

April 17, 1956

J. J. FALLS

2,741,881

GRINDER OR THE LIKE

Filed Jan. 13, 1950

4 Sheets-Sheet 1

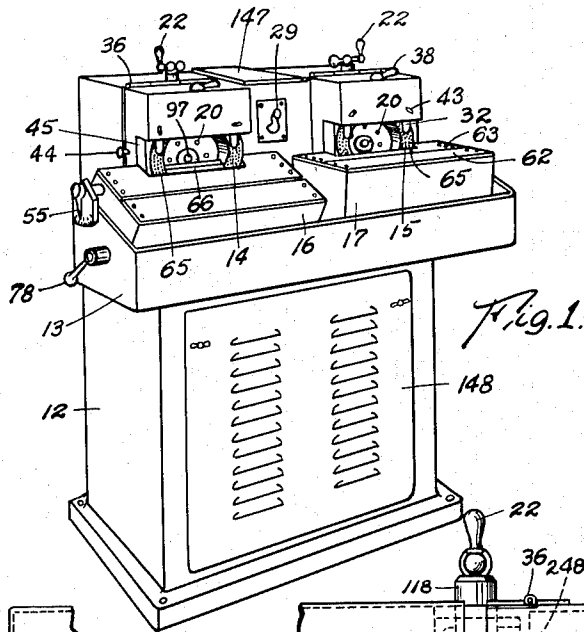


Fig. 1.

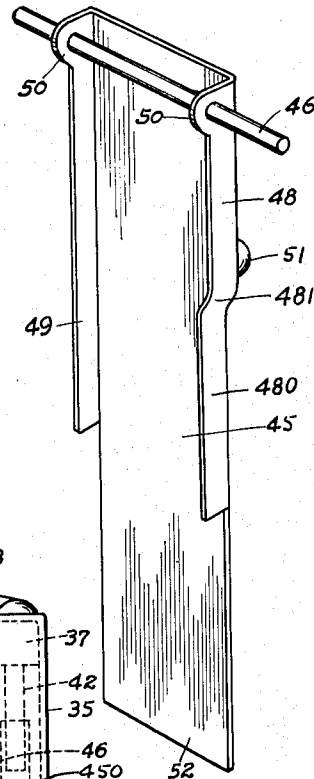


Fig. 3.

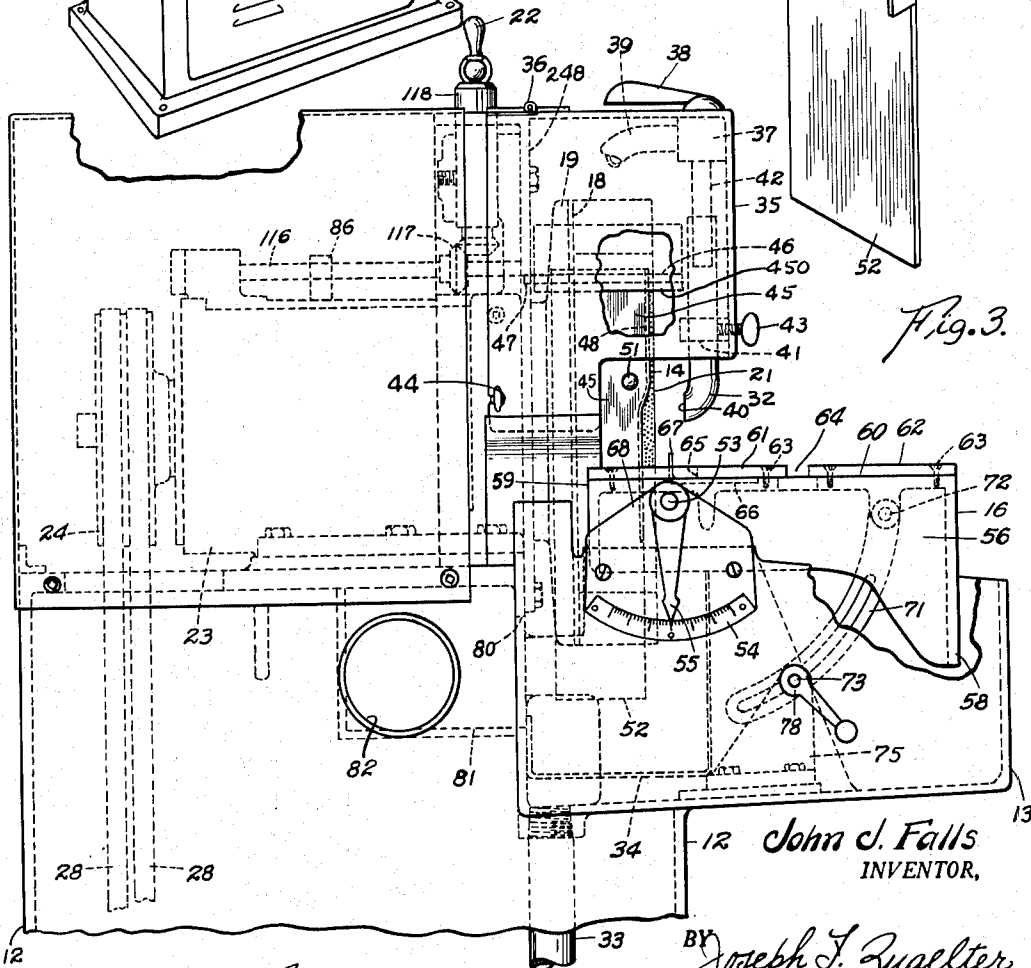


Fig. 2.

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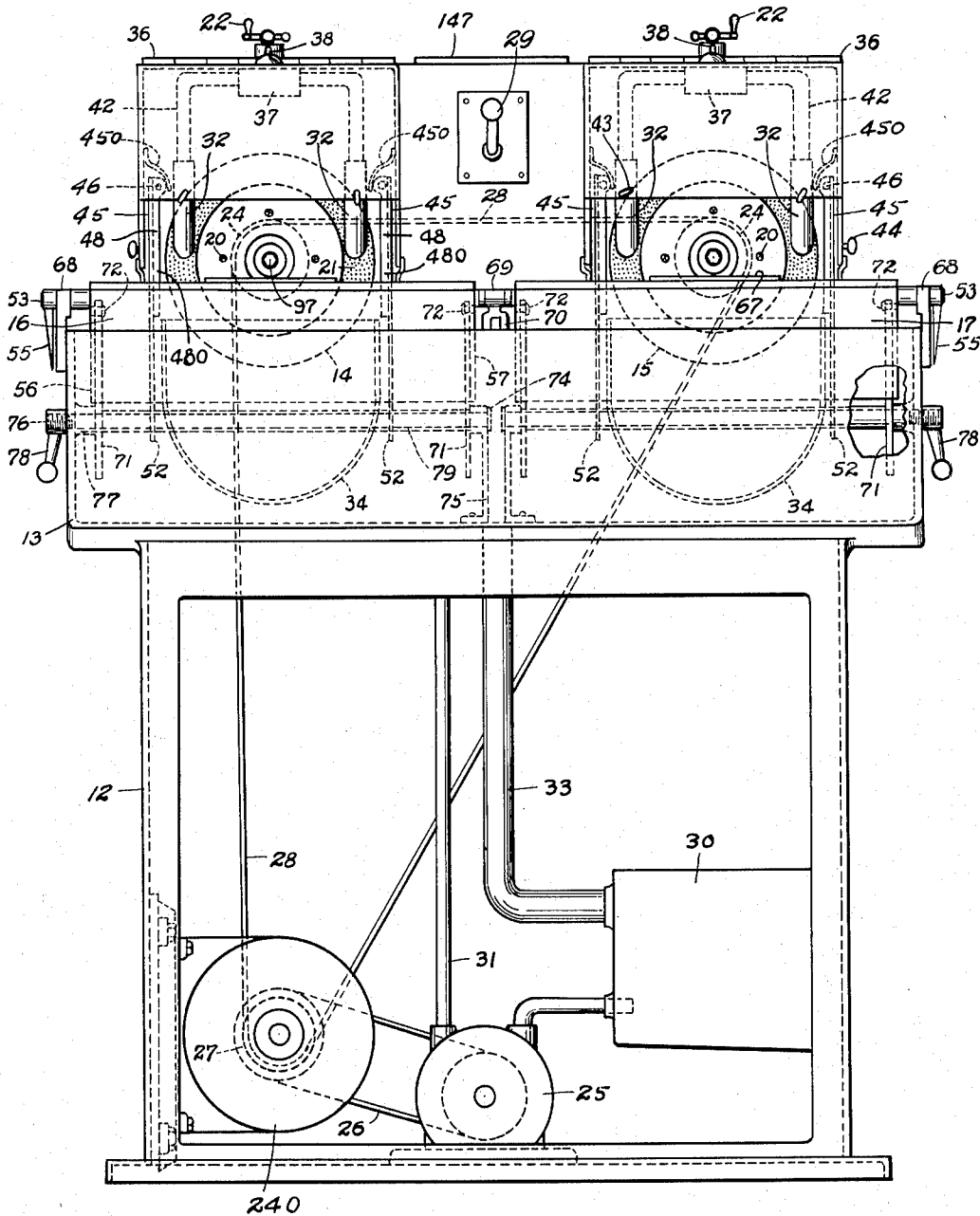


Fig. 4.

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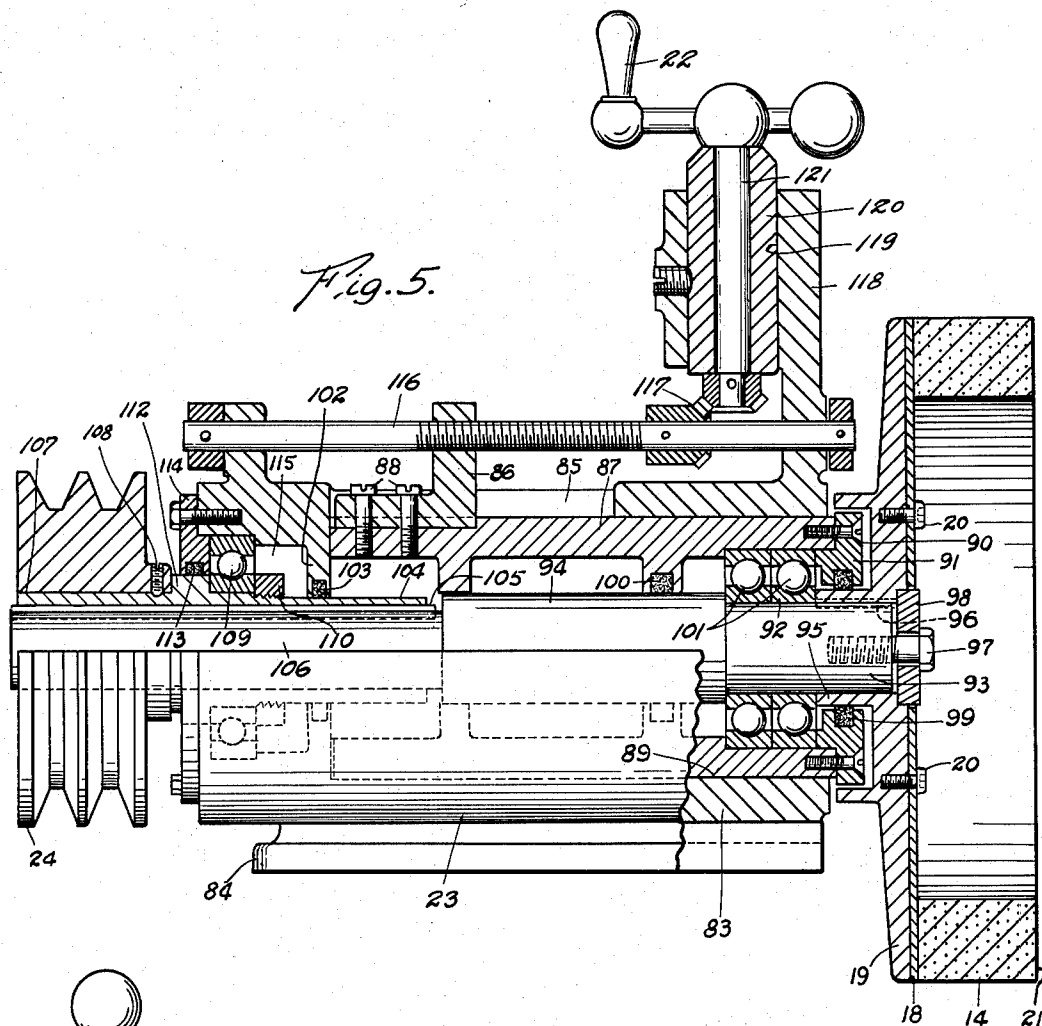
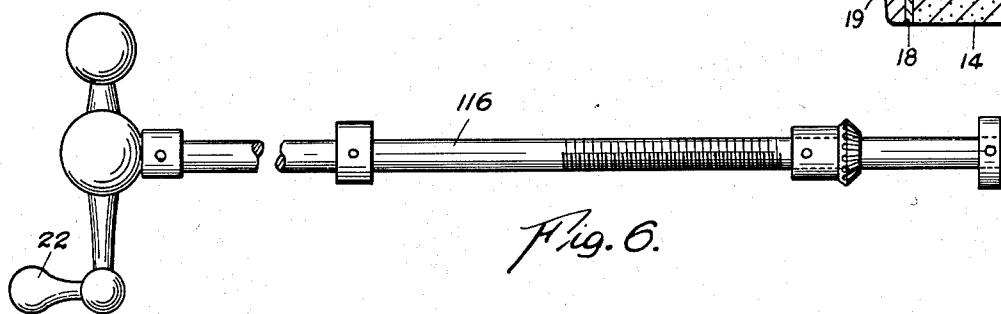
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4 Sheets-Sheet 3



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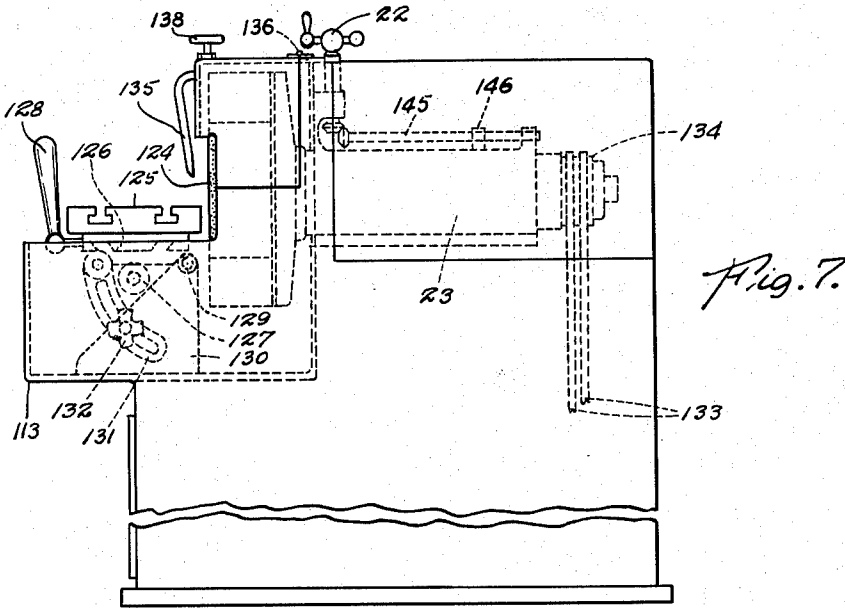
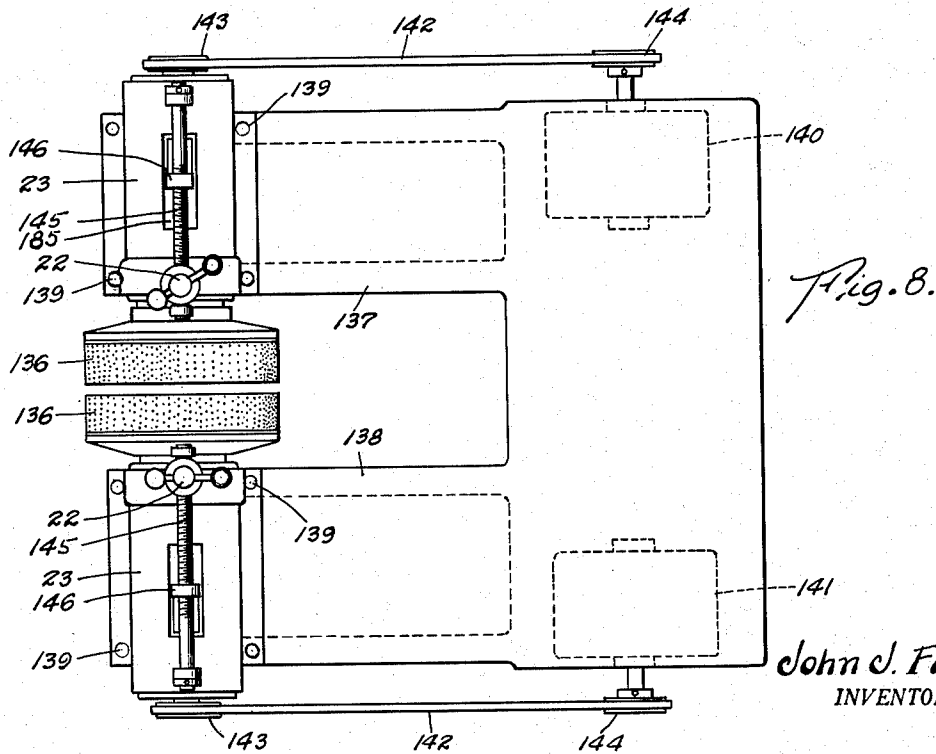
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4 Sheets-Sheet 4



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GRINDER OR THE LIKE

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Application January 13, 1950, Serial No. 138,448

4 Claims. (Cl. 51—109)

The present invention relates to a grinder or similar machine for the shaping of high speed steel tools or other objects.

An object of the invention is to provide a novel construction in grinders, whereby to enhance the convenience of usage, of adjustment, and of maintenance.

Another object is to provide means in association with a grinding machine, for firmly supporting the object undergoing grinding with greater than usual solidity, thereby to improve the quality of the work and the speed with which it may be performed.

Another object of the invention is to provide improvements in a grinding machine whereby to achieve maximum rigidity, durability, and simplicity of the machine, with attendant advantages of vibrationless operation and increased safety for the benefit of the operator.

A further object is the production of a bodily replaceable drive unit for the grinding wheel, having a novel adjustment means incorporated therein, and adapted for independent usage in different types of machines.

Other objects are: to ensure maximum operator visibility and comfort, savings in grinding time and floor space, ease of adjustment, and of replacement of wearing parts, provision for wet or dry grinding, convenient access to all parts requiring periodic or occasional attention, and effective control adjustment of coolant flow.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawings, in which:

Fig. 1 is a perspective view of the new grinder or the like, embodying the improvements of the present invention.

Fig. 2 is a side elevation of the upper half of the machine illustrated by Fig. 1.

Fig. 3 is a perspective view of a coolant splash guard.

Fig. 4 is a front elevational view of the machine, parts broken away, and the front cover plate being removed.

Fig. 5 is a longitudinal vertical cross-section of the independent drive unit for the grinding wheel, showing the means for axially projecting and retracting the wheel.

Fig. 6 is a side elevational view of an alternative form of adjuster for the grinding wheel of the unit.

Fig. 7 is a side elevational view of a grinder including the unit of Fig. 5, said grinder being of a different type than that of Fig. 1.

Fig. 8 is a side elevational view of a third type of grinder, including a pair of the Fig. 5 units.

In general, the grinder as illustrated upon Figs. 1 to 5, inclusive, includes a suitable stand for pedestal 12 upon which is rigidly mounted a trough member 13 adapted to collect grindings and/or coolant gravitating from the grinding wheels 14 and 15; and forwardly of the grinding wheels are arranged the work tables or tool supports 16 and 17, which, unlike the tables commonly used upon grinding apparatus, are fixed against bodily movement or adjustment toward and from the working faces of the wheels 14 and 15. The wheels themselves are bodily shiftable or adjustable toward and from the tables, whether the wheels are in motion or at rest. This bodily adjustment of the grinding wheels is accomplished without

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disalignment of the driving means therefor, as will be explained in detail hereinafter.

It may here be noted that the grinding wheels employed on the present machine are of the cup type (see Fig. 5), meaning that the abrasive substance of the wheel is in the form of a short cylinder or ring fixed axially upon a base disc 18, which disc in turn may be demountably attached to a driving disc 19 forming part of the driving unit 23 of Fig. 5. Screws 20 having socket heads are suggested as convenient means for detachably mounting the grinding wheel upon the disc 19 of the driving unit. The abrasive ring may be attached to its disc 18 by cementing, vulcanizing, or other means immaterial to the present invention. The parts consisting of the abrasive ring and its permanently attached disc 18, may properly be termed a grinding unit, as it is bodily replaceable upon the drive disc 19 whenever the ring wears down to an appreciable extent in the direction of the disc 18. The working or wearing surface of the grinding wheel is indicated at 21, and is generally normal to the axis of rotation.

With further reference to Fig. 5, it should be remembered that the grinding wheel and the driving disc 19 are bodily shiftable axially of the driving unit 23 by manipulating a handle 22, to adjust the working face of the wheel toward and from the work table. This adjustment is obtained chiefly by reason of the fact that the main shaft of the driving unit is telescopically extensible, without axially shifting the drive pulley 24. It is for this reason that the work table remains fixed and rigid throughout the grinding operation, to enhance the accuracy and speed of the grinding operation.

According to Fig. 1, the working faces of both grinding wheels face the front of the machine, where the operator is stationed, so that the operator may grind a tool or other object upon either of the wheels 14 or 15, without walking partly around the machine. That is, the operator need only take a short sidestep to the right or left in order to use either grinding wheel, one of which may be a coarse grinder and the other a finish grinder. Moreover, this machine may be placed with its back against a wall, without inconvenience to the operator, and with a saving of valuable floor space about the machine. All controls and adjustments are easily accessible from the operator's station at the front of the machine.

In Fig. 4, the driving motor for the machine is at 240, while 25 indicates a self-priming pump for liquid coolant, driven from the motor by a belt or chain 26. A double pulley 27 on the motor shaft drives a pair of belts 28—28, both of which may be trained over the double pulleys 24—24 of the drive units to rotate both grinding wheels in a common direction, preferably. The motor 240 is reversible, and may be started and stopped by means of any suitable type of electric switch controlled by a handle or switch actuator 29 located preferably between the two grinding wheels. The wheels, of course, may be driven by a single belt 28 or by means of a chain and sprocket arrangement, if desired. Both the motor and the pump 25 may be mounted upon the machine frame, in position to properly tension the belts 26 and 28. The pump is arranged to draw liquid coolant from a reservoir 30, and to force the coolant upwardly through pipe 31 which feeds the several delivery nozzles 32 located at the grinding faces of wheels 14 and 15. The coolant, after striking the faces of the wheels, gravitates into the hollow trough member 13 and returns to the reservoir 30 by way of pipe 33. Before entering the pipe 33, the coolant passes through a strainer box 34 (Fig. 2), located within the trough member.

Each of the coolant delivery nozzles 32 (Fig. 2), is mounted in upright position upon a hinged wheel-hood 35, which may be swung upwardly about a hinge such as 36 to expose the grinding wheel. The hood 35 car-

ries also a selector valve 37 of any approved type, operative by means of a handle 38 to supply coolant to either nozzle of a pair associated with each grinding wheel. A flexible hose 39 feeds coolant from the pump line to the valve 37. This valve may preferably include a shut-off, to terminate coolant flow to both nozzles supplied thereby.

The coolant delivery nozzle in each instance may be adjustable vertically to dispose its delivery port 40 at different elevations above the work table and any tool or other object supported thereon for grinding. One representative form of adjusting means is illustrated upon Fig. 2 by way of example, and consists of a bored block 41 slidably receptive of the pipe-like nozzle element to permit sliding of the latter upon a tube 42 leading from the valve. The nozzle may be fixed in adjusted positions by means of a thumb-screw 43 screw-threaded into the block as shown, the block being fixed to the hood 35. A hood latch is indicated at 44.

When the hood 35 is swung upwardly about its hinge 36, through an arc approximating 90 degrees, the grinding wheel is fully exposed for application of a wrench to the several screws 20 which secure the wheel to the driving disc 19. By removing said screws, the worn or used grinding wheel may simply be lifted bodily from its normal position adjacent the work table, and, without any interference from the nozzles 32 or other parts of the machine, replaced by a new wheel. The hood may then be lowered and re-fastened at screw 44.

To avoid splashing of coolant beyond the sides of the hood, there is provided a pair of splash guards for each grinding wheel. These splash guards, detailed at 45, (Fig. 3), may depend vertically from horizontal rods 46 (Fig. 2), and lie close to the grinding wheel periphery, to intercept liquid coolant thrown outwardly by centrifugal action as the wheel rotates. The rods 46 may be anchored at 47 in the front frame panel 248 of the machine pedestal, and are independent of movements of the hood 35. Referring to Fig. 3, the splash guard consists of a sheet, preferably metal, having opposite side edges turned approximately at right angles to provide opposed flanges 48 and 49, developed at their upper ends to form perforated ears 50 receptive of the rod 46. The guard is slidable upon the rod longitudinally thereof, to an operative position at which the inwardly offset lower portion 480 of flange 48 lies substantially in or slightly behind the plane of the working face of the grinding wheel, to avoid interference with manipulation of a work piece or tool undergoing grinding. The upper flange portion 48, being offset outwardly beyond portion 480, will naturally extend forwardly of the working face of the wheel, and at an elevation such as to likewise avoid such interference. Coolant striking the guard anywhere above the curve or offset 481, will be thereby directed down toward the end 52, which depends into trough 13. To prevent coolant from running down the outer faces of the splash guards, baffles fixed to the hoods may overlie the upper ends of the splash guards, as at 450 (Fig. 4). Depending upon the direction of rotation of the grinding wheel, one or the other of a pair of splash guards will be adjusted to the wheel as above explained. A finger piece or knob 51 facilitates adjustment of the splash guard along its support rod 46.

Attention is now directed to the work tables 16 and 17, which are identical in construction, wherefore a description of one will suffice for the other also. Referring to Fig. 2, in which the table is shown horizontal, rather than tilted as in Fig. 1, the character 53 indicates a rock stud shaft which supports the table in an infinite number of angular positions between the limits of the graduations marked upon the indicator plate 54. The pointer 55 is adapted to indicate in degrees of inclination, the slope of the upper face of the work table. Accordingly, the pointer and the shaft should move with the table when tilted about the shaft axis.

The table may be in the form of a metal casting hav-

ing opposite ends 56-57, a forward depending apron 58, an open back portion 59 to admit the grinding wheel, and an upper plane surface 60 to which is secured the accurately machined and hardened wear plates 61 and 62. These wear plates are replaceable when worn or damaged, and may be held to the table top by means of screws or other fasteners 63. The plates preferably are spaced apart as indicated at 64, to accommodate a tractor tool guide or holder, if desired. The wear plate 61 is cut away to provide a straight edge 65 forwardly of the grinding wheel working face, and from said straight edge may project an adjustable slide 66 carrying a safety lip 67 to prevent tools or other objects dropping into the central recess of the grinding wheel. In practice, the lip extends into the wheel recess. As heretofore pointed out, the grinding wheel is adjustable bodily toward and from the table edge 65, and no provision is made for shifting the table toward and from the working face of the grinding wheel.

Means are provided for tilting the work table and locking it at predetermined degrees of inclination relative to the plane of the wheel face. As previously pointed out, the table may tilt with the studs 53 supported in bearings 68-69 at opposite ends of the table, the bearings 68-69 being carried by the trough member 13 or any other stationary part of the machine available as a bearing support, such as bracket 70. To hold the table in its various positions of inclination, opposite ends of the table may be provided with arcuate slotted arms 71 pivoted to the table ends at 72, and reaching down into the trough member to engage a clamping shaft 73 that passes through the slots of the arcuate arms. The shaft 73 is supported at its inner headed end 74, (Fig. 4) by a bracket 75 fixed within the trough member, whereas the outer end of the shaft is threaded as at 76 and receives support from a bored boss 77 formed on an end wall of the trough member. A hand nut 78 serves as the means to draw the shaft toward the boss, with slight flexation of bracket 75 resulting, to clamp the arcuate arms 71-71 against the ends of a loose sleeve 79 which surrounds the shaft between said arms. By means of this arrangement or any one of many possible variations thereof, the tiltable table may be set and held at predetermined degrees of inclination, in accordance with the requirements of the grinding operation.

It may here be noted that the rear wall of the trough member, at 80 (Fig. 2), has an opening behind each grinding wheel leading to a collecting chamber 81 provided with an exhaust port 82 in the side of the pedestal, to which may be attached a suction pipe for carrying away dust and grit produced when the machine is used in dry-grinding operations.

The grinding wheel driving unit of Fig. 5, indicated generally at 23 throughout the drawings, has many different applications of usage in the grinding art, and possibly in other fields where a rotary cutter or trimmer may best be advanced to the work and retracted therefrom, instead of moving the work bodily relative to the cutter or trimmer. Two typical applications are illustrated by Figs. 7 and 8, these having been selected from a number of current applications presently undergoing development. The devices of Figs. 7 and 8 will be described following the detailed explanation of Fig. 5, below.

In Fig. 5, the cylindrically bored housing 83 is provided with a mounting base 84, and opposite the base is formed a longitudinally extending slot or guideway 85 in which may travel a nut 86. The nut in traversing the guideway 85, carries with it a cylindrical ram 87 to which the nut is secured by fasteners 88, or otherwise. The width of the nut approximates the width of the guideway, so that the ram may reciprocate within the housing bore 89, but may not rotate therein. At the right or forward end of the ram, there is mounted fixedly, as by means of screws 90, an anti-friction bearing retainer 91. One or more anti-friction bearings 101 support the reduced

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end 93 of the main drive shaft 94 of the unit. The hub 95 of disc 19 fits over the reduced end of the shaft and is keyed thereto at 96, with a bolt and washer 97—98 serving to force and hold the hub firmly against the inner bearing race 92. The outer machined surface of the hub 95 may be sealed against leakage of lubricant from the bearings, by the annular packing ring 99 carried by member 91. A second lubricant retaining ring 100 may be carried by the ram, to provide in association with the first ring, a lubricant retentive chamber for the bearings 101.

The rear or left end of the cylindrically bored housing 83 has an annular partition wall 102 formed therein, with a groove provided to seat a lubricant retaining ring 103. This ring surrounds and seals against a rotary sleeve 104, which through the medium of one or more elongated keys or splines 105, has a driving connection with the main shaft 94. The spline or keyway for the key 105 is provided in the elongate reduced-diameter end 106 of the shaft, and as Fig. 5 indicates, this end of the shaft may extend beyond the end 107 of the sleeve 104. The driving pulley 24 is secured to the sleeve end 107 by one or more set-screws 108, and may also be keyed thereto in accordance with common practice.

The rear end of the housing 83 is recessed to receive the bearing 109 and the nut 110 which secures the bearing to the annular shoulder 112 of the drive sleeve 104. The periphery of this shoulder may be sealed by means of the lubricant retaining ring 113 carried by the end cap or plate 114 used in closing the bearing recess or chamber 115.

It will be understood from the above explanation, that pulley 24 drives the sleeve 104 with a rotary motion only, the sleeve being incapable of any perceptible longitudinal movement. Through the medium of the key or spline connection 105, the sleeve 104 drives the main shaft 94 and the grinding wheel 14 thereto attached. Now if the adjusting screw 116 be rotated for the purpose of traversing the nut 86, and extending the ram 87 attached thereto, the splined or keyed end 106 of the main shaft 94 will be drawn to the right, along with the ram and the grinding wheel. Regardless of the extent to which the ram and grinding wheel are thereby projected by the action of the adjusting screw upon the nut 86, as limited by the length of slot 85, the driving connection between the pulley, the sleeve, and the shaft, is always maintained. It should be understood that the shaft is a single piece, from the drive pulley to the wheel disc 19. The shaft has no relative movement longitudinally of the ram 87.

Fig. 5 shows the ram and the grinding wheel in fully retracted position, which is the same position shown in Fig. 2. To place the grinding wheel in normal operating position, the adjusting screw 116 would be operated by means of the handle 22 and the intermediate gearing 117, to advance the nut 86 to the right. The nut carries with it the ram, the drive shaft, and the grinding wheel as previously explained. When the screw 116 has been rotated sufficiently to bring the working face of the grinding wheel within a short distance of the table edge 65, the machine is ready for operation. Of course, as the wheel wears away, readjustment of the unit by means of the adjusting handle 22 becomes necessary if the proper working relationship between the grinding wheel and the work table is to be maintained.

Referring to Figs. 5 and 6, it may be noted that the adjusting means can be designed for actuation in several ways. In accordance with the Fig. 5 disclosure, the unit housing has an extension 118 provided with a bore 119 in which is fitted a sleeve 120. The sleeve provides a vertical bearing for the actuating shaft 121 which rotates the miter gears for rotating the adjusting screw and traversing the nut 86. When an angular relationship between the adjusting screw and the actuating handle is not required, the screw may simply have a direct connection with the handle as suggested by Fig. 6. Another possible variation can be attained by mounting the unit of Fig. 5

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with its base applied to an upright surface, as in Fig. 8, in which case the operating shaft will extend horizontally or laterally outwardly from the unit. In certain installations, these various alterations or modifications of usage may result in added conveniences or advantages.

Fig. 7 illustrates a single wheel grinder incorporating one of the driving units 23. The unit, as before, is adjustable by means of the handle 22, to advance and retract the grinding wheel 124 relative to the work table 125. In this machine, the table may be of the type illustrated by Fig. 1, or in the alternative, it may be reciprocable on the ways 126 transversely of the grinding wheel, either manually or automatically. As shown, the table may be actuated along the ways by means of a pneumatic or hydraulic cylinder motor 127 applied in a customary manner. Manual reciprocation may be had by means of a handle 128 secured to the table, or otherwise arranged to move the table by manipulating the handle. In the reciprocating table type of machine, the work piece may be secured to the table in the usual way to engage the grinding wheel.

The table bed carrying the ways 126 may be tiltable about a stationary pivot or rock shaft 129 supported upon bracket means 130, and suitable clamping means may be provided for maintaining the table at adjusted inclinations. A simple conventional clamping means is shown by way of example, as an arcuate slotted arm 131 securable by means of a hand nut 132, substantially in accordance with the disclosure at 71—72—73 of Fig. 2. In Fig. 7, driving belts 133 corresponding to those at 28 of Figs. 2 and 4, transmit power from the motor (not shown) to the drive pulley 134 of unit 23. A coolant delivery nozzle is indicated at 135.

The device of Fig. 8 is a machine utilizing two of the drive units 23 arranged with the main shafts thereof in axial alignment. Each unit carries a grinding wheel 136, and the working faces of the wheels are disposed in closely spaced parallelism so that between them may be inserted a plate or strip to be ground and dressed on opposite faces. The arrangement is suitable for grinding smooth a weld joining the edges of two coplanar sheets or plates, for example. The space between the grinding wheels 136—136 may be varied by simply manipulating one or both handles 22 of the driving units 23. The units may be mounted upon the parallel frame members 137 and 138 of the machine, as by bolts or other fasteners 139, and may be driven by one or more motors, the drawing suggesting by way of example the individual electric motors 140 and 141, driving the upper and lower units by means of belts and pulleys 142, 143, and 144, or the equivalent. In this modification, 145 indicates the unit adjusting screw, and 146 is the nut which travels along the screw to advance the ram and the grinding wheel, as was explained in the description of Fig. 5.

The machine of Fig. 1 is known as a twin wheel grinder, and in practice it will be furnished with grinding wheels of different grades so that rough grinding and finish grinding may be performed on the same machine with great facility and unusual speed and accuracy. A single wheel machine is sometimes desired, and in that event the machine may be built upon a smaller pedestal or base, with omission of such parts as are not needed for single wheel operation. That is, the single wheel machine will require but one each of the grinding wheels, drive units, work tables, and coolant systems. A single drive belt 23 ordinarily will suffice, also.

Referring to Fig. 1 of the drawings, the character 147 indicates a resilient tray conveniently accessible to the operator, and upon which may be placed tools, hones, and other objects needed at the machine. The tray may be mounted atop the machine frame, preferably between the grinding wheels, and will preferably consist of a slab or sheet of composition board material other than metal, upon which the tools or other objects may be placed without injury to the sharpened or finished edges or faces thereof.

The forward panel 148 is made removable for ready

access to the coolant system, the drive motor, and their adjustments, (see Fig. 4). An examination of Fig. 4 clearly reveals the fact that any of the belts driven by the motor 240 may be quickly replaced when worn, without in any way dismantling the machine. The pump 25 is indicated conventionally for the reason that it may be any one of several known forms which produces a unidirectional flow of liquid irrespective of the direction of rotation of its driven shaft. Diaphragm types of pumps, for example, are in this category.

It is to be understood that various modifications and changes in the structural details of the devices embodying the invention may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed is:

1. A grinding machine comprising in combination, a stationary frame having an apertured front wall, a reversible rotatable shaft having a forward end projecting through the aperture of said wall, and a grinding wheel fixed to the forward end of the shaft, said grinding wheel having a peripheral curved face, and a planar face normal to said shaft, the faces aforesaid meeting to form an outer edge of the wheel, means for bodily shifting the grinding wheel axially, means delivering coolant to the wheel, and adjustable splash control means for coolant, comprising a pair of elongate substantially flat upright plates each having a head end, a foot end, and opposed forward and rear edges, means supporting the upright plates in position at opposite ends of a diameter of the grinding wheel, for bodily shiftability in the direction of shiftability of said wheel, with the flat portion of each plate intermediate the head and foot ends thereof disposed tangentially to the curved face of the grinding wheel, and said head and foot ends disposed remotely from the periphery of said wheel, a flange on the forward edge of each plate, extending in substantial parallelism with the planar working face of the grinding wheel, and movable with the plate to positions for intercepting coolant thrown from the aforesaid outer edge of the grinding wheel.

2. A grinding machine comprising in combination, a stationary frame having an apertured front wall, a reversible rotatable shaft having a forward end projecting through the aperture of said wall, and a grinding wheel fixed to the forward end of the shaft, said grinding wheel having a peripheral curved face, and a planar working face normal to said shaft, the faces aforesaid meeting to form an outer edge of the wheel, means for bodily shifting the grinding wheel axially, means delivering coolant to the wheel, and adjustable splash control means for coolant, comprising a pair of elongate substantially flat upright plates each having a head end, a foot end, and opposed forward and rear edges, means supporting the upright plates in position at opposite ends of a diameter of the grinding wheel, for bodily shiftability in the direction of shiftability of said wheel, with the flat portion of each plate intermediate the head and foot ends thereof disposed tangentially to the curved face of the grinding wheel, and said head and foot ends disposed remotely from the periphery of said wheel, a flange on the forward edge of each plate, extending in substantial parallelism with the planar working face of the grinding wheel, and movable with the plate to positions for intercepting coolant thrown from the aforesaid outer edge of the grinding wheel, and a rearward offset in the flange performing as a gutter to divert toward the front wall of the frame, such coolant as may be thrown from the aforesaid outer edge of the wheel by centrifugal action.

3. A grinder comprising in combination, a frame having a forward planar portion, a grinding wheel having a planar

working face for rotation in a plane parallel to the forward planar portion of the frame, means for adjustably shifting the grinding wheel bodily toward and from the forward planar portion of the frame into planes parallel to said frame portion, a splash guard in the form of a substantially flat elongated plate having opposite ends, a forward flange on the plate parallel with the planar working face of the wheel, to intercept substance thrown from the grinding wheel by centrifugal action, and means shiftably supporting the splash guard tangentially to the grinding wheel with said ends remote from said wheel, for movement toward and from the forward planar portion of the frame, to dispose said intercepting flange in substantially the plane of the working face of the grinding wheel, in various shifted positions of the grinding wheel.

4. A grinder comprising in combination, a frame having a forward planar portion, a grinding wheel having a working face for rotation in a plane parallel to the forward planar portion of the frame, means for adjustably shifting the grinding wheel bodily toward and from the forward planar portion of the frame into planes parallel to said frame portion, a splash guard in the form of a plate having a forward edge to intercept substance thrown from the grinding wheel by centrifugal action, means shiftably supporting the splash guard for movement toward and from the forward planar portion of the frame, to dispose said intercepting edge in substantially the plane of the working face of the grinding wheel, in various shifted positions of the grinding wheel, a hood over the grinding wheel displaceably mounted upon the grinder frame to expose the wheel and the splash guard, said hood being movable independently of said guard, and coolant delivery means including a nozzle carried by the displaceable hood, for directing coolant normally toward the working face of the grinding wheel.

References Cited in the file of this patent

UNITED STATES PATENTS

270,365	Bancroft	Jan. 9, 1883
377,201	Johnston	Jan. 31, 1888
401,278	Hyde	Apr. 9, 1889
647,413	Johnson	Apr. 10, 1900
789,741	Kaltenbach	May 16, 1905
988,231	Vernet	Mar. 28, 1911
1,405,922	Knowles	Feb. 7, 1922
1,625,127	Malone	Apr. 19, 1927
1,680,360	Bath	Aug. 14, 1928
1,842,538	Burgess	Jan. 26, 1932
1,862,583	Skriba	June 14, 1932
1,911,857	Stumpf	May 30, 1933
1,927,655	Belden et al.	Sept. 19, 1933
1,972,160	Osterholm	Sept. 4, 1934
2,000,667	Osterholm	May 7, 1935
2,021,602	Jackson	Nov. 19, 1935
2,052,031	Merrigan	Aug. 25, 1936
2,175,347	Granberg et al.	Oct. 10, 1939
2,209,711	Young	July 30, 1940
2,292,229	Krueger	Aug. 4, 1942
2,361,550	Krueger	Oct. 31, 1944
2,428,903	Zeun	Oct. 14, 1947
2,444,523	Nye	July 6, 1948
2,469,531	Toth	May 10, 1949
2,512,303	Butler	June 20, 1950
2,538,532	Oliver	Jan. 16, 1951
2,560,944	Garrison	July 17, 1951

FOREIGN PATENTS

110,446	Germany	1900
169,048	Great Britain	Sept. 21, 1921
562,355	Great Britain	June 28, 1944