

March 13, 1934.

R. N. HEALD

1,950,491

GRINDING MACHINE

Filed May 3, 1928

2 Sheets-Sheet 1

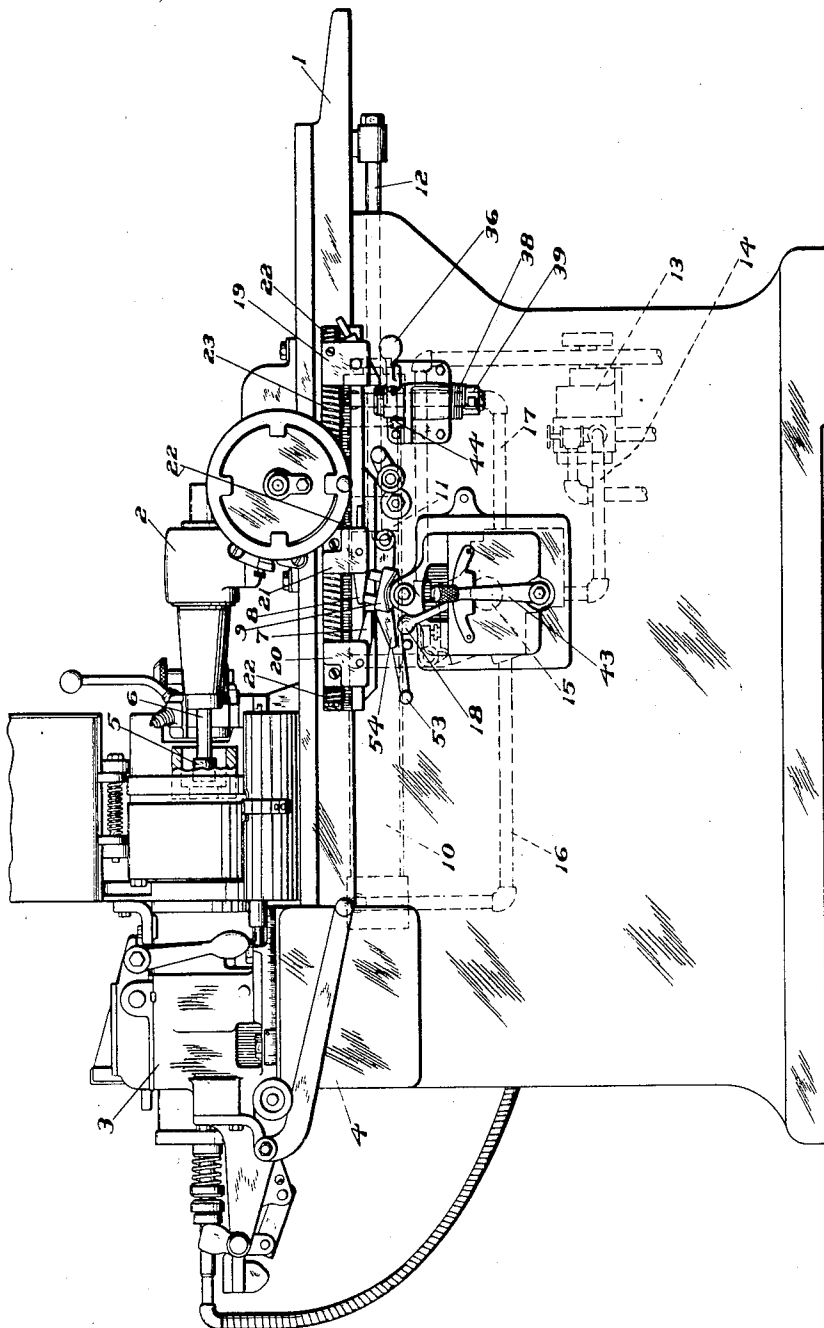


Fig. 1

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2 Sheets-Sheet 2

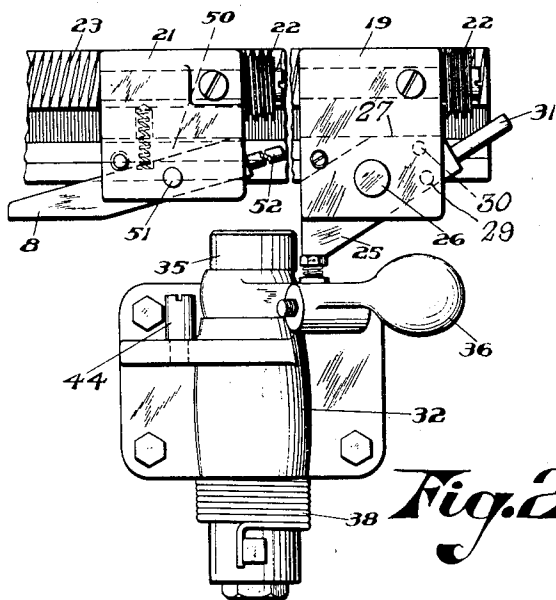


Fig. 2

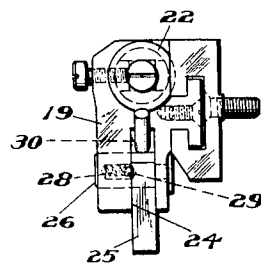


Fig. 5

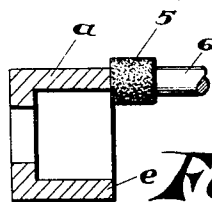


Fig. 7

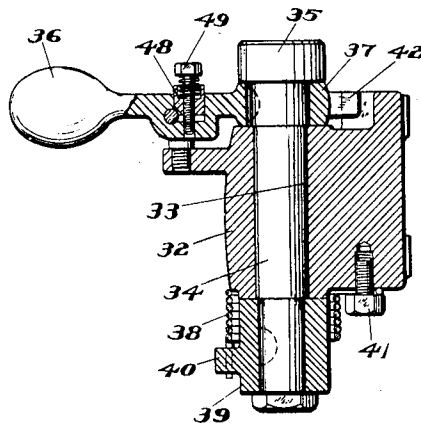


Fig. 4

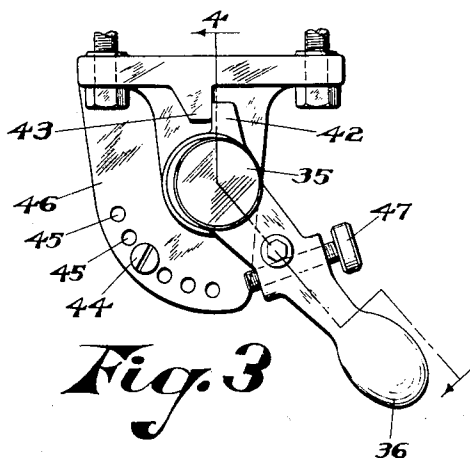


Fig. 3

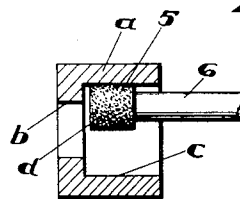


Fig. 6

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UNITED STATES PATENT OFFICE

1,950,491

GRINDING MACHINE

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Application May 3, 1928, Serial No. 274,824

4 Claims. (Cl. 51—50)

The invention relates to internal grinding machines which are adapted to grind the internal peripheral surfaces of hollow cylinders, gears, ball races, and other similar hollow or annular bodies. Such articles frequently have one or more shoulders breaking their internal cylindrical or conical surfaces, and much time is saved if such shoulders, which generally constitute plane surfaces, can be ground at the same time as the surfaces of revolution are ground; for one chucking of the article then suffices for two or more operations.

The ordinary internal grinding machine is provided with a table or carriage which, carrying either the grinding wheel or the work holder, serves to reciprocate one of these parts in relation to the other, so that the grinding traverse of the wheel may be produced. In connection with such a table or carriage a reversing mechanism is provided which may take any one of several different forms, but which, whatever form it takes, depends for its operation on some reversing member actuated from dogs or stops provided by the table or carriage, and which incorporates some form of spring or fluid pressure snap over device to shift the main reversing control means beyond the dead center, so that the table may be reversed and not come to a stop. Such snap over device whether it be spring actuated, fluid pressure actuated, or operated in some different mode, is inherently uncertain in its action no matter how carefully it may be made or adjusted. The usual grinding practice, when grinding internal surfaces, is to cause the wheel to travel slightly beyond the opposite extreme limits of such surfaces, thus to insure grinding despite slight variation in the range of travel of the grinding carriage but this, obviously, cannot be done in the case of a shouldered workpiece. One object of the invention therefore is to provide positive means for limiting the stroke of the table or carriage in one direction, so that internally shouldered objects may be ground right up to a sharp re-entrant corner, without danger of smashing the grinding wheel or disrupting some other mechanism of the machine.

Another object of the invention is the grinding of these flat surfaces or shoulders themselves, and when it is required that this be done on the same machine that grinds the surface of revolution, the front face of the small internal grinding wheel must necessarily perform the task. To perform such an operation the wheel must be fed slowly into this flat or shouldered surface at a rate commensurate with the ordinary cross or

transverse feed provided by internal grinding machines, which feed is totally disproportionate to the relatively fast normal longitudinal movement of the table or carriage. At the same time, it is highly desirable that the fluid pressure actuating and reversing mechanism, which has been found so useful in internal grinding machines, be retained. It is plain that the provision of any screw feed or the like to move the table or carriage would complicate the machine and would have to be connected and disconnected from the table to allow of normal fluid pressure actuation thereof. The invention, therefore, provides a rigid stop for co-operation with the table or carriage in bringing the wheel to the shoulder, and incorporates means for varying the locus of the stop so as to provide for a very fine feed. The invention further contemplates the combination of such variable stop with the fluid pressure actuating and controlling system, whereby the latter holds the table to the stop without possibility of lost motion. It will readily be seen that results not obtainable with the use of a pinion gear and rack, or a screw and nut means of reciprocating the table, are attained, the fluid pressure system of actuation being resilient in its nature while the others mentioned are positive and unyielding.

The above and other advantageous features of the invention will hereinafter more fully appear from the following detailed description, taken in connection with the accompanying drawings, in which:—

Fig. 1 is a front elevation of a grinding machine embodying the invention, showing certain parts of the fluid pressure actuating mechanism in dotted lines.

Fig. 2 is a fragmentary elevation of the adjustable positive stop which is part of the invention, together with the table dog with which it operates.

Fig. 3 is a plan view of the stop shown in Fig. 2.

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is an end view of the table dog shown in Fig. 2.

Figs. 6 and 7 are diagrammatic views showing respectively how the grinding wheel is adapted to grind a shoulder at the far end of a hollow cylindrical body, and how the invention may be made use of to grind the front annular face of a work piece.

Like reference characters refer to like parts throughout the drawings.

Referring to Fig. 1, the machine provides the usual reciprocatory table or carriage 1 which is

present in most internal grinding machines, and by the reciprocation of which the grinding traverse between the wheel and the work is produced. Such table or carriage may carry either the grinding wheel or the workpiece; as here shown said table supports the wheel head 2 while the work head 3 is supported by a bridge 4 which spans the slide ways provided for the back and forth reciprocation of the table 1. The grinding wheel 5 is mounted on the end of a spindle 6 which is suitably journaled in the wheel head 2, and any suitable means, not shown, may be provided to rotate the grinding spindle, such means forming no part of my present invention. By means of adjustable dogs or stops 7 and 8 carried by the table 1, a pivoted reversing member 9 is shifted, first in one direction and then in the opposite direction, thus producing the normal working traverse of said table through the medium of fluid pressure operating mechanism, which said member 9 controls. Such fluid pressure operating mechanism may and desirably does take the form shown in United States Letters Patent No. 1,582,468 granted to Heald and Guild on April 27, 1926 and comprises essentially a fluid pressure cylinder 10 which contains the usual double acting piston 11 suitably connected, as by a rod 12 with the table 1. For the back and forth movement of said table 1, fluid under pressure is admitted to one end or the other of the cylinder 10, the pressure fluid being forced by a pump 13 into a supply pipe 14, the latter leading to a reversing valve designated generally by the numeral 15; the position therein of a movable valve member, not shown, suitably connected to the reversing member 9, determines the flow of the pressure medium to one end or the other of the cylinder 10 by way of a pipe 16 or a pipe 17 as the case may be. The usual spring snapover device, not shown, is operative either on the member 9 or on the fluid-directing member in the valve 15, so that the latter, when actuated by the reversing dogs 7 and 8, will always pass through its neutral or center position. However a handle 18 is provided on the front of the machine by means of which the reversing valve may be manually placed in such neutral position. It is not deemed necessary to further describe the fluid pressure actuating and reversing mechanism, since any of the known forms thereof may be employed, and reference may be had to the aforesaid patent for any further details of the particular construction herein referred to.

Referring to Figs. 1 and 2, the table 1 carries a block 19 adjustably mounted thereon beyond the outer reversing dog 8. As is the case with the blocks 20 and 21 that carry the reversing dogs 7 and 8, the block 19 may be readily adjusted in its position longitudinally of said table 1, as by means of the usual hand screw nuts 22, 22, 22, carried by all three blocks and meshing with a screw rack 23 formed on the table. As best shown in Fig. 5, the block 19 is provided with a downwardly opening channel 24, and received in this channel is a dog or stop 25, pivotally mounted on a pin 26 that extends across the channel. The lower or striking end of the dog 25 normally extends below the bottom of the block 19, and this striking end is rigid against movement to the right in relation to the block, for the dog 25 cannot turn further counterclockwise than the position shown in Fig. 2 since an upper surface 27 of said dog is in contact with the floor or inner surface of the channel. The dog 25, moreover, is resiliently prevented from turning in a clockwise direction by means of a ball and spring device 28 located in

the block 19, the ball of which is adapted to seat in either of two depressions 29 and 30 provided in the front fact of the dog, the lower depression 29 receiving said ball when the parts are in the position shown, and the upper depression 30 receiving the ball when the striking end of the dog is lifted, to render it inoperative for a purpose that will be pointed out hereinafter. By means of a suitable handle 31 the dog 25 can be easily and quickly placed in either of these positions by the machine operator.

Suitably fastened to the front of the machine frame, as by means of the cap screws illustrated, is a bracket 32. Referring now to Fig. 4, the bracket 32 provides a vertical hole 33 extending there-through which constitutes a bearing support for a shaft 34. Formed integrally with or fastened to the upper end of this shaft 34 is an eccentric of cam member 35 which lies in the path of travel of the dog 25. The eccentric portion 35 may be manually turned by means of a handle member 36 which provides a collar portion 37 that surrounds the shaft 34 and is fastened thereto as by a key and spline.

Referring to Figs. 2, 3 and 4, the above described parts are normally maintained in the position shown in said figures by means of a coiled spring 38, one end of which exerts its torsion on the shaft 34 through the medium of a sleeve 39 having a projection lug 40, the other end of said spring being anchored to the bracket 32 by means of a screw or bolt 41. The action of the spring 38, as will be clearly apparent from the drawings, tends to turn the shaft 34 and eccentric 35 in a counterclockwise direction as viewed in the plan view of Fig. 3. The shaft and eccentric are prevented from turning beyond the position of Fig. 3 by means of a stop lug 42 projecting from the collar portion 37, which engages a lug 43 formed on the bracket 32.

When the machine is to be used for the internal grinding of unshouldered workpieces, or workpieces having shoulders remote from their surfaces to be ground, the dog 25 is rendered inoperative, by merely depressing the pin 31 and raising the striking end of the dog 25 above the top of the eccentric 35. When, however, it becomes desirable to grind a succession of workpieces *a* such as shown in Fig. 6 as closely as possible to an internal flange *b* of each workpiece without any danger of the grinding wheel impacting said flange and being broken, the operator raises the pin 31 to place the striking end of the dog 25 on a level with the eccentric 35, and having first moved the table 1 to carry the grinding wheel 5 into the workpiece, he moves the lock 19 relative to the table 1 until the dog 25 is actually touching the eccentric 35. The operator then shifts the control lever 18 so as to force the table 1 to the left by fluid pressure, and turns the hand screw nut 22 provided by the block 19 in the direction to allow the table to be slowly moved to the left until the desired limit of required inward traverse of the grinding wheel is attained. The operator should then set the right-hand table reversing dog 8 so that it has just shifted the reversing member 9 beyond the dead center position in order that the travel of the table will be reversed at this point and, after establishing the right hand or outward limit of the traverse in the well known manner, he causes the table 1 to reciprocate slowly (which may be done by the use of the throttle lever 43 on the front of the machine). If the table 1 in its movement to the left causes the dog 25 to strike the eccentric 35 the dog 8 should be shifted to re-

verse the member 9 slightly earlier, and this may be done by means of the hand screw nut 22 provided by the block 21. In the grinding of the workpiece *a* which can then be proceeded with, there will be no danger of the grinding wheel 5 striking the flange *b* and being fractured, as the dog 25 and the eccentric 35 will act as a positive stop to limit the leftward motion of the table, although the parts will have been set so that, barring some sudden change in the pressure of the operating fluid or in the resistance of the ways on which the table 1 travels, these members will not quite come into contact, or if they do so will barely touch gently.

The invention, however, has more extensive use as a means whereby the plane surface of the flange *b*, Fig. 6, can itself be ground. In using the invention for this purpose, whether the internal cylindrical surface *c* has been ground or not, the operator moves the grinding wheel by the method already described as near to the flange *b* without touching it as he is able, by the use of good judgment, to do, it being understood that the hand lever 18 has been shifted to cause the pressure fluid to enter the right hand end of the cylinder 10 by way of the pipe 17 to force the table 1 to the left, and that the striking end of the dog 25 is in actual engagement with the eccentric portion 35. The operator will then grasp the handle 36 and turn it slowly clockwise against the tension of the springs 38. This causes the grinding wheel to be fed with a slow cutting feed to carry its front radial or annular surface *d* into engagement with the flange *b*, since the eccentric member 35 is in its extreme right-hand position when the parts are in the position shown in Figs. 1 and 3, and any movement from that position will allow the dog 25 to move to the left. In case extreme motion of the eccentric does not result in any contact between the grinding wheel and the flange *b*, the operator can return the eccentric to its initial position and feed the table inwardly by use of the screw 22 on the block 19 and repeat the operation. When, ultimately, the flange *b* has been ground to the required depth, as determined in any manner such as by the use of a gage, the operator may preserve the trial result thus brought to a conclusion by means of a screw or pin 44, which can be located in any one of a plurality of holes 45 provided in a web 46 extending horizontally from the member 32, and which, together with a set screw 47 provided by the handle 36, constitute locating stops to enable the parts to again be moved to the exact position found. To do this it is only necessary to locate the stop screw 44 close to the screw 47 and then turn the latter until it engages the stop screw 44; the screw 47 can then be locked in position as by means of a screw binding device 48 actuated from a bolt 49. The operator can then grind a whole series of flanges *b* on workpieces *a* to the same depth as the first one of the series was ground, and when the screw 47 contacts with the stop screw 44, the operator will know that the operation is finished.

The invention further provides a ready means for causing the table 1 to undergo its normal reciprocatory traverse under the control of the reversing dogs 7 and 8, and to be then quickly moved to the left to carry the stop 25 into engagement with the eccentric or cam portion 35. This means has particular utility in case it is desired, first, to grind the internal cylindrical surface *c* of the workpiece *a*, and subsequently to grind the side of the flange *b*, without in any

manner changing the setting of the machine. To this end, the right-hand table dog 8, which normally limits the left-hand motion of the table 1 that carries the grinding wheel 5 into the workpiece, is a pivotally mounted dog. As best shown in Fig. 2, the dog 8 fits in a channel 50 provided on the under portion of its carrying block 21, in much the same fashion that the dog 25 fits in the channel 24; the dog 8 is pivotally mounted in said channel on a pivot pin 51 extending thereacross, and is normally maintained in the position shown in Fig. 2 by a spring 52. Assuming the carrying blocks 20 and 21 of the table dogs 7 and 8 to have been so adjusted relative to said table that the grinding wheel 5 undergoes a traverse to properly grind the internal cylindrical surface *c* of the workpiece *a*, the operator when said grinding operation is finished has only to press downwardly a pin 52 on the right-hand end of the dog 8, and this raises the striking end of said dog above the reversing member 9 and allows the table 1 to move to the left until the striking end of the dog 25 comes in contact with the member 35, which will have been previously adjusted to proper position to stop the table just before the front of the grinding wheel strikes the flange *b* in the workpiece, as hereinbefore described. The operator may now swing the lever 37 in a clockwise direction, or to the left, until the already adjusted set screw 47 strikes the pin 44, and now the grinding of the workpiece *a* to both the cylindrical surface *c* and the flange *b* is completed in practically one operation. It will be readily seen that this operation can be performed very rapidly.

The workpiece being now completed, the operator need only run the grinding wheel 5 to its inoperative position relative to the work head 3, this being done by causing movement of the table 1 to the right beyond its normal working traverse in a manner which forms no part of the present invention, but which for illustrative purposes is shown as embodied in the pivotal mounting of the table dog 7, and the provision of a hand lever 53, which has an inclined surface 54 adapted to be raised into the path of said table dog 7 to cause it to be lifted over the reversing member 9, thus allowing the table to continue its right-hand movement to separate the grinding wheel and the workpiece, the table being brought to a stop in its retracted position by any suitable means, such as that disclosed in the aforesaid patent to Heald and Guild. The operator may now place a new workpiece *a* in the chuck and repeat the grinding operation, the setting of the adjustable stops of the invention and also the table reversing dogs 7 and 8 being undisturbed.

The apparatus of the invention can also be made use of to grind the front annular surfaces *e* of a workpiece *a*, as shown in Fig. 7, but the procedure for performing this operation, being in all respects substantially similar to that already described in connection with the grinding of the face of the flange *b*, it need not be here-in further set forth.

I claim,

1. In a grinding machine, a positive stop comprising an eccentric or cam member suitably journaled in the frame of the machine, a co-operating stop carried by a table or carriage, means to swing said first named stop to change the location of engagement of the second stop therewith, and adjustable means to limit the

swing of the first named stop to bring it to a desired position.

2. In a grinding machine, a positive stop comprising an eccentric or cam member suitably journaled in the frame of the machine, a co-operating stop carried by a table or carriage, means to swing said first named stop to change the location of engagement of the second stop therewith, and spring means to swing said stop in a retrograde direction and further means to fix the initial position of said first stop to locate the surface thereof in reference to the other stop so as to fix the initial position of engagement therebetween.

3. In a grinding machine, a reciprocatory table for producing a relative axial traverse between a grinding wheel and a workpiece, fluid pressure mechanism for reciprocating said table, including a reversing member and stops on said table to engage and shift said member in

opposite directions, thereby to effect successive reversals of the table travel, in combination with means operating independently of said reversing member and stops for positively limiting the extent of table travel in one direction, said means comprising a projection on said table and an abutment in the path of said projection, and means for operating said last-mentioned parts to procure an axial feed of the grinding wheel.

4. In a grinding machine, a base member, a table member movable on said base member, a positive stop comprising an eccentric or cam suitably journaled in one of said members, a co-operating stop carried by the other of said members, means to swing said first named stop to change the location of engagement of the second stop therewith, and adjustable means to limit the swing of the first named stop to bring it to the desired position.

ROGER N. HEALD.

25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150