Sept. 18, 1928. 1,684,485

W. J. GUILD ET AL

GRINDING MACHINE

Original Filed July 26, 1926 6 Sheets-Sheet 1

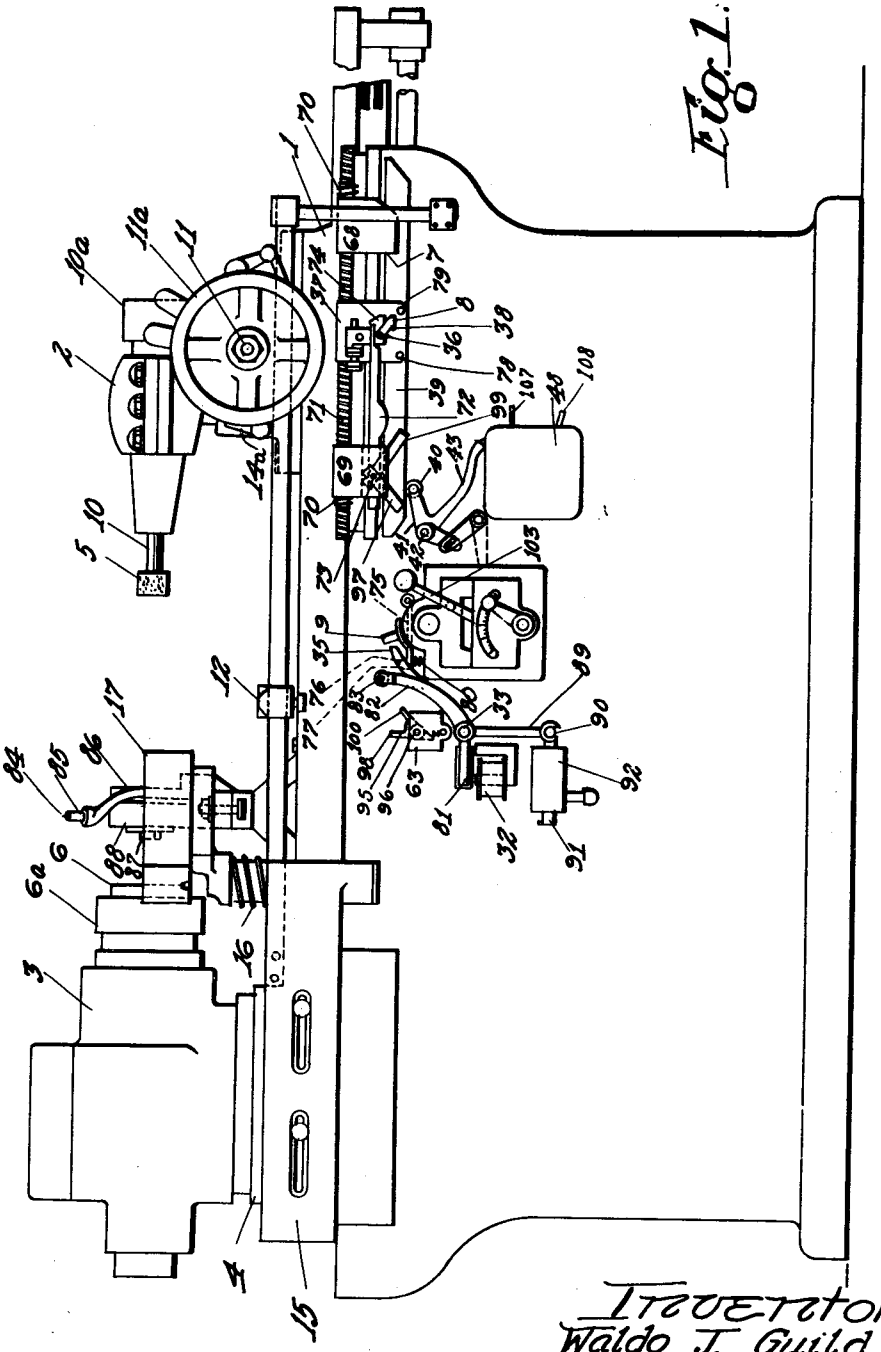


Fig. 1.

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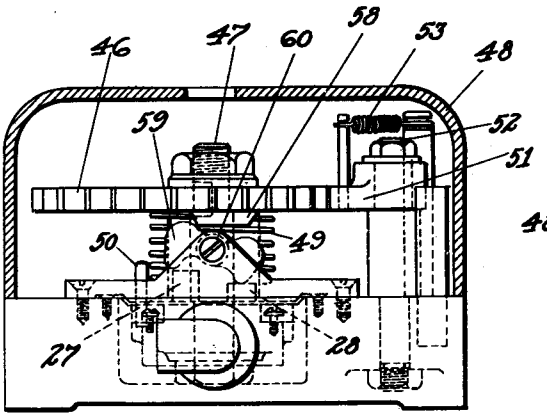


Fig. 4.

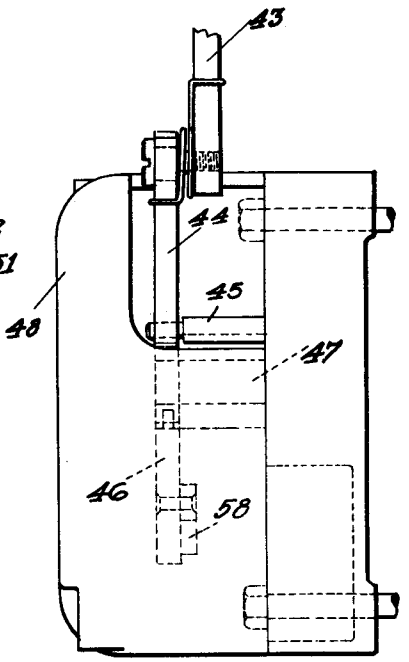


Fig. 5.

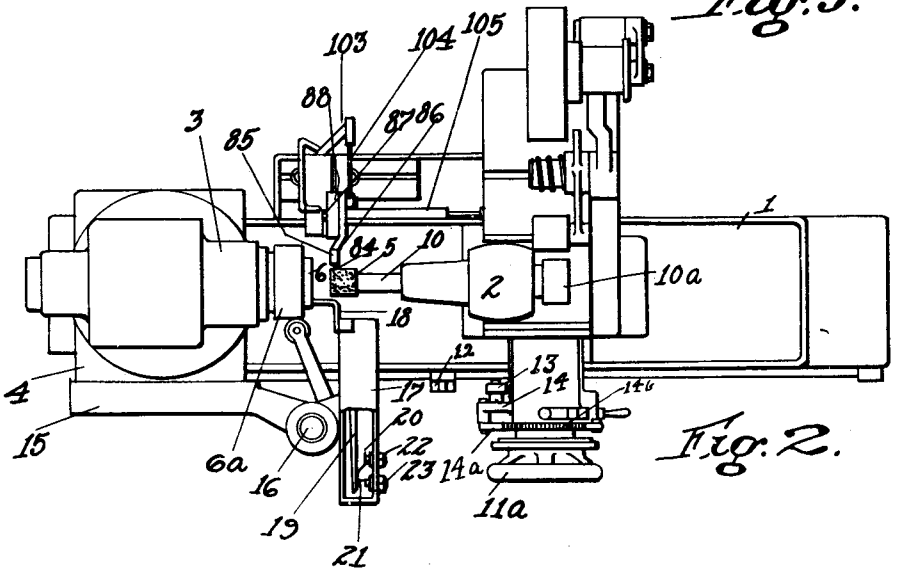


Fig. 2.

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GRINDING MACHINE

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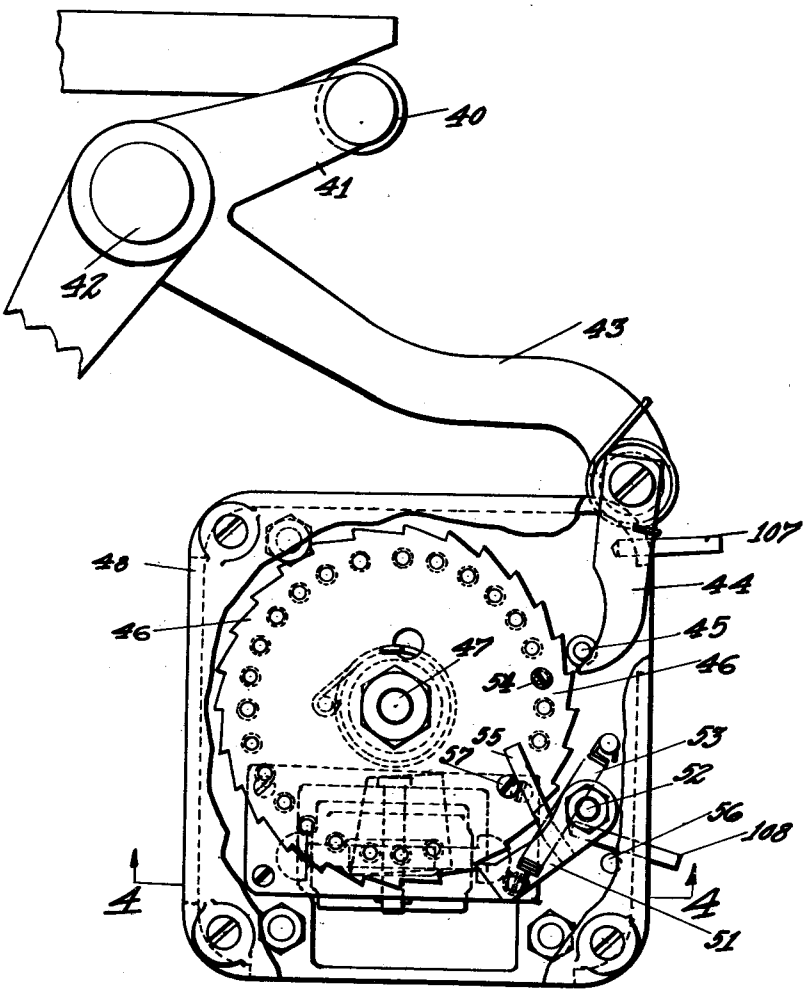


Fig. 3.

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GRINDING MACHINE

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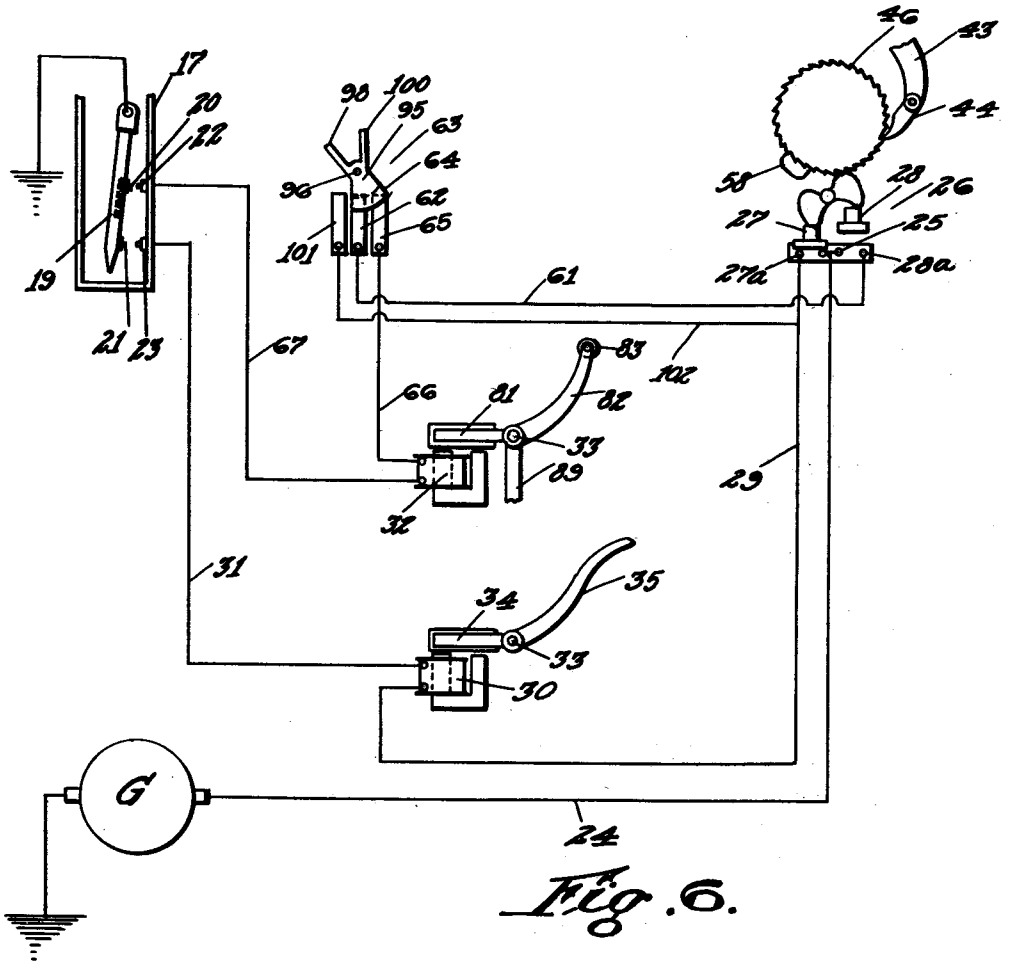


Fig. 6.

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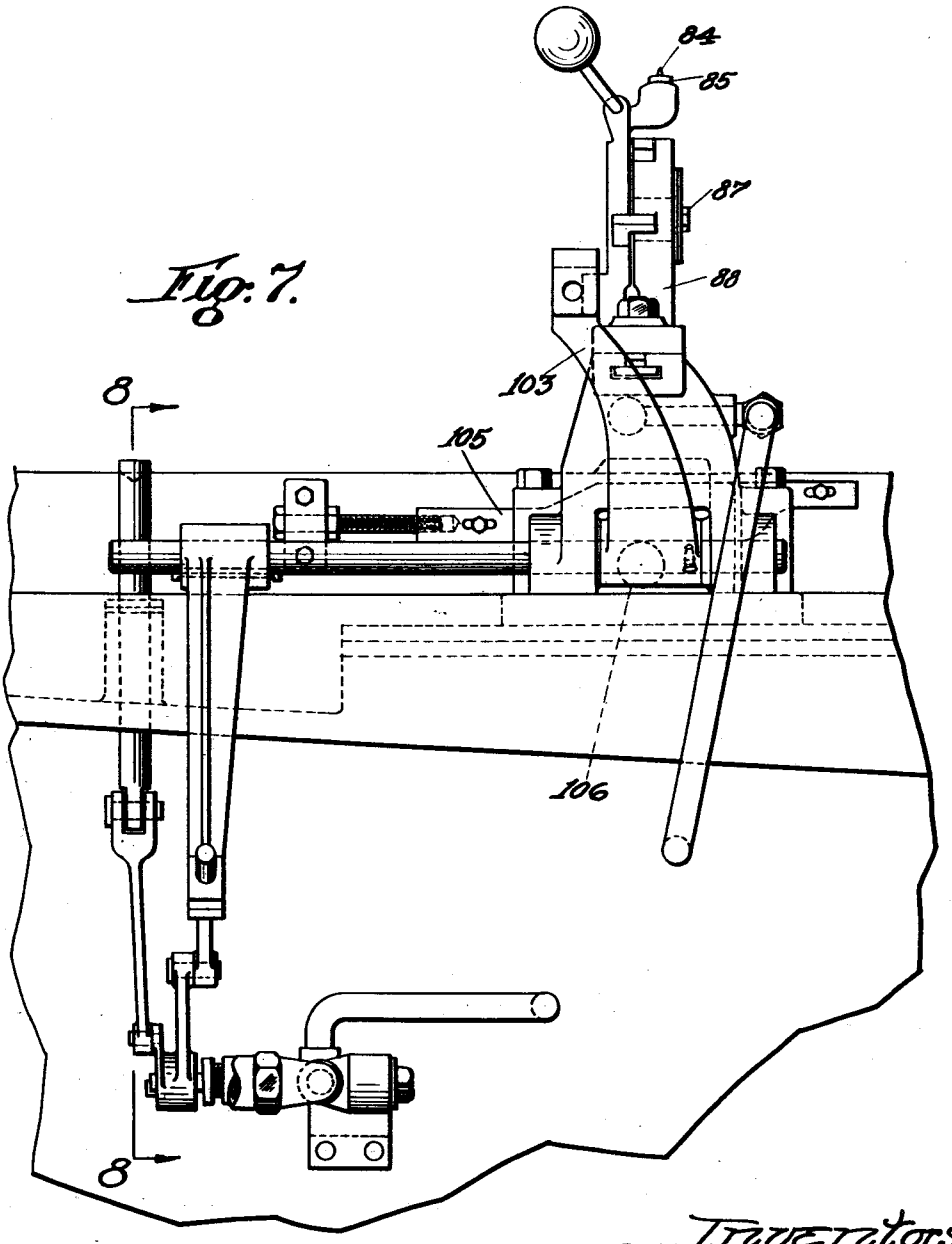
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Fig. 7.



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GRINDING MACHINE

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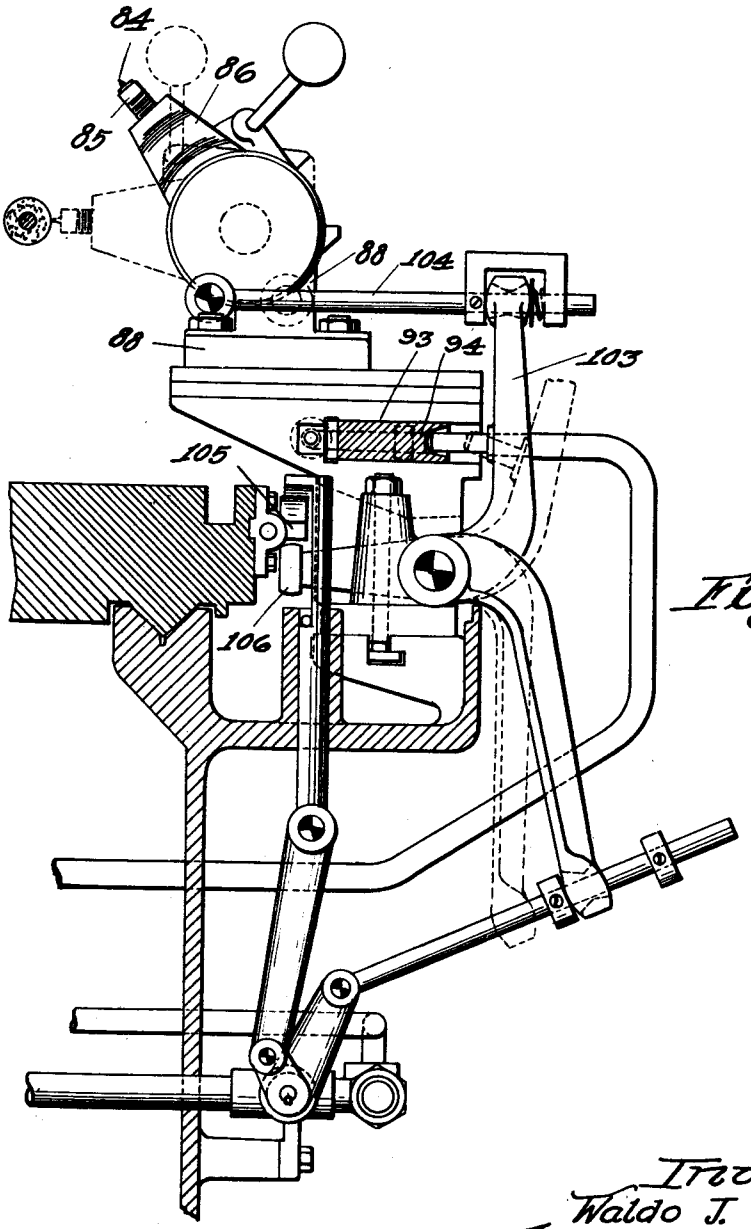


Fig. 8.

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Patented Sept. 18, 1928. 1,684,485

UNITED STATES PATENT OFFICE.

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GRINDING MACHINE.

Application filed July 26, 1926, Serial No 124,954. Renewed April 3, 1928.

The invention relates to grinding machines, particularly those adapted to grind the internal peripheral surfaces of sleeves, gears, bushings, and like articles. The invention described herein and illustrated in the accompanying drawings, is an improvement upon and an addition to the prior invention shown and claimed in the copending application of Kempton and Gallimore, Serial No. 6,689, filed Feb. 4, 1925, and also to the prior invention shown and claimed in the copending application of Heald, Guild, Burns, and Garno, Serial No. 4,466, filed Jan. 24, 1925.

The invention of said copending application provides a calipering mechanism having a member in contact with the internal surface of a workpiece, and mechanism controlled thereby for automatically dressing and truing the grinding wheel at a given point in the grinding of each workpiece, and further mechanism for automatically separating the grinding wheel and workpiece when the latter has reached the desired finished size. It is to be understood, however, that the mechanism of the present invention can equally well be applied and added to the grinding machine shown and claimed in the copending application Serial No. 48,734 of Waldo J. Guild, filed August 7, 1925, which provides automatic means for similarly dressing the grinding wheel and causing final separation between wheel and workpiece, said means, in the absence of a work-calipering device, being controlled by the transverse feeding mechanism which feeds the grinding wheel relative to the workpiece in a lateral direction to take successively deeper cuts.

The present invention is designed for use with automatic grinding machines of the character set forth in the aforesaid copending applications, in connection with grinding operations where the greatest possible speed of production is required, and where, on certain classes of work, it is possible to sacrifice the automatic wheel truing operation on each individual workpiece, that is characteristic of the machines of said copending applications. It is a fact that in grinding certain classes of work, where only a very small amount of stock is required to be removed, that the grinding wheel does not require dressing for each individual workpiece. Accordingly, this invention provides mechanism for automatically dressing the wheel every second, fifth, twenty-fifth, or other predetermined number of workpieces. The increase of production of the present machine over said former machines results, not so much from the time saved by omitting needless dressing, although that is a factor, but principally because the grinding wheel itself does not have to be replaced so often.

The above objects and advantages will fully appear in the following description of the present illustrative embodiment of the invention.

In the drawings:

Fig. 1 is a front elevation of a grinding machine built in accordance with the invention.

Fig. 2 is a plan view of the machine.

Fig. 3 is a front elevation, on an enlarged scale, of the counting mechanism of my invention.

Fig. 4 is a horizontal sectional view of the same parts, the section being taken on the line 4—4 of Fig. 3.

Fig. 5 is a side elevation of these parts.

Fig. 6 is a wiring diagram of the machine.

Fig. 7 is a fragmentary view from the rear of the machine, showing the dresser moving mechanism.

Fig. 8 is a sectional view on the line 8—8 of Fig. 7.

Like reference characters refer to like parts in the different figures.

Referring first to Fig. 1, the machine provides the usual reciprocatory table or carriage 1 which is ordinarily provided in any internal grinding machine. In such a machine, either the grinding wheel or the work to be ground may be carried on the table 1, the reciprocation of the latter being utilized in either case to produce a relative traversing movement between the grinding wheel and the work. As here shown, the table 1 supports and carries a wheel head 2, while the work which is to be operated upon is held in a work head 3, the latter being carried by a bridge 4, which spans the slideways provided by the machine frame for the back and forth movement of the table 1.

This back and forth movement of the table 1, to cause the rotating grinding wheel 5 to

make the required interior traverse of the rotating workpiece 6, may be imparted in any well known manner. Desirably, the fluid pressure controlling and reversing mechanism of United States Letters Patent No. 1,582,468, dated April 27, 1926, is employed. As described in said patent, the table is reciprocated by fluid pressure means, its motion being reversed at the end of each working stroke by the use of spaced adjustable dogs 7 and 8, which, during the grinding operation, alternately strike and move a reversing member 9.

In the present machine, the grinding wheel 5 is rotated at high speed in any suitable manner, as for instance, by a belt drive for the wheel spindle 10, the latter for this purpose carrying a pulley 10ª. The workpiece 6 is also rotated, but at a slower speed, this rotation being imparted in any suitable manner as by a belt drive, not shown, from a countershaft. The machine also embodies the usual instrumentalities for both manual and automatic cross feed between work and wheel, here shown as embodied in a screw shaft 11 for feeding the wheel head 2 transversely of the table 1. Said screw shaft 11 may be operated, if desired, by the usual hand wheel 11ª. The automatic operation of said screw shaft 11 is effected in the usual manner, at each reciprocation of the table 1, by a fixed dog or stop 12 which is engaged by a roller 13 carried by a pivoted arm 14; the movements of said arm are transmitted through pawl 14ª and ratchet wheel 14ᵇ, through reduction gearing, not shown, to the screw shaft 11, thereby to obtain the automatic cross feed of the grinding wheel 5 at each reciprocation of the table.

Referring now to Figs. 1 and 2, enough of the calipering mechanism of the said copending application Serial No. 4,466 is shown to make the present invention understandable. A bracket 15 is attached to the bridge 4, or to any other convenient stationary part of the machine, this bracket providing a journal 16 for a box-like structure 17 which contains the very sensitive calipering mechanism. It would serve no useful purpose to describe the latter in detail here,—suffice it to say that it comprises a caliper lever 18 adapted to contact the inside of a workpiece, the motion of said lever being transmitted greatly magnified to an indicating lever 19 which carries two contact terminals 20 and 21, adapted to successively ground a pair of stationary terminals 22 and 23. During the normal grinding operation, the box 17 is in the position shown in Fig. 2, the lever 18 being in contact with a workpiece; at the cessation of grinding, the box 17 is automatically swung on its pivot 16 to take the lever 18 out of the workpiece, the parts being shown in this position in Fig. 1.

Referring now to the wiring diagram of Fig. 6, any source of electric current is provided, as by a generator "G". One terminal of said generator is grounded as indicated, and the other terminal leads by a conductor 24 to the two inside terminals 25 of a four terminal push button switch 26, of ordinary construction. The switch provides buttons 27 and 28, only one of which can be "in" at any one time. With the button 27 in, as shown in Fig. 6, one of the terminals 25 (which electrically considered are one, as indicated) is connected to a terminal 27ª that connects by a conductor 29 to a terminal of an electromagnet 30. The other terminal of electromagnet 30 is connected by a conductor 31 to the stationary terminal 23 in the box 17.

Referring now to Fig. 1, the electromagnet 30 is one of a pair of such, mounted on the front of the machine,—magnet 30 being behind another electromagnet 32 that appears in said figure. Each of said magnets has associated with it an armature and an operating lever, all of these parts being pivoted on a common pivot pin or stud 33.

During the majority of grinding operations, and except, as will be presently described, during those grinding operations in which the grinding wheel 5 is automtically dressed and trued, the push button switch 26 is in the position shown in the diagram of Fig. 6, with the terminals 25 and 27ª connected. Consequently the grinding on a given workpiece will continue uninterrupted until the hole therein is enlarged to such an extent that the calipering lever 18 shall have moved the indicating lever 19 to bring the contacts 21 and 23 together. This action, as will be readily seen from Fig. 6, energizes the electromagnet 30, the current proceeding from the generator by way of conductor 24, terminals 25—27ª, conductor 29, through said electromagnet 30, by conductor 31, terminals 23—21, lever 19 to ground and back to the generator. The immediate result of this energization is to attract an armature 34, thus raising an attached lever arm 35, and this causes a cessation of the grinding operation, and a withdrawal of table 1 to carry the grinding wheel 5 well away from the workpiece 6. The action takes place as follows:—

The dog 8 is pivotally mounted at 36 (see Fig. 1) on a carrying block 37, and normally rests by gravity against a pin 38. When the arm 35, as above described, moves upwardly, it is in the path of dog 8, and on the next right hand movement of table 1, the free end of said dog rides upon the upwardly inclined surface of said arm 35, and is thus carried clear of the reversing member 9. The table 1, therefore, continues its movement to the right, carrying the grinding wheel 5 out of the work, said table being finally brought to a stop by any suitable means, such, for example, as disclosed in the aforesaid Patent No. 1,582,468.

This extended travel of the table 1 is made use of to operate the counting mechanism of my invention. As shown in Fig. 1, the block 37 carries a cam bar 39, which, when the table 1 undergoes the extended movement just described, engages and depresses a roller 40 on a lever 41 pivoted at 42 on the machine frame; this action rocks said lever in a clockwise direction and, as fully described in the aforesaid Patent No. 1,582,468, causes the table 1 to travel at accelerated speed. In the present invention, movement of the lever is also made use of to actuate a pawl device for the counting mechanism. As best shown in Fig. 3, lever 41 has a downward extension 43 on the lower end of which is pivotally mounted a spring pressed pawl 44. The latter normally rests, as shown in said figure, against a pin 45, but when the lever 41 and, therefore, the extension 43 is moved, the pawl 44 engages and moves a ratchet wheel 46. The latter is rotatably mounted on a stud 47 and is inclosed in a box-like structure 48 mounted on the front of machine. See Figs. 1, 3, 4 and 5.

As best shown in Fig. 4, a coil spring 49 surrounds the inwardly extending hub of ratchet wheel 46, one end of said spring being attached to the ratchet 46 and the other end being fixed to a stationary pin 50. Each separate actuation of the pawl 44, responsive to the withdrawal of table 1, moves the ratchet 46 by the distance of one tooth thereof against the force of spring 49. Referring again to Fig. 3, the ratchet is held from retrograde movement by a hold pawl 51, pivotally mounted on a stud 52 and normally held in engagement with ratchet 46 by a spring 53. This step-by-step movement of the ratchet continues until such time as a screw stud 54 carried thereby comes into engagement with an arm 55 projecting from one side of pawl 51, which action moves the pawl far enough to shift the pull of the spring 53 to the other side of stud 52, thus carrying the pawl out of engagement with ratchet 46, the pawl being held from further movement by a stop 56. Since nothing now holds the ratchet wheel 46, it moves counterclockwise under the action of coil spring 49, thus causing a second screw stud 57 to strike the arm 55 and bringing the parts back to the position shown in Fig. 3, ready to undergo the same cycle of operation again.

The screw stud 54 has no fixed definite position, but can be placed in any one of a series of tapped holes spaced around the ratchet 46, so that the cycle of operation just described can take place in as few as two successive withdrawals of the table 1 (each withdrawal signifying the grinding of a separate piece of work) or, as shown, it can take place in as many as twenty-five withdrawals, or in any number between two and twenty-five. It is obvious, of course, that the limit can be extended upwards indefinitely, simply by providing a larger ratchet wheel 46, though there would seem to be little utility in extending the cycle beyond twenty-five workpieces.

Once during each of the above cycles, the grinding wheel 5 is automatically dressed and trued, and this action is effected in the following manner:—

Referring to Fig. 4, the ratchet 46 carries on the side thereof a cam 58. In the path of this cam is a rocker 59 pivoted on a stud 60. In the initial position of the ratchet, that is to say, immediately at the finish of a cycle as described, the cam 58 has engaged the rocker 59 so that the latter has pushed in the button 28. This connects one of the terminals 25 to a terminal 28^a, and disconnects terminal 27^a from either of said terminals 25. Fig. 6, as aforesaid, shows the parts after the cycle has started, said figure showing the parts diagrammatically and projected into a plane, while Fig. 4 is a section looking upwardly in the box 48. Referring now to Fig. 6, and considering that terminals 25 and 28^a are connected, when the grinding of the particular workpiece then in the machine has proceeded far enough to bring the contacts 20 and 22 together, responsive to movement of levers 18 and 19, the electromagnet 32 is energized. Current proceeds from the generator, by way of conductor 24 to terminal 25, to terminal 28^a, thence by a conductor 61 to a central bar or plate 62 of a switch 63, the movable connector 64 of which is then in the position shown in said figure. Bar 62 is therefore connected to a right hand bar 65, and a conductor 66 leads the electricity to magnet 32 therefrom. The other terminal of magnet 32 connects by a conductor 67 to terminal 22, which as stated is now in contact with terminal 20 which is grounded, as the terminal of the generator not connected to conductor 24 is also grounded, the current will flow by the connections described.

As shown in Fig. 1, and as already stated, the left hand table dog 8, which limits the right hand movement of table 1, is carried by a block 37 which, instead of being secured directly to the table 1, as is the case with the block 68 of dog 7, is mounted so as to be capable of sliding freely longitudinally of said table. Under normal conditions, when the table is making its usual working reciprocations to traverse the grinding wheel 5 back and forth within the workpiece, the block 37 of dog 8 is held in definite spaced relation to a block 69, which latter, the same as the block 68 of right hand dog 7, is a stationary block adapted to maintain its predetermined setting or adjustment longitudinally of the table 1, as given it by any suitable adjustment of adjusting and holding devices, such for instance, as the hand screw nuts 70, 70, applied to both blocks 68 and 69

and engaging with a screw rack 71 on the table 1.

The device employed to hold the slidable block 37 in spaced relation to the fixed block 69 is here shown as a latch lever 72 pivoted at 73 on block 69, and having its free end disposed by gravity in abutting relation to a shoulder 74 on block 37, thereby holding the block 37 at a predetermined distance to the right of block 69. When the latch member 72 is lifted to free its end from the shoulder 74, the normal connection between the slidable block 37 and the fixed block 69 is broken, and when this occurs, on the right hand movement of the table 1, the dog 8 will bear without effect against the member 9. Thus the right hand movement of the table 1 on this particular stroke will be extended beyond the usual reciprocatory working path, and the grinding wheel 5 will be carried out of the hole in the workpiece to a point just beyond that occupied by a dressing device which, as will be presently described, has been moved into operative position as the amplified right hand travel of table 1 begins. This amplified right hand travel of table 1 involves relative sliding movement between said table and the block 37, owing to the obstruction which the reversing member 9 imposes against the dog 8 to prevent the block 37 from moving with the table; finally, the block 37 brings up against the block 69, whereupon the solid backing thus afforded for the block 37 enables the dog 8 to shift the member 9. This procures the reversal of the table 1, and the left hand movement of said table thus inaugurated is caused to restore the parts automatically to normal position in the following manner.

A member 75, pivotally mounted on the frame of the machine, has a pair of inclined surfaces 76 and 77 for cooperating, respectively, with inclined surfaces 78 and 79 at the lower corners of the block 37. A spring 80 presses said member upwardly. In the normal grinding operation of the machine when the blocks 37 and 69 are connected by latch 72, the surfaces 76 and 77, although in the path of block 37, offer no effective obstruction to the back and forth travel of said block in unison with the table 1, it being obvious that when either lower corner of the block under these conditions strikes either of the bevelled surfaces 76 or 77, such contact will wedge the spring 80 downwardly, said spring yielding sufficiently to allow the block 37 to pass over the member 75. However, when the block 37 has been freed from the block 69 as above described, to amplify a single right hand stroke of the table 1, the ensuing reversal of said table, with the block 37 still free, finds the surface 76 in position to contact with the corner 78 of said block, and under these conditions, the obstruction offered is sufficient to overcome whatever friction there may be tending to cause the block 37 to move to the left with the table. The block 37 being thus held stationary while the table 1 and block 69 continue to move to the left, the latch member 72 finally resumes its normal position relative to the block 37, the end of said latch member dropping behind the shoulder 74 and the parts being thus automatically restored to normal position at the conclusion of each single amplified reciprocation of the table 1.

Energization of the magnet 32 attracts an armature 81, to which is attached a lever arm 82, these parts being pivotally mounted on the stud 33. Movement of lever arm 82 is adapted to raise the latch lever 72, the former being desirably supplied with a roller 83 for this purpose. Thus energization of magnet 32 causes the table 1 to undergo a single amplified movement to the right.

Similarly, as already indicated, energization of magnet 32 causes a dressing diamond 84 to be moved into the amplified path of travel of wheel 5. Referring to Fig. 1, said diamond is mounted in an adjustable screw plug 85 carried by a carrying arm 86 which is pivotally supported by a trunnion 87 in an adjustable standard 88. The precise means to move the carrying arm 86 forms the subject matter of the copending application of Heald and Guild, Serial No. 25,900, filed April 25, 1925; for the purpose of the present invention, it is sufficient to observe that, as described in said copending application, the lever arm 82 has a downward extension 89, connected at 90 to a valve 91. When, responsive to energization of electromagnet 32, said valve 91 is moved to the right in its casing 92, fluid pressure is admitted to a cylinder 93, see Fig. 8, which actuates a piston 94, and by means of a lever 103 and link rod 104, moves the carrying arm 86 to bring the diamond 84 into the path of the wheel 5, it being shown in actual contact with the wheel in Fig. 2. Thus the grinding wheel is dressed and trued, and as the table 1 moves back to restore the normal working traverse of the wheel 5, a cam bar 105, best shown in Figs. 7 and 8, engages a roller 106 carried by a forward extension of the lever 103 and thus mechanically and positively restores the diamond 84 to the full line position of Fig. 7, out of the path of the wheel 5. As will be seen from Figs. 7 and 8, the cam bar 105 is adjustably fastened to the table 1.

In the present invention, the function of the switch 63 is two-fold, as will be explained. Said switch comprises a movable member 95 on which is located the connector 64, already referred to. Member 95 is pivoted at 96, and normally, during the grinding of a workpiece, is in the position shown in Fig. 6, being placed in said position when

the table 1 moves in to grind a new workpiece, by an arm 97 carried by the table 1 and in the path of which is an arm 98 of said member 95. When the dressing stroke occurs, an arm 99 carried by the table, strikes an arm 100 of the switch (said arms 99 and 100 being in a different vertical plane from the arms 97 and 98) and places the movable member 95 in the position shown in Fig. 1. The switch member 95 retains this position during the final and finishing cuts on the particular workpiece then being ground, with the connector 64 now connecting the bar 62 with a left hand bar or plate 101. This prevents a repetition of the dressing operation until the counting device has moved to again inaugurate it, despite the fact that during the remainder of the grinding operation on this particular workpiece, the terminals 20 and 22 will be together, for the electric circuit that inaugurated said dressing is broken between the bars 62 and 65.

The table withdrawal and cessation of grinding circuit that has been described is likewise broken at this stage, because of the gap between the terminals 25 and 27ª, and the second function of the automatic switch 63 is to establish a new table withdrawing circuit so that the workpiece will not be overground. To that end the bar 101 is connected by a conductor 102 to the conductor 29. Consequently when, owing to the workpiece having reached finished size, the terminals 21 and 23 come together, the table withdrawing magnet is energized as follows:— Current proceeds from the generator, by conductor 24 to terminal 25, thence by button 28 to terminal 28ª, thence by conductor 61 to bar 62, thence by connector 64 to bar 101, thence by conductors 102 and 29 to electromagnet 30, thence by conductor 31 to terminal 23, thence to terminal 21 and ground back to the generator.

The operation of the machine has been set forth with the description of parts, but briefly recapitulating, the operator finds the machine with the table 1 in the position of Fig. 1. Assuming now that a plurality of workpieces are to be ground to a given size, and that the work calipering mechanism in the box 17 has been properly adjusted to automatically cause separation of work and wheel when said size is reached, as described in the said copending application Serial No. 4,466, the operator adjusts the counting mechanism in the box 48 to bring the parts to the position shown in Fig. 3. This may be readily done by manipulating the pawls 44 and 51 by means of pins 107 and 108 attached to the pawls and protruding outside of box structure 48, since both of these are spring-pressed pawls. This adjustment having been made, and the first of the aforesaid series of unground workpieces having been placed in the chuck 6ª carried by the workhead 3, the operator causes the table 1 to travel to the left and inaugurate the grinding operation. This is readily accomplished by shifting the hand lever 103, which is connected to the reversing member 9.

As the table 1 carries the grinding wheel 5 into the workpiece 6, the pivotally mounted dog 8 passes over the reversing member 9, thus placing the latter between said dog and the dog 7. Coincidently therewith, the box 17 automatically moves to carry the work calipering lever 18 into the workpiece. The grinding now proceeds automatically, the table 1 being reversed at each end of its proper working stroke by the dogs 7 and 8, until such time as contact is made between the terminals 20 and 22 responsive to movement of levers 18 and 19. Since, during the grinding of this initial workpiece, the cam 58 is in that position in contact with the rocker 59 which disposes the button 28 inwardly and the button 27 outwardly, the electric circuit that inaugurates the dressing action is now completed, the current passing by the connections already described. Consequently, the wheel dressing instrumentalities fully described hereinbefore come into operation and the grinding wheel is dressed and trued to give it a perfectly cylindrical surface and a sharp cutting edge. As the table 1 moves outwardly in the operation of dressing the wheel, the arm 99 carried by the table, throws the switch member 95 to that position where the connector 64 connects bars 101 and 62. It should be noted that the amplified wheel dressing stroke does not carry the arm 97 past the switch arm 98. Because of the shift of connector 64 of the switch 63, no repetition of the dressing stroke occurs during the grinding of this particular workpiece, despite the maintenance of contact between the terminals 20 and 22, but the grinding continues uninterruptedly until, responsive to further movement of the calipering member 18 and indicating member 19, the terminals 21 and 23 are brought together. This, as already described, causes the table 1 to run out to the position of Fig. 1. The box 17 is, of course, disposed in its outward position, and the cam bar 39 through the medium of lever 41, extension 43 and pawl 44, moves the ratchet wheel 46 by the distance of one tooth. This carries the cam 58 to the other side of rocker 59 and disposes the switch bars 26 in the position shown in Fig. 6. Consequently, the grinding of the next workpiece will not be interrupted to dress and true the grinding wheel 5, but will continue uninterruptedly until such time as the workpiece reaches finished size, whereupon the table 1 will again run out responsive to contact between terminals 21 and 23. This again causes actuation of the lever 41, moving the ratchet wheel 46 through the distance of one more tooth.

The grinding of the workpieces without

dressing and truing the grinding wheel continues until such time as movement of the ratchet wheel brings the screw stud 54 in contact with the arm 55. During the grinding of the next succeeding workpiece after said contact, and as the table 1 runs inwardly to that point where the roller 40 is relieved from pressure by the cam bar 39, the ratchet wheel 46 springs back to the original position of Fig. 3, and consequently the dressing stroke will again occur. It should be noted that since the cam bar 39 is carried by the block 37, and since the amplified dressing movement of the table 1 involves a relative sliding movement between said block and said table, the cam bar 39, during this dressing stroke, never reaches the roller 40. Thus the counting mechanism of the invention is actuated only when the table 1 runs out to the position of Fig. 1.

From the foregoing, it will be seen that we have provided an automatic dressing mechanism which, however, only takes place and interrupts the grinding of workpieces sufficiently often to keep the wheel 5 sharp and true. By the adjustable features of our invention, whereby the screw stud 54 can be placed to cause the cycle of operations to take place after any desired number of workpieces are ground, the machine can be adjusted, in accordance with the requirements for precision of the workpieces to be ground, to give the maximum output. Obviously, for example, if workpieces must be ground within limits of one-half a thousandth, the machine will be set so that the dressing and truing operation will take place more frequently than if workpieces only have to be ground to say a limit of two thousandths of an inch.

The foregoing description of parts represents an illustrative embodiment of our invention, the scope whereof is set forth in the following claims.

We claim:

1. In a grinding machine, the combination with a grinding wheel, work holding means, and means for reciprocating one of said parts relative to the other, of a wheel dressing device, means for extending the amplitude of said reciprocation to dress said wheel by said dressing device, and means causing said dressing device to operate only periodically, upon the completion of the grinding of a predetermined plurality of workpieces by the machine.

2. In a grinding machine, the combination with a grinding wheel, work holding means, and means for reciprocating one of said parts relative to the other, of a wheel dressing device, means, operable during the grinding of a workpiece, for extending the amplitude of said reciprocation to dress said wheel by said dressing device, and means causing said dressing device, in the grinding of successive workpieces by said machine, to operate only after the completion of the grinding of a predetermined plurality of said pieces.

3. In a grinding machine, a grinding wheel, a wheel dressing device, a counting mechanism and means under control of said counting mechanism for causing said wheel to be dressed by said device at intervals, alternating with the completion of a predetermined plurality of workpieces by said machine.

4. In a grinding machine, a grinding wheel, means operable to dress and true said wheel during the grinding of certain workpieces in a succession of similar workpieces ground by said machine, and means for preventing said dressing operation during the grinding of the other workpieces in said succession of workpieces.

5. In a grinding machine, a grinding wheel, a wheel dressing device, and means for automatically subjecting said wheel to the action of said dressing device only after a predetermined plurality of a succession of similar workpieces have been finished on said machine.

6. In a grinding machine, a grinding wheel, a wheel dressing device, and means, responsive to the completion of the grinding of a plurality of workpieces successively introduced to said machine, for subjecting said wheel to the action of said dressing device.

7. In a grinding machine, a grinding wheel, means operable automatically to interrupt the grinding operation on a workpiece in said machine, in order to dress and true said wheel, and means for preventing said interruption during the grinding of a predetermined plurality of successive workpieces.

8. In a grinding machine, the combination with a grinding wheel, work holding means, and a dressing device, said grinding wheel having a working position and an idle position with respect to said work holding means, and means responsive to a plurality of movements of said wheel to said idle position for inaugurating each action of said dressing device on said wheel.

9. In a grinding machine, the combination with a grinding wheel, work holding means, and a dressing device, said grinding wheel having a working position and an idle position with respect to said work holding means, a counting mechanism responsive to each movement of said wheel to said idle position, and means, responsive to a plurality of actuations of said counting mechanism, for subjecting said wheel to the action of said dressing device.

10. In a grinding machine, a grinding wheel, means operable to dress and true said wheel, means to cause cessation of grinding when each successive workpiece reaches predetermined size, and counting means, respon-

sive to a plurality of such cessations, for inaugurating the operation of said wheel dressing means.

11. In a grinding machine, wheel dressing instrumentalities including a dressing device having a normal position away from the path of the grinding wheel, and an operative position in the path of said wheel, electromagnetic means to inaugurate the movement of said device to its operative position, a switch controlling said electromagnetic means, and counting mechanism to close said switch once during the grinding of a plurality of workpieces.

12. In a grinding machine, the combination with a grinding wheel, a dressing device, and instrumentalities to cause said dressing device to dress and true said grinding wheel, of a ratchet wheel, a pawl, means operable at a given stage in each grinding operation to move said pawl and thereby to turn said ratchet wheel, means operated by said ratchet wheel at a given position thereof to set into operation the said instrumentalities, and means brought into operation when said ratchet wheel has been moved a predetermined angular distance to cause said ratchet wheel to reassume its initial position.

13. In a grinding machine, the combination with a grinding wheel, a dressing device, and instrumentalities to cause said dressing device to dress and true said grinding wheel, of a ratchet wheel, a pawl, means operable at a given stage in the grinding operation of each workpiece for moving said pawl whereby to turn said ratchet wheel, means actuated by said ratchet wheel at a given position thereof to set into operation said instrumentalities, a torsion spring connecting said ratchet wheel to a stationary part of the machine thereby opposing movement of said ratchet wheel by said pawl, and means operable when said ratchet wheel has been moved, a predetermined angular distance to cause said torsion spring to return said ratchet wheel to its initial position.

14. In a grinding machine, the combination with a grinding wheel, a dressing device, and instrumentalities to cause said dressing device to dress and true said grinding wheel, of a ratchet wheel adapted to set into operation said instrumentalities, a torsion spring connecting said ratchet wheel to a stationary part of the machine frame, a pawl, automatic means to operate said pawl to turn said ratchet wheel, a hold pawl normally preventing retrograde movement of said ratchet wheel in response to the tension of said spring, and tripping devices brought into operation at the end of a predetermined angular displacement of said ratchet wheel for releasing said hold pawl, whereby said spring causes said ratchet wheel to reassume its initial position.

15. In a grinding machine, the combination with a grinding wheel, work holding means, a table or carriage carrying one of said parts, means to give said table or carriage a reciprocatory motion, a dressing device, and instrumentalities to cause said dressing device to dress and true said grinding wheel, the relative motion between the wheel and the dressing device being embodied in the motion of the table or carriage, of a ratchet wheel, a pawl, means operable by the motion of the table to move said pawl and thereby to turn said ratchet wheel, means operated by said ratchet wheel to set in operation the said instrumentalities, and means brought into operation by the motion of said table to return said ratchet wheel to its initial position.

Dated this twentieth day of July, 1926.

WALDO J. GUILD.
FREDERICK H. GRIMSHAW.