Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 1

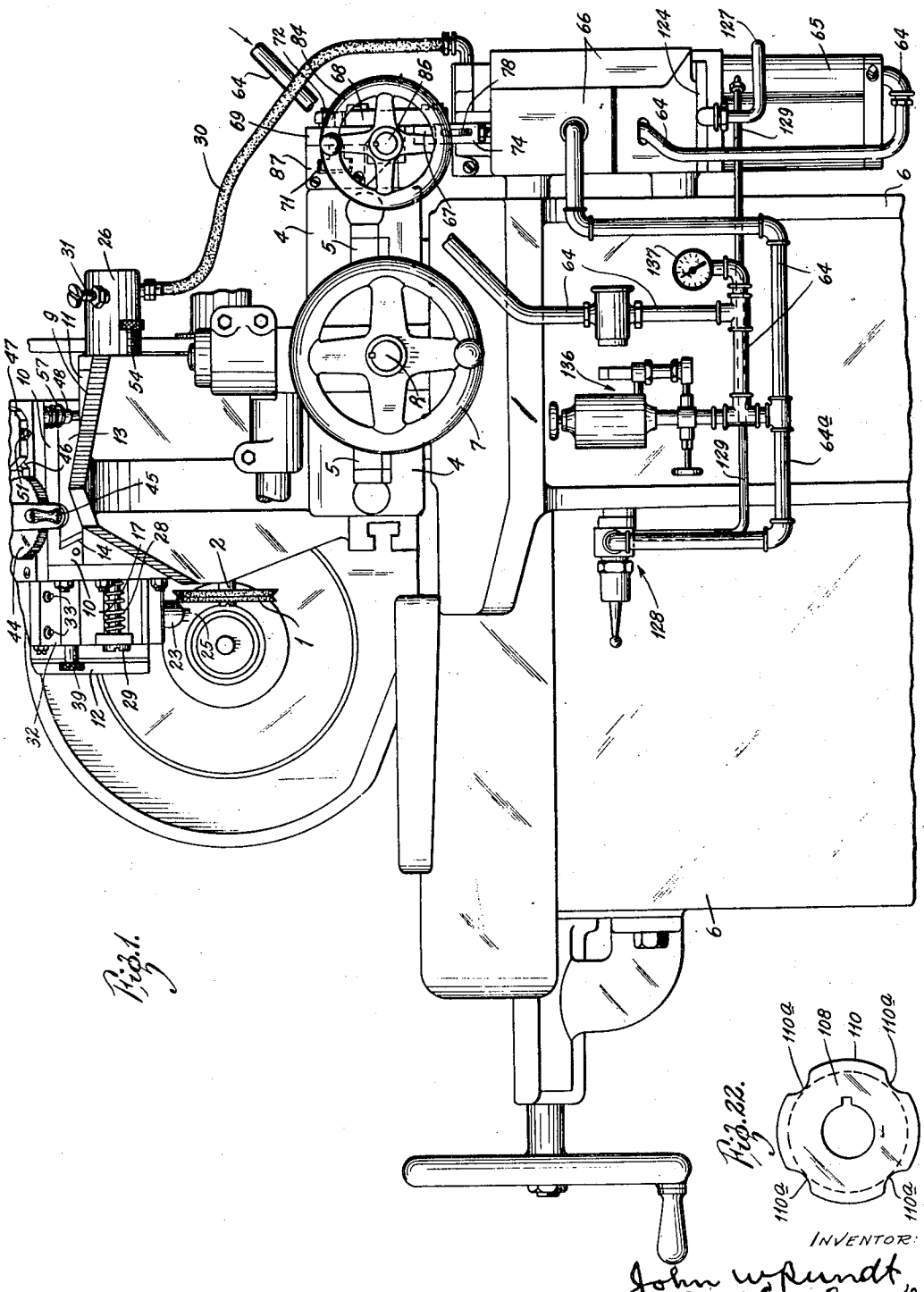


Fig. 1.

Fig. 22.

INVENTOR:
John W. Rundt,
by Carr Hare & Gravely,
HIS ATTORNEYS.

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 2

Fig. 2

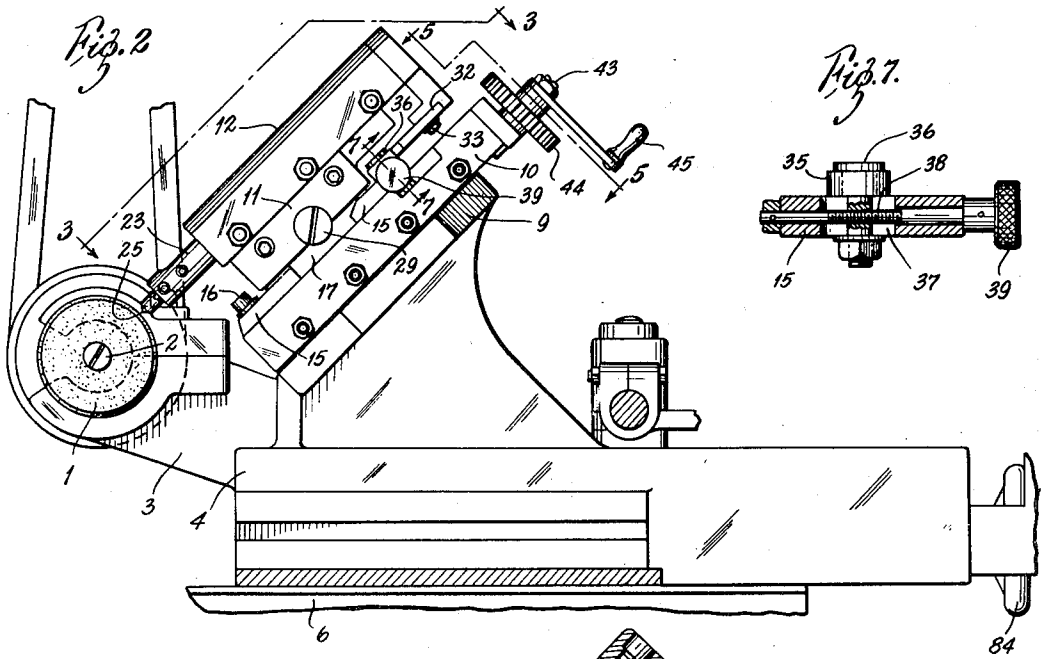
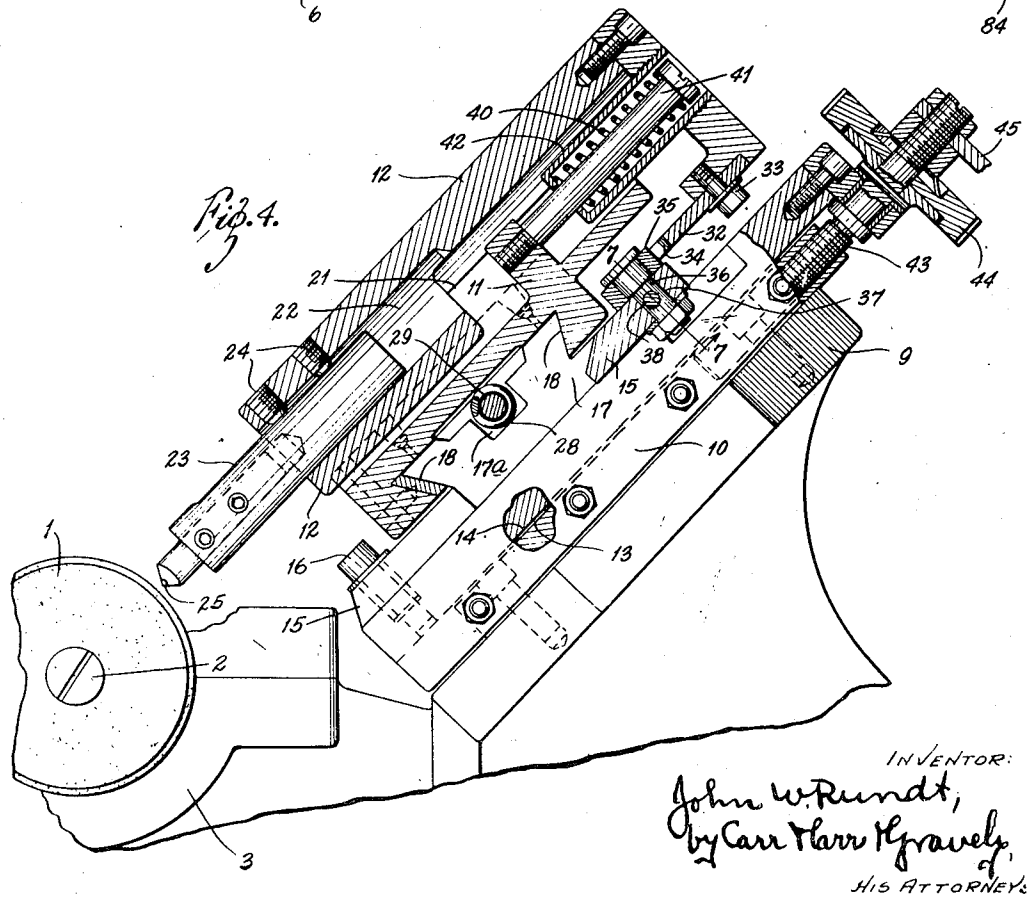


Fig. 7.

Fig. 4.



INVENTOR:
John W. Rundt,
by Carr Harr & Gravely,
HIS ATTORNEYS

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 3

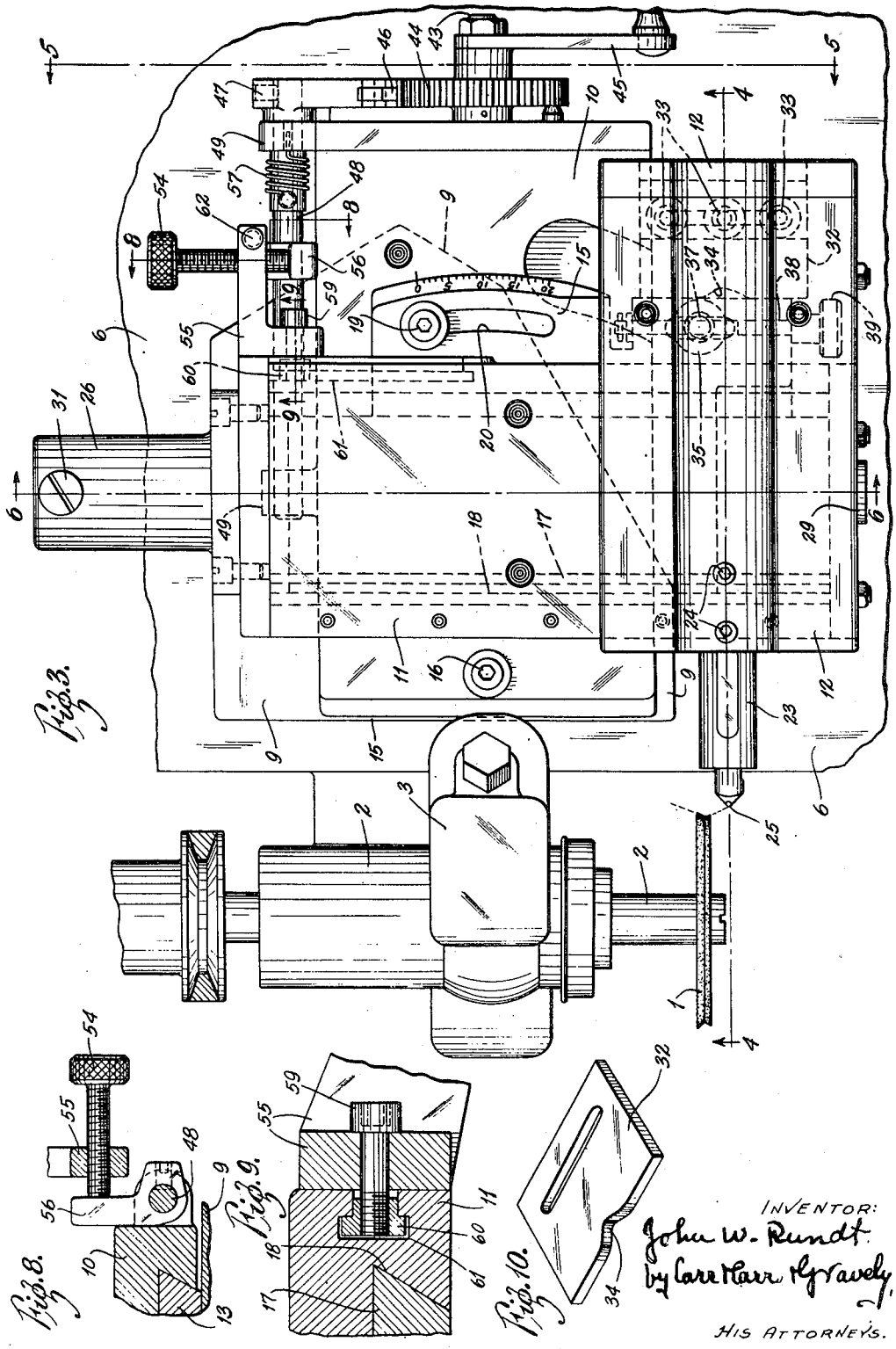


Fig. 3.

Fig. 8.

Fig. 9.

Fig. 10.

INVENTOR:
John W. Rundt
by Carr Carr & Gravely
HIS ATTORNEYS.

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 4

Fig. 5.

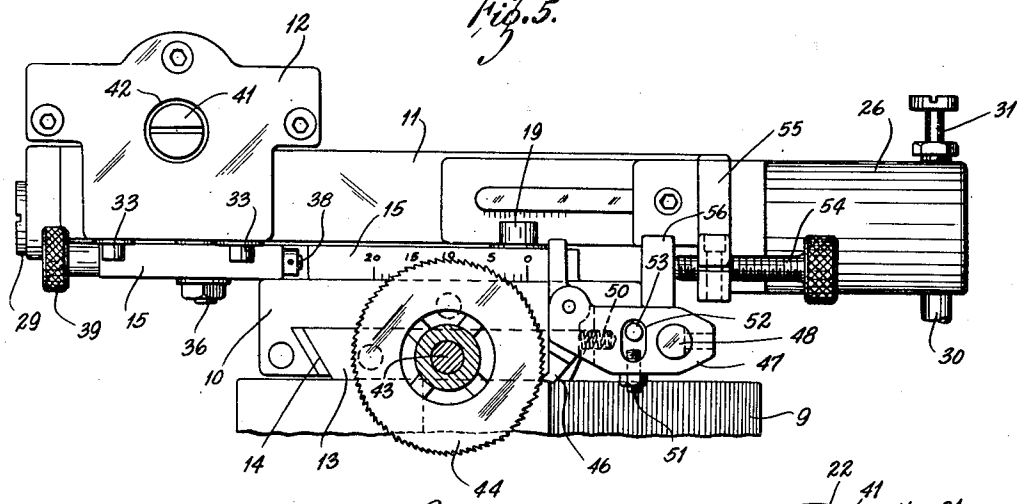


Fig. 6.

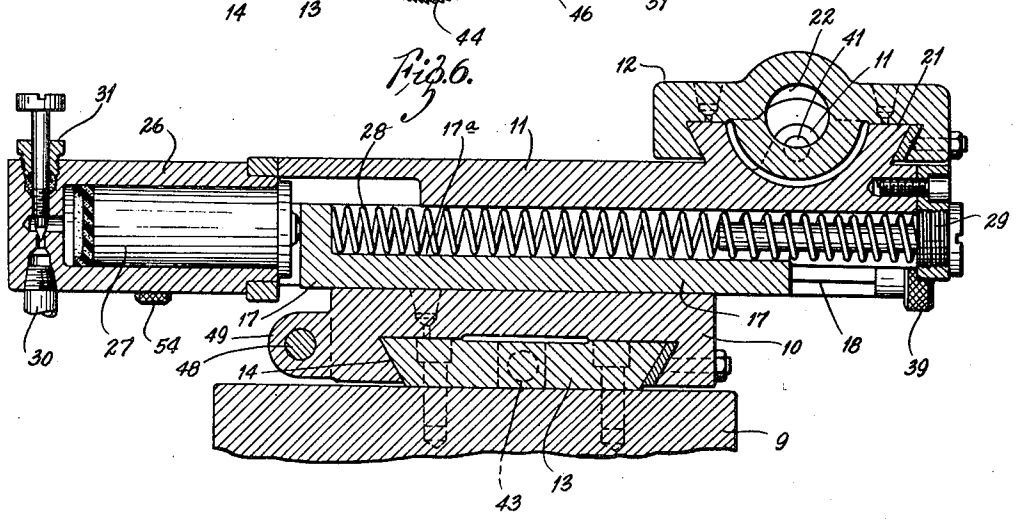
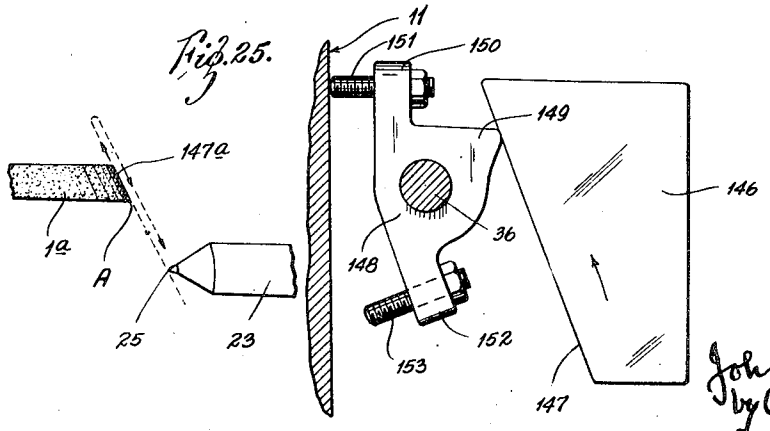


Fig. 25.



INVENTOR:
John W. Rundt,
by Carr Carr & Gravely,
His Attorneys.

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 5

Fig. 11.

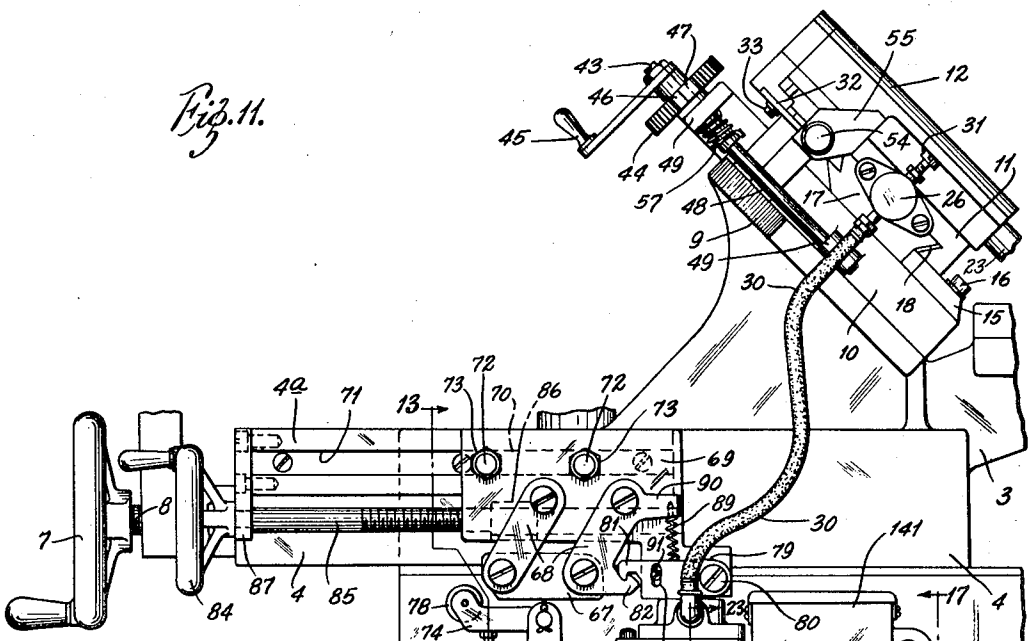


Fig. 13.

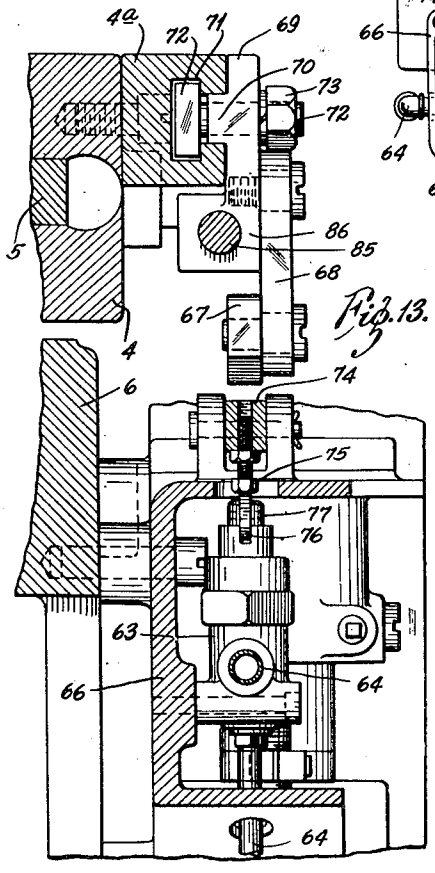
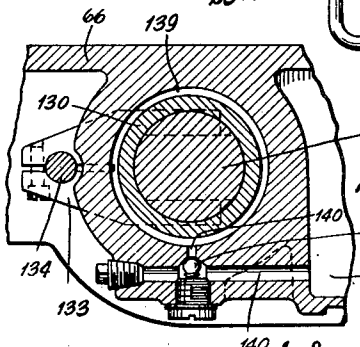


Fig. 14.



INVENTOR:
John W. Rundt,
By Carr Carr & Gravely,
His Attorneys

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 6

Fig. 12.

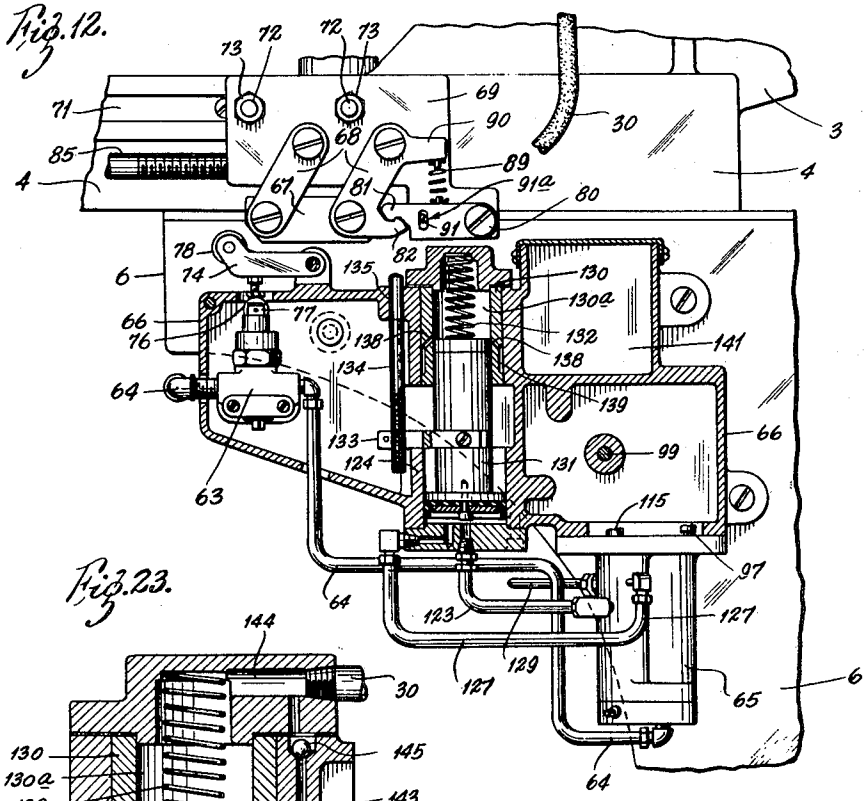


Fig. 23.

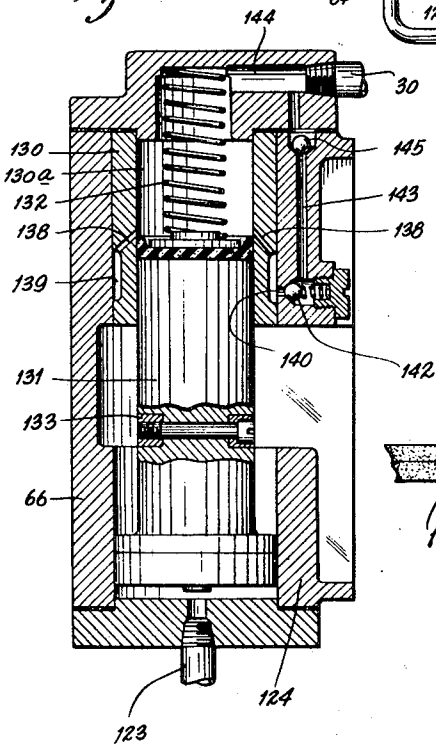
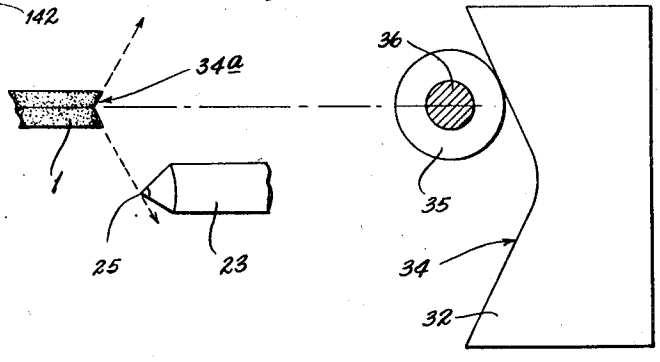


Fig. 24.



INVENTOR:
John W. Rundt,
by Carr Harr & Gravely,
HIS ATTORNEYS.

Aug. 17, 1948. J. W. RUNDT 2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

Filed Feb. 19, 1945 7 Sheets-Sheet 7

Fig. 15.

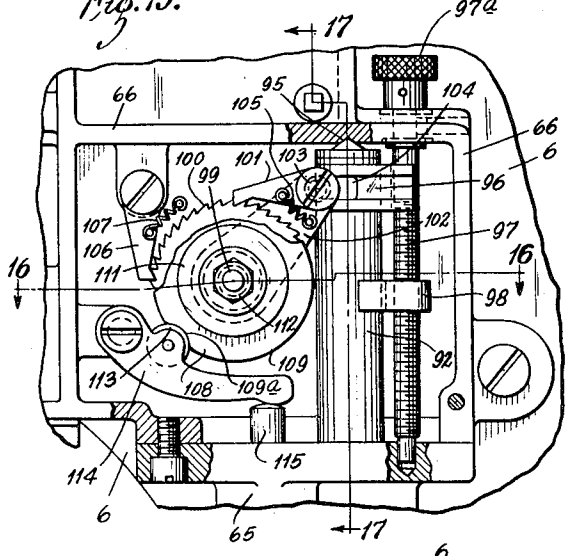


Fig. 17.

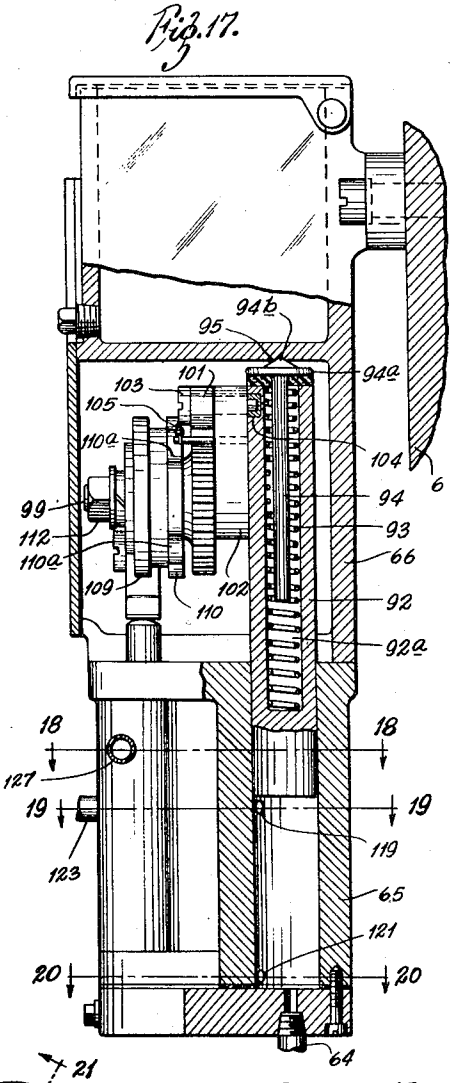


Fig. 16.

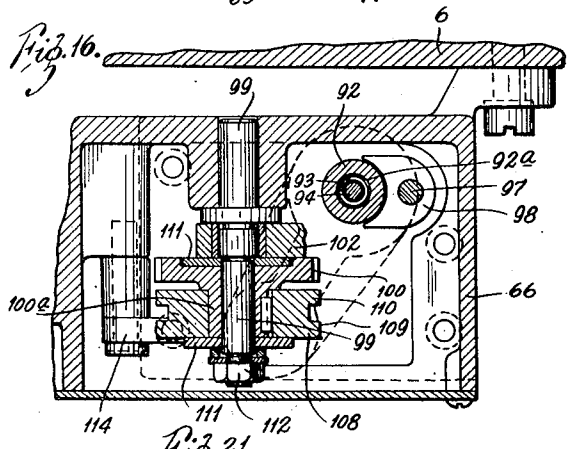


Fig. 21.

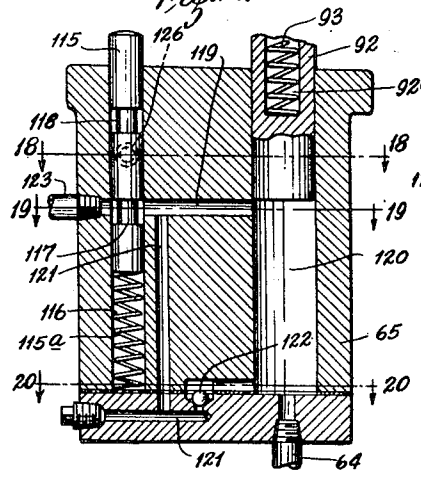


Fig. 18.

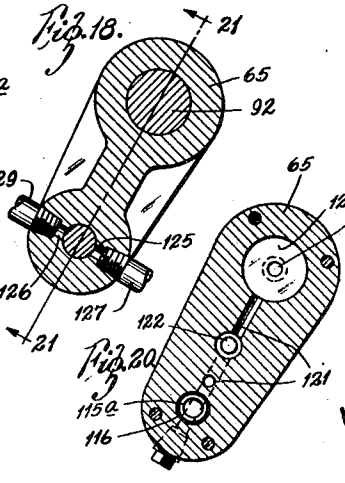
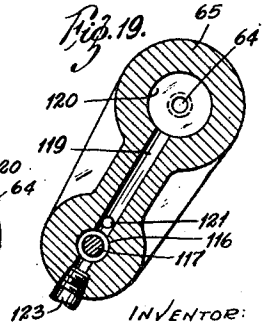


Fig. 19.



INVENTOR:
John W. Rundt
by Carr Kerr & Hovey,
HIS ATTORNEYS.

Patented Aug. 17, 1948

2,447,478

UNITED STATES PATENT OFFICE

2,447,478

GRINDING MACHINE WITH WHEEL DRESSER

John W. Rundt, Canton, Ohio, assignor to The Timken Roller Bearing Company, Canton, Ohio, a corporation of Ohio

Application February 19, 1945, Serial No. 578,626

22 Claims. (Cl. 51—2)

1

This invention relates to improvements in grinding machines in which means are provided for dressing and truing the working face of the grinding wheel without removing said wheel from said machine. The objects of my improvement are to provide a wheel dressing means which is entirely automatic in operation so as to relieve the operator of the grinding machine of all responsibility of dressing the grinding wheel thereof; that will perform the dressing operation while a ground work piece is being replaced with a work piece that is to be ground; that will provide for dressing the grinding wheel after a predetermined number of work pieces have been ground; that is readily adjustable to dress the grinding wheel after any given number of work pieces have been ground; that will produce a working face on the grinding wheel that is more smooth and accurate than is possible by hand methods; that can be adapted for dressing grinding wheels having working faces of straight or irregular profile; that will accurately control the amount of material removed from the wheel during each dressing; and that will have other advantages hereinafter appearing. The invention consists in the automatic wheel dressing and truing mechanism and in the parts and combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawings, which form part of this specification and wherein like symbols refer to like parts wherever they occur.

Fig. 1 is a front end elevational view of a grinding machine provided with a grinding wheel dressing and truing mechanism embodying my invention,

Fig. 2 is a fragmentary view showing the wheel dressing and truing unit in side elevation and the grinding wheel in end elevation,

Fig. 3 is a fragmentary view of the parts shown in Fig. 2, looking in the direction of the arrows 3—3 in Fig. 2,

Fig. 4 is a vertical sectional view on the line 4—4 in Fig. 3,

Fig. 5 is a sectional view on the lines 5—5 in Figs. 2 and 3,

Fig. 6 is a sectional view on the line 6—6 in Fig. 3,

Fig. 7 is a fragmentary section on the line 7—7 in Figs. 2 and 4,

Fig. 8 is a fragmentary sectional view on the line 8—8 in Fig. 3,

Fig. 9 is a fragmentary section on the line 9—9 in Fig. 3,

Fig. 10 is a perspective view of the cam plate for

2

moving the diamond slide towards and away from the grinding wheel,

Fig. 11 is a fragmentary side elevational view of the grinding machine, showing the cover plate removed from the housing for the fluid operated mechanism which controls the operation of the wheel dressing unit,

Fig. 12 is a view similar to Fig. 11, showing said housing and the air and oil cylinders and oil reservoir in vertical section,

Fig. 13 is a fragmentary vertical section on the line 13—13 in Fig. 11,

Fig. 14 is a horizontal section on the line 14—14 in Fig. 11,

Fig. 15 is a fragmentary side elevational view of the portion of the housing containing the mechanism for causing the wheel dressing unit to operate after a predetermined number of work pieces have been ground,

Fig. 16 is a horizontal section on the line 16—16 in Fig. 15.

Fig. 17 is a vertical section on the line 17—17 in Fig. 15,

Figs. 18, 19 and 20 are horizontal sectional views on the lines 18—18, 19—19 and 20—20, respectively, in Fig. 17 and 21,

Fig. 21 is a vertical sectional view on the line 21—21 in Fig. 18,

Fig. 22 is an end elevational view of the ratchet operated cam wheel for controlling the master valve of the fluid control system for the dressing and truing unit,

Fig. 23 is a vertical section on the line 23—23 in Fig. 11,

Fig. 24 is a diagrammatic view, showing the grooved working face of the grinding wheel and the cam plate for determining the contour of said working face; and

Fig. 25 is a diagram similar to Fig. 24, showing a grinding wheel with a beveled working face and a cam plate and rocker arrangement for moving the diamond clear of said face during the return movement of the traversing slide.

In the accompanying drawings, my invention is shown embodied in a grinding machine comprising an abrasive grinding wheel 1 fixed to a belt driven spindle 2 journaled for rotary and angular movement in a pedestal bearing 3 provided therefor on a wheel slide 4 mounted for horizontal movement on a suitable slideway 5 provided therefor on the top of the table or stationary main body portion 6 of said machine. The spindle 2 is disposed crosswise of the wheel slide 4 which, in accordance with common practice, is reciprocated on the slideway 5 by a suit-

able manually operated fast acting lever mechanism (not shown) to move the grinding wheel 1 into and out of engagement with the rotating work piece (not shown) that is to be ground. This lever mechanism is adjusted to set the feed position of the wheel slide 4 by means of a hand wheel 7 fixed to screw 8 that is carried by said wheel slide and operatively engages said lever mechanism. The construction of grinding machine thus far described is well known and it is considered unnecessary to illustrate it in detail.

The mechanism for truing and dressing the grinding wheel 1 is supported on a raised plate 9 that is formed integral with the wheel slide 4 and inclines downwardly toward the grinding wheel spindle 2 on one side thereof. Said mechanism comprises a feed-up slide 10 mounted on the inclined plate 9 for movement toward and from the grinding wheel spindle 2, a traversing slide 11 mounted on said feed-up slide for movement lengthwise of said spindle, and a diamond slide 12 mounted on said traversing slide for movement towards and away from the grinding wheel 1. The sliding connection between the feed-up slide 10 and the inclined supporting plate 9 comprises a dovetail guide plate 13 that is fixed to the top of said plate and fits in a dovetail groove 14 in the underside of said feed-up slide. The sliding connection between the traversing slide 11 and the feed-up slide 10 comprises a plate 15 that is secured by a pivot 16 to said feed-up slide for swiveling movement thereon and has a dovetail guide rib 17 that fits in a dovetail groove 18 in the bottom of said traversing slide. The swivel mounted guide plate 15 for the traversing slide 11 is secured to the feed-up slide 10 in the desired position of adjustment by means of a cap screw 19 that extends through an arcuate slot 20 in said plate and is threaded in said feed-up slide. The sliding connection between the diamond slide 12 and the traversing slide 11 comprises a dovetail guide rib 21 that is integral with the top of said traversing slide and fits in a dovetail groove in the underside thereof. The lower or grinding wheel opposing end of the diamond slide 12 has a bore 22 therein adapted to receive and support a telescopic or extensible diamond holder 23 which is locked in said bore by means of set screws 24. The diamond holder 23 terminates at its exposed outer end in a tapered portion having a diamond 25 set therein for truing and dressing the peripheral working face of the grinding wheel 1.

The traversing slide 11 is operated in one direction of its sliding movement by means of a hydraulic cylinder 26 which is fixed to one end of said slide and has a piston 27 disposed in endwise abutting relation to the corresponding end of the guide rib 17 for said slide. The traversing slide 11 is moved in the opposite direction of its sliding movement by means of a coil compression spring 28 which is mounted in a longitudinal groove 17*a* in the guide rib 17 for said slide with one end in abutting relation to one end of said groove and with the other end held in said groove by means of a screw 29 that is threaded into said slide and extends into said spring. The cylinder 26 is supplied with operating fluid through a hose or other flexible conduit 30 and is provided with a suitable throttle valve 31 for controlling the speed of movement of the traversing slide 11 in both directions.

During the reciprocating movement of the traversing slide 11, the diamond slide 12 carried thereby is reciprocated crosswise thereof so that the diamond 25 will move in a path corresponding to the contour desired for the peripheral working face of the grinding wheel 1. The mechanism for imparting the crosswise movement of the diamond slide 12 relative to the traversing slide 11 preferably comprises a plate 32 that is secured by screws 33 flat-wise to the underside of said diamond slide at the end thereof remote from its diamond support end and has a longitudinal cam edge 34 that cooperates with a roller 35 journaled on a bolt 36 fixed to the swivel mounted guide plate 15 for the traversing slide 11. As shown in the drawings, the roller supporting bolt 36 is disposed in a slot 37 that is located in the swivel mounted traversing slide supporting plate 15 and is disposed parallel to the guide rib 17 thereon. The roller supporting stud or bolt 36 is adjustable longitudinally of the elongated slot 37 by means of an adjusting screw 38 that is journaled for rotary but non-axial movement in the swivel plate 15 and is threaded through said bolt and is provided with a knurled operating knob 39. The cam plate 32 is yieldably held in engagement with the roller 35 by means of a coil spring 40 mounted around a screw 41 that is fixed to the traversing slide 11 and projects from one side thereof. The screw 41 extends through a tubular housing 42 fixed to the adjacent end of the diamond slide 12; and the spring 40 is located in said housing with one end seated against the inner end thereof and with the other end seated against the head of said screw. By this arrangement, the spring 40 forces the diamond slide 12 in the direction of the grinding wheel 1 and holds the cam surface 34 of the cam plate 32 fixed to said slide in engagement with the roller 35 journaled on the swivel mounted guide plate 15 for the traversing slide 11, whereby the wheel dressing diamond 25 travels back and forth across the peripheral work grinding face of the grinding wheel during the reciprocating movement of the traversing slide 11 along a path corresponding to the contour of the cam edge 34 of the cam plate 32.

The feed-up slide 10 is moved along the guide plate 13 in the direction of the grinding wheel 1 to remove a certain amount of stock from the working face thereof during each dressing or truing operation. This intermittent feed movement is imparted to the feed-up slide 10 preferably by means of a feed screw 43 that is mounted for rotary but non-axial sliding movement in one end of said slide and is threaded into the corresponding end of the guide plate 13 therefor. The feed screw 43 is automatically rotated after each wheel dressing operation by means of a ratchet wheel 44 that is fixed to said feed screw. The feed screw 43 may also be manually rotated by a crank 45 fixed to the outer end thereof. The ratchet wheel 44 is operated by a pawl 46 which is pivotally mounted on one end of a lever 47 fixed to a horizontal shaft 48 journaled in bearings 49 provided therefor in the feed-up slide 10. The pawl 46 is yieldably held in engagement with the teeth of the ratchet wheel 44 by means of a coil expansion spring 50 interposed between said pawl and the supporting lever 47 therefor; and the feed movement of said pawl is regulated by means of an adjustable stop pin 51 which is threaded into said lever with its inner end located in a slot 52 therein in abutting relation to a pin 53 that is fixed to the adjacent end of the feed-up slide 10 and extends into said slot.

The shaft 48 is rotated to impart a feed move-

ment to the ratchet wheel 44 at the end of the spring actuated stroke of the traversing slide 11 preferably by means of a screw 54 that is threaded through a bracket 55 fixed to the side of said slide. The screw 54 is disposed on one side of the shaft 48 in endwise abutting relation to a dog 56 fixed thereto, whereby said screw is adapted, during the spring actuated stroke of the traversing slide 11, to rotate said dog and shaft in a direction that will impart a feed movement to the pawl 46 which rotates the ratchet wheel 44 and feed screw 43 and to thereby advance the diamond slide 12 towards the grinding wheel 1. During the reverse or fluid pressure actuated stroke of the traversing slide 11, the pawl 46 is drawn back and set for its next feed movement by means of a coil torsion spring 57 which is mounted on the shaft 48 with one end anchored thereto and with the other end anchored to said traversing slide. As stated above the feed movement of the feed-up slide 10 may be regulated by adjusting the screw 51. As shown in the drawings, the bracket 55, which carries the screw 54 for operating the dog 56 on the pawl operating shaft 48 is secured to the traversing slide 11 by means of a cap screw 59 that extends through said bracket and is threaded into a T-block 60 that is slidable in a longitudinal T-groove 61 in the adjacent side face of said slide. The stop screw receiving portion of the bracket 55 is split and provided with a clamp screw 62 for locking the stop screw 54 in the desired position of adjustment. By this arrangement, the screw 54 may be adjusted relative to its supporting bracket 55 and said bracket may be adjusted relative to the traversing slide 11. As shown in the drawings, the dog 56 fixed to the pawl operating shaft 48 is swung by the screw 54 into engagement with the feed-up slide 10 and thus constitutes a stop for limiting the spring actuated stroke of the traversing slide 11 and the feed movement of the pawl 46.

The mechanism for controlling the operation of the above described wheel dressing mechanism is mounted on the body 6 of the grinding machine below and at one side of the wheel head slide 4 which is manually operated to move the grinding wheel 1 and dressing mechanism therefor towards and away from the work piece that is to be ground. This operating mechanism comprises a suitable normally closed bleeder valve 63 located in a conduit 64 that leads from a suitable source of compressed air supply to the bottom of an upright ratchet operating cylinder 65 that is secured at its upper end to a suitable supporting housing 66 fixed to the side face of the body 6 of the grinding machine. The mechanism for opening the normally closed valve 63 to permit flow of air through the supply pipe 64 to the ratchet cylinder comprises a cam plate 67 suspended by means of a pair of parallel links 68 from a supporting plate 69 that is movable with the wheel slide 4 and is adjustable longitudinally thereof. The link supporting plate 69 is slidably supported on a longitudinal guide block 4a fixed to the side face of the wheel head slide 4; and the longitudinal sliding connection between said supporting plate and guide block comprises a rib 70 on the inner side face of said guide block that is slidable in a longitudinal groove 71 provided therefor in the outer side face of said guide block. The groove 71 has an undercut or widened bottom portion adapted to receive the heads of T-bolts 72 having nuts 73 threaded on the outer ends thereof for clamping the plate 69 to the guide block 4a in the desired position of adjustment.

Mounted for vertical swinging movement on the housing 66 is a lever 74 which overhangs the normally closed valve 63 and has a depending stud 75 that is supported on a roller 76 on the exposed upper end of the stem 77 of said valve. This valve stem 77 moves downwardly to open the valve 63 and normally supports the lever 74 without being depressed thereby. The lever 74 has a roller 78 journaled on the free end thereof in position to be engaged by the collapsible link supported cam plate 67 and force the valve stem 77 downwardly to open the valve 63 when the wheel slide 4 is moved outwardly to move the grinding wheel 1 away from the work piece. The cam plate 67 is normally held down in position for engagement with the roller 78 on the valve opening lever 74 by means of a latch arm 79 which is pivoted, as at 80, to the adjacent side of the supporting plate 69 for vertical swinging movement relative thereto and has a hooked end portion 81 that interlocks with a corresponding hook 82 formed integral with the rearmost cam plate supporting link 68 and thus prevents upward movement of the cam plate 67. The hooked end 81 of the latch 79 is yieldably held in locking engagement with the hook 82 on the rearmost cam plate supporting link 68 by means of a coil spring 89 interposed between the top of said latch arm and the underside of a lug 90 that extends rearwardly from said link in overhanging relation to said latch arm. Vertical swinging movement of the latch arm 79 is limited by means of a screw 91 which extends through a vertical slot 91a therein and is threaded into the adjacent side of the cam plate link supporting plate 69 fixed to the wheel head slide 4. The supporting plate 69 is moved longitudinally of the wheel slide 4 to adjust the cam plate 67 relative to the roller 78 on the valve actuating arm 74 preferably by means of a hand wheel 84 fixed to a feed screw 85 which extends longitudinally of said wheel slide with its inner end threaded through a lug 86 on said supporting plate and its outer end journaled in a plate 87 fixed to the outer end of said wheel slide.

The upright ratchet operating cylinder 65 contains a piston 92 which is forced upwardly in said cylinder by means of the air supplied to the bottom thereof through the supply pipe 64. The piston 92 is moved downwardly in the cylinder 65 by means of a coil spring 93 that is supported in an axial bore 92a provided therefor in the upper end of said piston with one end seated in the bottom of said bore and with the other end seated against the underside of the head portion 94a of a pin or plunger 94 that extends downwardly into said spring and forms a guide therefor. The head 94a has a conical top portion 94b that is held by the upward thrust of the spring 93 in a downwardly opening conical recess or seat 95 provided therefor in the housing 66. The piston 92 has a radial arm 96 rigid therewith at the upper end thereof that has a bifurcated end portion that straddles a vertical adjusting screw 97 that is journaled in the housing 66 alongside of said piston for rotary but non-axial movement and has a knurled operating knob 97a at its upper end. The adjusting screw 97 has a stop arm or lug 98 threaded thereon intermediate the ends thereof that is notched to straddle the piston 92. The stop lug 98 is located below the radial arm 96 on the upper end of the piston 92 and thus serves as a stop for said arm to limit the downward travel of said piston. The engagement of the radial arm 96 of the piston with

the screw 97 prevents rotation of said piston; and the engagement of the stop lug 98 with said piston prevents rotation of said stop lug. By this arrangement, the rotation of the screw 97 causes the stop 98 thereon to travel lengthwise thereof relative to the piston 92 and thus lengthen or shorten the downward stroke thereof.

Journaled on a horizontal stub shaft 99 fixed to the housing 66 is a ratchet wheel 100 which is actuated by means of a pawl 101 pivotally supported on the outer end of a supporting arm 102 which is also journaled on said shaft. The pawl 101 is pivotally supported on a horizontal stud 103 fixed to the arm 102 with its end slidably supported in a slideway 104 provided therefor in the adjacent side face of the piston 92, whereby said pawl supporting arm is oscillated on its supporting shaft 99 by the reciprocating movement of the piston 92 to impart a feed movement to the pawl 101 during the upward movement of the piston and a return movement of said pawl during the downward movement of said piston. The pawl 101 is held in engagement with the teeth of the ratchet wheel 100 by means of a spring 105 having one end anchored to said pawl and the other end anchored to the supporting arm 102 therefor. When the piston 92 moves downwardly, the pawl 101 rides over the ratchet teeth without imparting any movement to the ratchet wheel 100. During this return movement of the pawl 101, the ratchet wheel 100 is prevented from moving therewith by means of a second pawl 106 that is pivotally secured to the housing 66 and is held in continuous contact with the ratchet teeth by means of a coil spring 107 having one end fixed to said pawl and the other end fixed to said housing.

Keyed to an extended hub portion 100*a* of the ratchet wheel for rotation therewith on the stub shaft 99 is a rotary wheel 108 having two axially spaced edge cams 109, 110 thereon, the edge cam 109 having a single arcuate notch 109*a* therein and the other edge cam having four similarly shaped equally spaced notches 110*a* therein. Friction disks 111 are clamped to remote end faces of the ratchet wheel 100 and pawl supporting arm 102 by means of a nut 112 threaded on the outer end of the stub shaft 99. These disks operate as friction brakes to prevent overrunning of the cam and ratchet wheels. The cam wheel is reversible end for end so as to bring either edge cam thereof in position for engagement by a roller 113 journaled on a supporting lever 114 that is pivotally secured to the housing 66 for vertical swinging movement towards and away from said cam wheel.

The free end of the roller supporting lever 114 is held in engagement with the edge of the cam 109 in line therewith by a vertically disposed master slide or plunger valve 115 for the ratchet operating cylinder 65. The master slide valve 115 is slidable in a vertical valve bore 116 provided therefor in the ratchet operating cylinder 65; and a spring 115*a* located in the bottom of said bore forces said valve upwardly against the lever 114 and holds the roller 113 thereon against the edge cam 109. When the roller 113 on the lever 114 is in contact with the un-notched portion of the edge cam 109, the slide valve 115 is forced downwardly in the valve bore 116; and when said roller seats in the notch 109*a* in said cam, said valve is forced upwardly in said bore by the spring 115*a*.

The master slide or plunger valve 115 has two annular grooves 117, 118 therein that are spaced apart longitudinally thereof. The ratchet operating cylinder 65 has a radial passageway 119 therein that passes through the valve bore 116 and opens into the upper portion of the pressure space or chamber 120 in said cylinder below the piston 92 therein. The passageway 119 has a branch passageway 121 which opens into the lower portion of the chamber 120 and is provided with an inwardly opening ball check valve 122 which permits flow of air through the branch passageway to the chamber but not from the chamber through the branch passageway. The passageway 119 communicates through a pipe or conduit 123 with an air cylinder 124 hereinafter referred to. The slide valve supporting bore 116 also has diametrically opposed radial ports 125, 126 in communication therewith above the passageway 119, the port 125 communicating with the air cylinder 124 through a pipe or conduit 127 and the port 126 communicating with a manually operable valve 128 through a pipe or conduit 129. When the plunger valve 115 is raised, the annular groove 117 therein opens the passageway 119 and establishes communication between the cylinder 65 and the air cylinder 124 through the conduit 123 and said valve covers the ports 125 and 126 and cuts off communication between the air cylinder 124 and the valve 128 through the conduits 127 and 129. In the depressed position of the master slide valve 115, the passageway 119 is closed to cut off communication between the cylinder 65 and the air cylinder 124 through the pipe 123, and the ports 125 and 126 are opened by the annular groove 118 in said valve to establish communication between said air cylinder 124 and said valve through the pipe 129.

The air cylinder 124 is mounted vertically in the housing 66, a master hydraulic or oil cylinder 130 is mounted in said housing above and in vertical alinement with said air cylinder, and a piston 131 that is common to both cylinders has its lower end working in the air cylinder and its upper end working in the master cylinder. The piston is forced downwardly in the cylinders 124 and 130 by a spring 132 in the upper cylinder 130 and is forced upwardly in said cylinders by the air pressure supplied to the lower cylinder 124 by the conduit 123 leading from the pressure chamber 120 of the ratchet operating cylinder 65 or by the conduit 127 which, in the depressed position of the master valve 115, is placed in communication with the conduit 129 leading from the manually operable bleeder valve 128. The piston 131 has a radial arm 133 that is rigidly secured thereto between the cylinders 124 and 130 and is adapted to seat on the upper end of the lower cylinder 124 and limit the downward stroke of said piston. The arm 133 has a vertically disposed trip rod 134 threaded therethrough for axial adjustment relative thereto. The reciprocable trip rod 134 extends upwardly through a slide bearing 135 provided therefor in the top of the housing 66 and is adapted, when the piston 131 is forced upwardly and the latch bar 79 is located above said rod, to swing the latch bar upwardly and lift the hook 81 thereof out of engagement with the hook 82 on the link supported cam plate 67. As shown in the drawings, the air supply pipe 64 is provided in advance of the cam operated valve 63 with a branch 64*a* which is adapted to communicate with the conduit 129 through the manually operable valve 128. The pipe 64 is also provided in advance of the cam operated valve 63 with a conventional air line lubricator and pressure reducing valve 136 and a gage 137.

The pressure chamber 130*a* of the oil cylinder

130 communicates through a series of radial ports 138 with an annular chamber 139 formed in said cylinder; and a passageway 140 leads from said annular chamber to an oil reservoir 141 formed in the housing 66. The passageway 140 has a ball check spill valve 142 therein which permits flow of oil from the annular chamber 139 to the passageway 140 while preventing flow of oil from the reservoir 139 to said annular chamber; and said passageway has an upwardly extending branch passageway 143 that opens through a radial port 144 into the pressure chamber 130a. As shown in the drawings, the branch passageway 143 is provided with a ball check refill valve 145 which permits flow of oil from the reservoir 141 to the pressure chamber 138a, while preventing a return flow of oil from said pressure chamber to said reservoir. The radial port 144 leading from the pressure chamber 130a of the oil cylinder 130 communicates with the traversing slide operating cylinder 26 through the flexible pipe or conduit 30.

In operation, each time the operator manipulates the hand wheel 7 to move the wheel slide 4 and the grinding wheel truing and dressing mechanism thereon away from the finished workpiece to facilitate removal thereof from the grinding machine, the collapsing cam 67 carried by said wheel slide rides over the roller 78 journaled on the free end of the pivotal valve operating arm 74 and swings said arm downwardly. This downward movement of the arm 74 opens the self-closing valve 63 in the air supply line 64, thus admitting air under pressure to the air cylinder 65 and raising the piston 92 therein. This upward movement of the piston 92 operates the pawl 101 and imparts a feed movement to the ratchet wheel 100 and a corresponding feed movement to the cam wheel 108. Each time the wheel slide 4 is operated to replace a ground work piece with a work piece that is to be ground, the piston 92 moves upwardly in the cylinder 65 and imparts a rotary feed movement to the ratchet wheel 100 and cam wheel 108.

When the cam wheel reaches a position where the notch 109a therein is in position to receive the roller 113 on the lever 114, the master slide valve 115 is forced upwardly by the spring 115a and opens the passageway 119 in the cylinder 65, thereby permitting the air to flow from the pressure space or chamber 120 of said cylinder to the air cylinder 124 through the pipe or conduit 123. The air supplied to the air cylinder 124 forces the piston 131 upwardly therein and in the oil cylinder 130. This upward movement of the piston 131 in the oil cylinder 130 forces the oil trapped in the pressure space 130a thereof through the port 144 and the flexible conduit 30 into the hydraulic cylinder 26 fixed to the traversing slide 11, thus moving said traversing slide 11 relative to the feed-up slide 10 against the pressure of the coil spring 28. This movement of the traversing slide 11 causes the cam plate 32 carried by the diamond slide 12 to move relative to the cam roller 35 journaled on the swivel mounted guide plate 15, thereby causing said diamond slide to move crosswise of said traversing slide in the direction of the grinding wheel 1. This simultaneous movement of the diamond slide 12 both longitudinally and transversely of the grinding wheel 1 causes the wheel dressing diamond 25 carried by said diamond slide to move in a path corresponding to the shape of the curved cam edge 34 of the cam plate 32 and thus true and dress the peripheral working face of said grinding wheel to the contour desired for said face.

As the piston 131 moves upwardly in the air cylinder 124 and oil cylinder 130, the trip rod 134 also moves upwardly with said piston and presses upwardly against the underside of the latch arm 79, which moves over said trip rod when the wheel slide 4 is retracted, thereby swinging said latch arm upwardly and disengaging the hook 81 thereof from the hook 82 of the collapsing cam 67 and thus releasing said cam and permitting the valve 63 opened thereby to close. The closing of the valve 63 cuts off the air pressure through the conduit 64 to the air cylinder 65 and opens said conduit to the atmosphere through the bleeder orifice of said valve. The length of the fluid pressure actuated stroke of the traversing slide 11 may be varied by adjusting the trip rod 134 axially in its supporting arm 133. Upon release of the air pressure in the air cylinder 65, the piston 92 therein is forced downwardly by the spring 93 and thus imparts a return movement to the pawl 101 relative to the ratchet wheel 100, the safety pawl 106 preventing a return movement of said ratchet wheel during such return movement of the pawl 101.

A return stroke is then imparted to the traversing slide 11 by the spring 28, thus forcing the oil in the cylinder 26 carried by said slide back through the flexible conduit 30 into the oil cylinder 130 and permitting the spring 132 to force the piston 131 downwardly in said oil cylinder and in the air cylinder 124. This downward movement of the piston 131 forces the air in the air cylinder 124 through the conduit 123, passageways 119 and 121 and check valve 122 into the pressure chamber 120 of the air cylinder 65, thence through the conduits 64 to the bleeder valve 63 and thence to the atmosphere. This completes the wheel dressing cycle; and the dressing mechanism remains inoperative until the step-by-step feed movement imparted to the cam wheel 108 by movement of the wheel slide to remove and replace the work pieces again brings the notch 109a in said wheel in position to receive the roller 113 on the hold-down lever 114 and permit the master valve 115 to shift to a position which will cause the wheel dressing mechanism to again operate. The wheel dressing mechanism may be operated at the will of the operator regardless of the position of the cam wheel 108 by manually operating the valve 128 to establish communication between the branch 64a of the air supply pipe 64 and the conduit 129, thereby permitting air to flow through the conduit 129, depressed master valve 115, and conduit 127 to the lower end of the air cylinder 124 thus raising the piston 131 and forcing the oil from the oil cylinder 130 into the cylinder 26 fixed to the traversing slide 11.

By rotating the adjusting screw 97, the piston stop 98 may be raised or lowered thereon to lengthen or shorten the stroke of the ratchet operating piston 92 in the air cylinder 65 and thus vary the feed movement imparted to the ratchet wheel 100 and cam wheel 108 by the pawl 101 operated by said piston so as to cause the dressing mechanism to operate after a predetermined number of work pieces have been ground. For instance, with a sixty-tooth ratchet wheel and the single-groove edge cam 109 and a one-tooth advance of said ratchet wheel and cam with each complete reciprocation of the piston 92, the dressing mechanism will operate to dress the grinding wheel 1 after every sixtieth work piece has been

ground, while an advance of fifteen ratchet teeth for each complete reciprocation of said piston will cause the dressing mechanism to operate after every four work pieces have been ground. With a sixty-tooth ratchet wheel and the four-groove edge cam 110, an advance of one ratchet tooth with each complete reciprocation of the piston 92 will cause the wheel dressing mechanism to operate after every fifteen work pieces have been ground, while an advance of fifteen ratchet teeth with each reciprocation of said piston will cause the wheel dressing mechanism to operate after each work piece has been ground. The friction washers 111 clamped to the remote ends of the ratchet wheel 100 and cam wheel 108 serve to prevent said wheels from overrunning during the feed movement thereof, while the safety pawl 106 prevents said wheels from turning in a reverse direction during the return movement of the feed pawl 101.

The cam roller 35 may be adjusted by means of the screw 38 to properly locate the profile on the working face of the grinding wheel 1. The length of the return or spring actuated stroke of the traversing slide 11 is regulated by means of the adjustable stop screw 54; and said traversing slide may be disposed parallel with or at an oblique angle to the rotary axis of the grinding wheel by adjusting the swivel mounted guide plate for said slide relative to the feed-up slide 10, the screw 19 serving to lock the swivel mounted plate in the desired position of angular adjustment on said feed-up slide. After each dressing operation, the diamond 25 is automatically fed in the direction of the grinding wheel axis to remove a certain amount of stock from the grinding wheel 1. This automatic feed movement is imparted to the wheel dressing diamond 25 by the feed screw 43 for the feed-up slide 10, which feed screw is rotated a small amount by the feed-up pawl 46 after each dressing operation. As the traversing slide 11 nears the end of its spring-actuated return stroke, the stop screw 54 carried by said slide engages the dog 56 fixed to the shaft 48, thereby rotating said shaft in a direction which will impart a feed movement to the pawl 46 pivoted on the arm 47 fixed to said shaft. The amount of feed movement imparted to the wheel dressing diamond 25 may be varied by adjusting the stop screw 51 carried by the pawl supporting lever 47, adjustment of this screw changing the length of the return movement of said pawl 46 from feed position. When necessary, the diamond may be advanced in the direction of the grinding wheel by manually rotating the feed screw 43 by means of the crank 49 thereon.

As stated above, when the wheel slide 4 is retracted to remove a finished work piece from the machine, the cam plate 67 opens the air valve 63, thereby raising the piston 92 in the cylinder 65 and imparting a rotary feed movement to the ratchet wheel 100 and cam wheel 108. This upward movement of the piston 92 permits flow of the air from the cylinder 65 to the air cylinder 124, thereby moving the piston 131 upwardly in the oil cylinder 130 and forcing oil into the hydraulic cylinder 26 fixed to the traversing slide 11 and thus causing said slide to move in one direction of its sliding movement. This upward movement of the piston 131 also causes the trip rod 134 carried thereby to release the latch arm 79 for the cam plate 67, thus allowing the air valve 63 to close and removing the air pressure from the system and allowing the operating springs for the pistons 27 and 131 to return them to their original positions. Thus, the reversal of travel of the traversing slide 11 is controlled by the trip rod 134, and the point of such reversal is controlled by the vertical adjustment of said trip rod, the travel of the traversing sliding being shortened by upward adjustment of the trip rod and lengthened by downward adjustment thereof. This closing of the air valve 63 also relieves the air pressure in the cylinder 65 and permits the piston 92 therein to be moved downwardly by its operating spring 93. When the slide 4 is moved forwardly to engage the grinding wheel with a new work piece, the cam plate 67 moves clear of the valve operating roller 78 for the air valve 63 and swings downwardly and is locked in this position by means of the latch arm 79.

The dressing cycle takes place while the operator is placing a new work piece in position. When the operator is ready to move the slide forward to present the grinding wheel to the work piece, the dressing is already completed, the time required for the dressing cycle being less than the time required to remove and replace the work piece. If, when the slide 4 is withdrawn and the counting mechanism is in position to cause the dresser to operate, the cam plate 67 will be released by the trip rod 134 at the end of the stroke of the piston 131 and the slide 11, thus reversing the direction of travel of the slide. If the counting mechanism is not in position to allow the dresser to operate, depressing the air valve 63 by withdrawing the slide 4 merely operates the counting mechanism by raising the piston 92 and rotating the cam wheel 108 a predetermined amount, the piston staying at the top of its stroke until the slide is again moved forward and the air valve 63 is released by the cam plate 67 and the piston 92 drops to its normal position. This counting cycle is repeated with each back and forward movement of the slide 4 until the counting mechanism reaches the position shown in Fig. 15 with the roller 113 seated in the groove 109*a* of the cam 109 so as to release the valve 115 and allow it to raise and operate the dresser.

As stated above, the contour of the working face of the grinding wheel is determined by the contour of the cam edge of the cam plate fixed to the diamond slide. As shown diagrammatically in Fig. 24, the cam edge 34 of the cam plate 32 carried by the diamond slide 12 is longitudinally concave, whereby the dressing diamond moves both longitudinally and transversely relative to the grinding wheel axis to true and dress a grooved peripheral working face 34*a* on said wheel corresponding to the shape of the cam edge of the cam plate. With this arrangement, the diamod 25 contacts the wheel face 34*a* during both forward and return strokes of the traversing slide 11.

The diagram shown in Fig. 25 illustrates an arrangement which is desirable for dressing a grinding wheel 1*a* having a straight or slightly curved conical or beveled working face. In this arrangement, a cam plate 146 is secured to the underside of the diamond slide 12 by means of the screw 33 and has a straight cam edge 147 disposed at an oblique angle to the direction of movement of the traversing slide 11; and a rocker 148 is journaled on the pivot bolt 36 fixed to the guide plate 15 for said traversing slide and has a V-shaped radial projection 149 that is located between the opposite ends of said rocker and makes substantial line contact with said cam edge of

said cam plate. One arm 150 of the rocker 148 has a stop screw 151 thereon which abuts against the adjacent side face of the traversing slide 11 and limits the swinging movement of said rocker in one direction; and the other arm 152 of said rocker has a stop screw 153 thereon which is adapted to abut against said traversing slide and limit the swinging movement of said rocker in the opposite direction. The friction between the cam plate 146 and the V-shaped radial projection 149 on the rocker 148 causes said rocker to rock from one position to the other when the traversing slide 11 is reciprocated. During the forward or fluid pressure actuated stroke of the traversing slide 11, the rocker 148 is rocked by the cam plate 146 in a direction that will swing the cam contacting end of the V-shaped projection 149 in the direction of the grinding wheel 1a and thus permit the diamond slide 12 to move far enough in such direction to bring the diamond 25 into contact with the wheel face 147a. During the return stroke of the traversing slide 12, the cam plate 146 rocks the rocker 148 in the reverse direction and thus increases the distance between the cam contacting end of the V-shaped projection 149 and the grinding wheel, thereby moving the diamond slide away from said grinding wheel and enabling the diamond to clear the wheel face during the entire return stroke of said traversing slide. By this arrangement, the conical wheel face 147a is dressed by movement of the diamond thereacross from the sharp corner A of said face to the blunt corner thereof; and no dressing operation is performed during the return movement of said diamond, thereby preventing the diamond from breaking down the sharp corner of said wheel face or marking the same during such return movement.

Obviously, the hereinbefore described grinding wheel truing and dressing mechanism admits of considerable modification without departing from the invention. Therefore, I do not wish to be limited to the precise arrangements shown and described.

What I claim is:

1. In a grinding machine including a work support, a grinding wheel movable into engagement with and disengagement from a work piece on said work support, and a truing element for said grinding wheel, the combination of a fluid pressure system for moving said truing element into engagement with said grinding wheel, said system comprising a fluid pressure cylinder operatively connected to said truing element for moving the latter into engagement with said grinding wheel, a second fluid pressure cylinder for supplying fluid pressure to said first mentioned cylinder, a master valve, a fluid pressure cylinder for operating said master valve and for supplying fluid pressure to said second cylinder, a control valve operable by each disengaging movement of said grinding wheel to admit fluid pressure to said master valve operating cylinder to operate the same, said master valve being interposed between said second and master valve operating cylinders, means for holding said master valve in closed position, and a connection between said master valve operating cylinder and said valve closing means and operable by a predeterminable number of operations of said master valve operating cylinder to release said master valve and permit the same to open.

2. In a grinding machine including a work support, a grinding wheel movable into engagement with and disengagement from a work piece on said support, a truing tool for said grinding wheel movable into and out of engagement therewith, the combination of a fluid pressure operated system for moving said truing tool into engagement with said grinding wheel after a predetermined number of disengaging movements of the latter from the work piece, said system comprising a fluid pressure cylinder operatively connected to said truing element for moving the same into engagement with said grinding wheel, a second fluid pressure cylinder for supplying fluid pressure to said first mentioned cylinder to operate the same, a master valve, fluid pressure cylinder for operating said master valve and said second cylinder, a piston in said master valve operating cylinder, a control valve operable by each grinding wheel disengaging movement to admit fluid pressure to said master valve operating cylinder to operate the piston therein, said master valve being interposed between said second and master valve operating cylinders, a lever for holding said master valve in closed position, a rotary edge cam cooperating with said lever and having a portion for holding said lever in valve closing position and a portion that will release said lever and permit said master valve to open, and an operative connection between said piston and said rotary edge cam, whereby said cam is rotated to lever releasing position by a predetermined number of operations of said piston.

3. The combination set forth in claim 2, in which the operative connection between said piston and said rotary edge cam comprises a ratchet wheel rotatable with said cam and a pawl cooperating with said ratchet wheel and operated by said piston.

4. The combination set forth in claim 2, in which the operative connection between said piston and said edge cam comprises a ratchet wheel rotatable with said edge cam, a lever pivotal about the rotary axis of said ratchet wheel, a pawl pivotally supported on said last mentioned lever and engaging said ratchet wheel, a connection between said piston and said lever for rotating the latter and said pawl about the rotary axis of said ratchet wheel to rotate the same a predetermined distance each time said piston is operated, and means for varying the stroke of said piston to vary the amount of movement imparted to said ratchet wheel by each stroke of said piston.

5. The combination set forth in claim 2, in which the operative connection between said piston and said edge cam comprises a ratchet wheel rotatable with said edge cam, a lever pivotal about the rotary axis of said ratchet wheel, a pawl pivotally supported on said last mentioned lever and engaging said ratchet wheel, a connection between said piston and said lever for rotating the latter and said pawl about the rotary axis of said ratchet wheel to rotate the same each time said piston is operated, and means for varying the stroke of said piston to vary the amount of rotary movement imparted to said ratchet wheel by each stroke of said piston.

6. The combination set forth in claim 2, in which a fluid pressure conduit communicates with said second cylinder through said master valve, a manually operable valve is located in said conduit between said second cylinder and the source of fluid pressure supply for said conduit and is adapted to be opened at the will of the operator to supply fluid pressure to said sec-

ond cylinder and thereby operate said first mentioned cylinder to move said truing tool into engagement with said grinding wheel.

7. In a grinding machine including a work support, a rotary grinding wheel, a wheel slide for supporting said grinding wheel for engagement with and disengagement from a work piece on said support, and a truing tool for said grinding wheel movable into and out of engagement therewith, the combination of a fluid pressure operated system for moving said truing tool into engagement with said grinding wheel after a predetermined number of disengaging movements of the latter from the work piece, said system comprising a fluid pressure cylinder operatively connected to said truing element for moving the same into engagement with said grinding wheel, a second fluid pressure cylinder for supplying fluid pressure to said first mentioned cylinder to operate the same, a master valve, a fluid pressure cylinder for operating said master valve and for supplying fluid pressure to said second cylinder to operate the latter, a self-closing control valve for admitting fluid pressure to said master valve operating cylinder, a cam carried by said wheel slide for opening said control valve during each grinding wheel disengaging movement of said wheel slide, said master valve being interposed between said second and master valve operating cylinders, an operative connection between said master valve operating cylinder and said master valve for causing said master valve to open after a predeterminable number of operations of said master valve operating cylinder, and a trip member operable by said second cylinder for rendering said cam inoperative to close said control valve.

8. In a grinding machine including a work support, a grinding wheel movable into engagement with and disengagement from a work piece on said support, and a truing tool for said grinding wheel movable into and out of engagement therewith, the combination of a fluid pressure operated system for moving said truing tool into engagement with said grinding wheel after a predetermined number of disengaging movements of the latter from the work piece, said system comprising a fluid pressure cylinder operatively connected to said truing element for moving the same into engagement with said grinding wheel, a second fluid pressure cylinder for supplying fluid pressure to said first mentioned cylinder to operate the same, a third cylinder co-axial with said second cylinder, a piston common to said second and third cylinders, a fourth fluid pressure cylinder for supplying pressure to said third cylinder to actuate the common piston of said second and third cylinders, a piston in said fourth cylinder, a control valve operable by each grinding wheel disengaging movement to admit fluid pressure to said fourth cylinder to actuate the piston therein, a master valve interposed between said third and fourth cylinders, a lever for holding said master valve in closed position, a rotary cam cooperating with said lever for holding the latter in valve closing position and in a position permitting said master valve to open, and an operative connection between said cam and the piston in said fourth cylinder, whereby said cam is rotated to lever releasing position by a predetermined number of operations of the piston in said fourth cylinder.

9. The combination set forth in claim 8, in which a fluid pressure conduit communicates with said third cylinder through said master valve, a manually operable valve is located in said conduit between said third cylinder and a source of fluid pressure therefor for said conduit and is adapted to be opened at the will of the operator to supply fluid pressure to said third cylinder and thereby operate said common piston and said first mentioned cylinder to move said truing tool into engagement with said grinding wheel.

10. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, and a truing tool for said grinding wheel movable into and out of engagement therewith, the combination of a fluid pressure cylinder operatively connected to said truing element for moving the same into engagement with said grinding wheel, a second fluid pressure cylinder for supplying fluid pressure to said first mentioned cylinder to operate the same, a third cylinder co-axial with said second cylinder, a piston common to said second and third cylinders, a fourth fluid pressure cylinder for supplying fluid pressure to said third cylinder to actuate the common piston of said second and third cylinders, a piston in said fourth cylinder, a self-closing control valve operable by each grinding wheel disengaging movement of said wheel slide to admit fluid pressure to said fourth cylinder to actuate the piston therein, a self-opening master valve interposed between said third and fourth cylinders, means releasable by a predetermined number of operations of the piston in said fourth cylinder for holding said master valve in closed position, a cam carried by said wheel slide and adapted to open said control valve when said wheel slide is moved into grinding wheel disengaging position, means for releasably holding said cam in position to open said control valve in said last mentioned position of said wheel slide, and means carried by said common piston for rendering said cam holding means inoperative during the operative stroke of said common piston to thereby permit said control valve to close.

11. The combination set forth in claim 10, in which a pair of parallel links connect said cam to said wheel slide for movement relative thereto and to said control valve, and said cam is held in valve opening position by a latch lever which is pivoted to said wheel slide and is adapted to be released by the means carried by said common piston.

12. The combination set forth in claim 10, in which the means for releasably holding the cam in position to open said control valve is carried by the wheel slide and means is provided for adjusting said means and said cam longitudinally of said wheel slide.

13. The combination set forth in claim 10, in which a pair of parallel links connects said cam to said wheel slide for movement relative thereto and to said control valve, said cam is held in valve opening position by a latch lever which is pivoted to said wheel slide and is adapted to be released by the means carried by said common piston and means is provided for adjusting said cam, links and latch lever longitudinally of said wheel slide.

14. The combination set forth in claim 10, in which a support is secured to said wheel slide for adjustment longitudinally thereof, a pair of links connects said cam to said support for movement relative thereto and to said control valve and said cam is held in valve opening position by

a latch lever which is pivoted to said support and is adapted to be released by the means carried by the common piston.

15. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, and a truing tool for said grinding wheel movable into and out of engagement therewith, the combination of a fluid pressure system including a fluid pressure cylinder operatively connected to said truing element for moving the same into engagement with said grinding wheel, a reservoir containing an operating fluid and a second fluid pressure cylinder for supplying such fluid to said first mentioned cylinder to operate the same, a second fluid pressure system including a third cylinder for operating said second cylinder, a fourth fluid pressure cylinder for supplying fluid pressure to said third cylinder to operate the same, a fluid pressure supply conduit opening into said fourth cylinder, a control valve in said conduit and operable by each grinding wheel disengaging movement to admit fluid pressure through said conduit to said fourth cylinder to operate the same, a self opening master valve for controlling the flow of fluid pressure between said third and fourth cylinders, means for holding said master valve in closed position, and means operated by a predetermined number of operations of said fourth cylinder for releasing said valve closing means to permit said master valve to open.

16. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, and means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said transverse slide during the reciprocating movement of the latter, said tool slide reciprocating means comprising a cam plate fixed to said tool slide and having a cam edge that extends in the direction of movement of said traversing slide and follows the contour desired for the working face of said grinding wheel, and a rocker lever journaled on said machine and having a portion cooperating with said cam edge and positioned thereby during movement of said traversing slide in one direction to permit said truing tool to engage said working face and positioned by said cam edge during movement of said traversing slide in the opposite direction to move said tool clear of said working face.

17. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, and means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said transverse slide during the reciprocating movement of the latter, said grinding wheel having a beveled peripheral working face, said tool slide reciprocating means comprising a cam plate fixed to said tool slide and having a straight cam edge disposed at an oblique angle to the direction of movement of said traversing slide, and a rocker lever journaled on said machine and having a portion cooperating with said cam edge and positioned thereby during the movement of said traversing slide in one direction to cause the truing tool to move along said beveled working face from the sharp corner thereof to the blunt corner thereof and positioned by said cam edge during the movement of said traversing slide in the opposite direction to cause said tool to move clear of said working face.

18. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said transverse slide during the reciprocating movement of the latter to move said truing tool across the working face of said grinding wheel during the movement of said traversing slide in one direction and to move said truing tool clear of said working face during the return movement of said traversing slide, and means for feeding said traversing slide a predeterminable distance in the direction of said grinding wheel with each complete reciprocation of said traversing slide, said last mentioned means comprising a feed-up slide movably supporting said traversing slide and mounted on said machine for sliding movement transversely of said wheel axis, a feed screw journaled for rotary but non-axial sliding movement on said feed-up slide and threadedly engaging a stationary part of said machine, a ratchet wheel secured to said feed screw, a pawl cooperating with said ratchet wheel, and means operated by the movement of said traversing slide in one direction for actuating said pawl to rotate said ratchet wheel in feeding direction.

19. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, means movable with said

tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said traversing slide during the reciprocating movement of the latter to move said truing tool across the working face of said grinding wheel during the movement of said traversing slide in one direction and to move said truing tool clear of said working face during the return movement of said traversing slide, and means for feeding said traversing slide a predeterminable distance in the direction of said grinding wheel with each complete reciprocation of said traversing slide, said last mentioned means comprising a feed-up slide movably supporting said traversing slide and mounted on said machine for sliding movement transversely of said wheel axis, a feed screw journaled for rotary but non-axial sliding movement on said feed-up slide and threadedly engaging a stationary part of said machine, a ratchet wheel secured to said feed screw, a lever pivoted on said feed-up slide for movement transversely of the said ratchet wheel, a pawl mounted on said lever and cooperating with said ratchet wheel, means operated by the movement of said traversing slide in one direction for actuating said lever to impart a feed movement to the pawl thereon, and means for imparting a return movement to said lever and pawl during the movement of said traversing slide in the other direction.

20. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said traversing slide during the reciprocating movement of the latter to move said truing tool across the working face of said grinding wheel during the movement of said traversing slide in one direction and to move said truing tool clear of said working face during the return movement of said traversing slide, a fluid cylinder fixed to said traversing slide, a piston mounted in said cylinder in abutting relation to a stationary part of said machine, whereby said traversing slide is moved in one direction of its sliding movement when fluid pressure is supplied to said cylinder, a spring for moving said traversing slide in the opposite direction of its sliding movement, and means for admitting fluid pressure to said cylinder after a predetermined number of grinding wheel disengaging movements of said wheel slide.

21. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding

wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said traversing slide during the reciprocating movement of the latter to move said truing tool across the working face of said grinding wheel during the movement of said traversing slide in one direction and to move said truing tool clear of said working face during the return movement of said traversing slide, a fluid pressure cylinder operatively connected to said traversing slide to operate the same, and means for admitting fluid pressure to said cylinder after a predeterminable number of grinding wheel disengaging movements of said wheel slide.

22. In a grinding machine including a support for a work piece, a rotary grinding wheel, and a wheel slide for supporting said grinding wheel for movement into and out of engagement with said work piece, the combination of a truing mechanism for the working face of said grinding wheel comprising a traversing slide movable longitudinally of the grinding wheel axis, a truing tool slide supported on said traversing slide for movement therewith and for reciprocating movement relative thereto transverse to said grinding wheel axis, a truing tool fixed to said tool slide for movement therewith into and out of engagement with said grinding wheel, means movable with said tool slide cooperating with means fixed to said machine for reciprocating said tool slide on said traversing slide during the reciprocating movement of the latter to move said truing tool across the working face of said grinding wheel during the movement of said traversing slide in one direction and to move said truing tool clear of said working face during the return movement of said traversing slide, and a fluid pressure system for operating said traversing slide, said system including a fluid pressure cylinder operatively connected to said traversing slide, a second fluid pressure cylinder for supplying fluid under pressure to said first mentioned cylinder, a normally closed master valve, a fluid pressure cylinder for opening said master valve and for supplying fluid pressure to said second cylinder, a control valve operable by each grinding wheel disengaging movement of said wheel slide to admit fluid pressure to said valve opening cylinder to operate the same, said normally closed master valve being interposed between said second and valve opening cylinders, and an operative connection between said valve opening cylinder and said master valve adapted to cause said master valve to open after a predeterminable number of operations of said valve opening cylinder.

JOHN W. RUNDT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,416,462	Hanson	May 16, 1922
1,684,485	Guild et al.	Sept. 18, 1928
1,825,753	Nenninger	Oct. 6, 1931
2,171,902	Wood	Sept. 5, 1939
2,178,875	Kearns	Nov. 7, 1939
2,335,207	Flygare et al.	Nov. 23, 1943
2,409,240	Barker et al.	Oct. 15, 1946