation, means for rotating the reducing tool, means for cooperatively positioning the reducing tool and work holder one with respect to the other, means for imparting a fast lateral movement to the reducing tool for positioning purposes, and means for imparting a slow feeding movement to said tool for cutting purposes.

53. A work holder and a reducing tool supported in cooperative relation, a member for relatively moving one of these elements with respect one to the other, to place them in approximate cutting relation, and means exerting force on said member to feed said element in the direction of cutting movement.

54. A work holder and cutter movably mounted with respect to each other, means exerting a force upon one of said members to move it towards the other, a stop to limit such movement and means for moving said stop relative to said last-named means to permit said force to effect a cutting action between the cutter and a piece of work carried by said holder.

HUGH M. ROCKWELL.