

March 14, 1933.

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1,901,236

GRINDING MACHINE

Filed Jan. 11, 1929

5 Sheets-Sheet 1

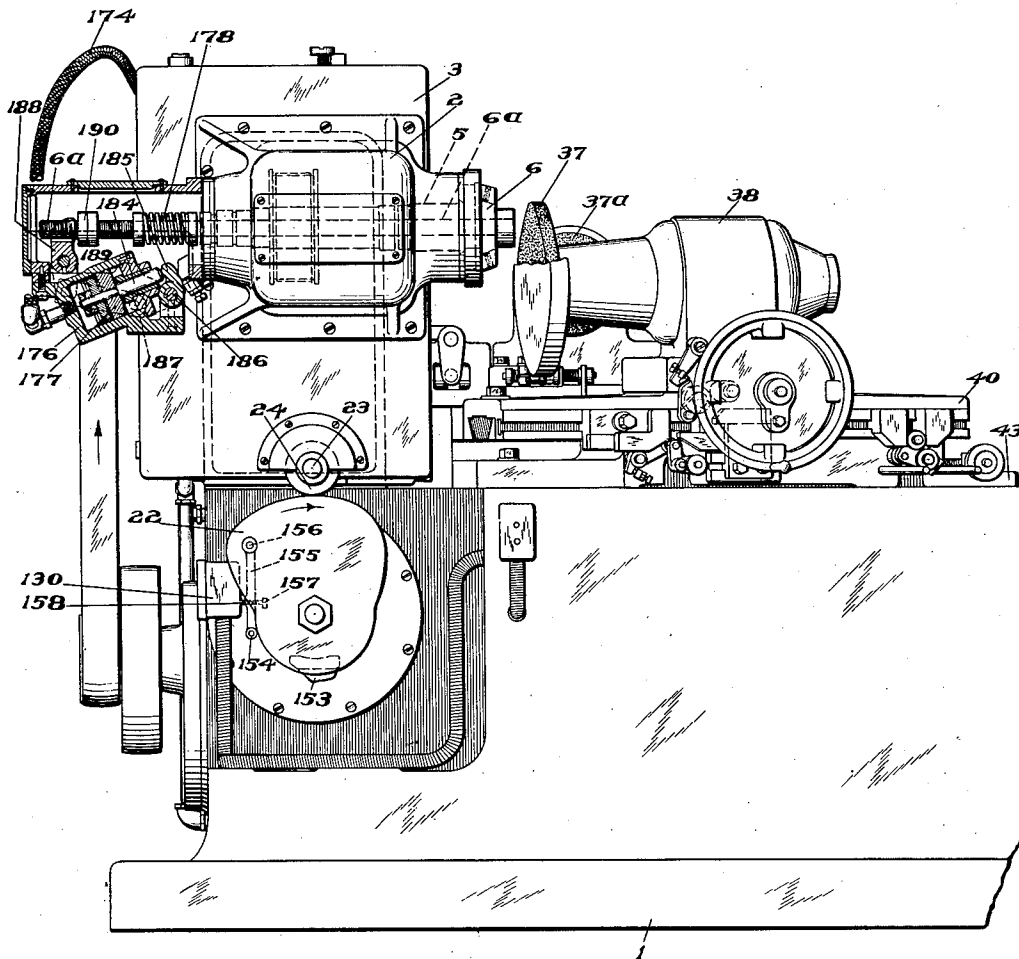


Fig. 1

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5 Sheets-Sheet 2

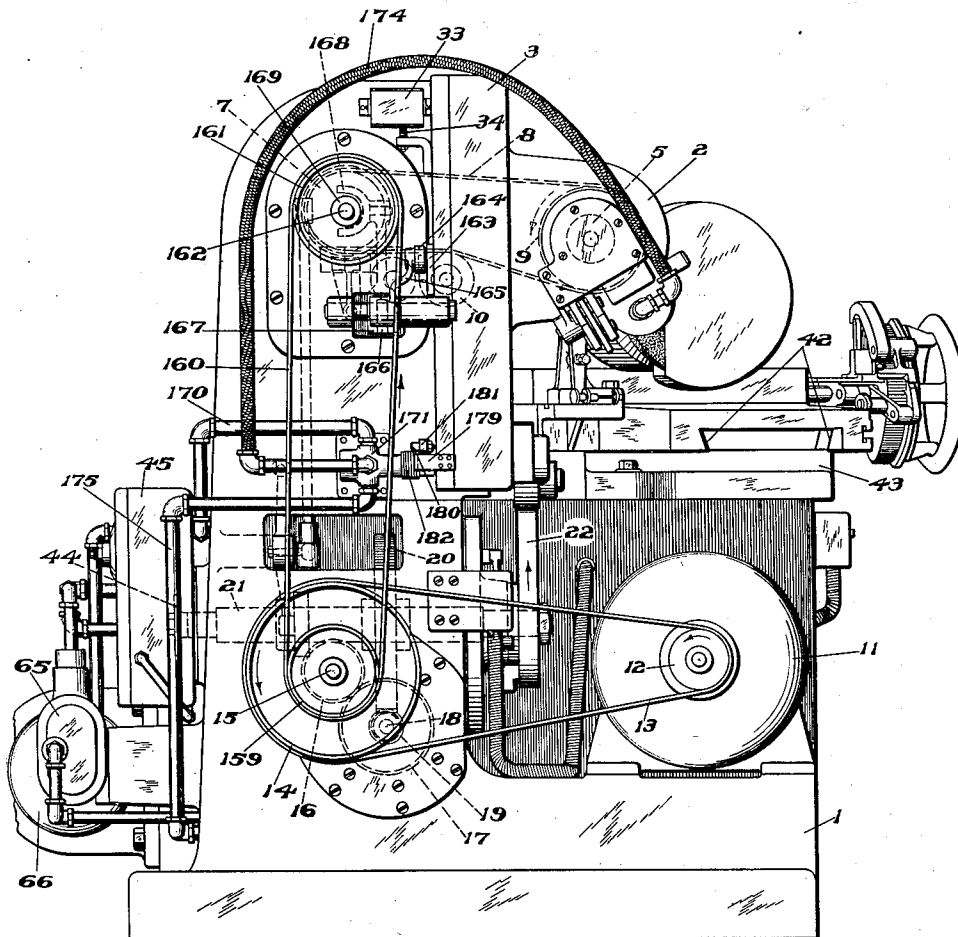


Fig. 2

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5 Sheets-Sheet 3

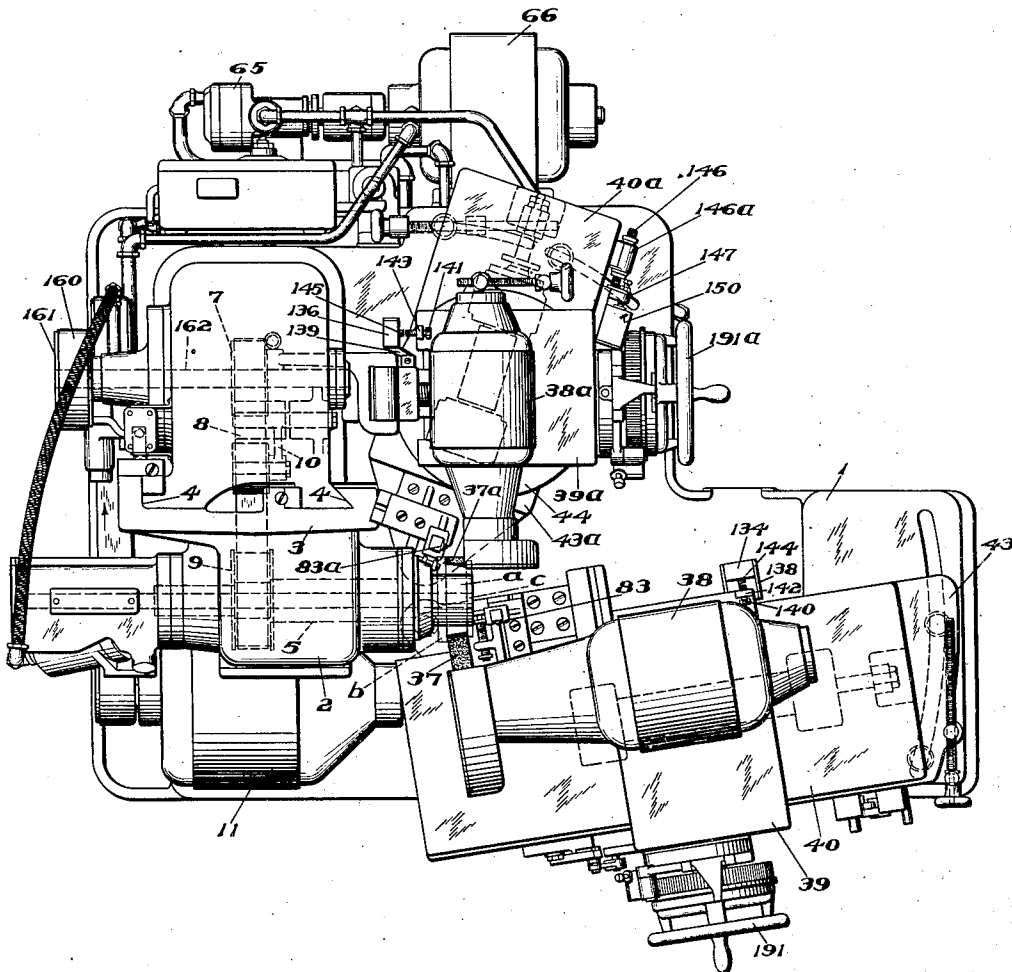


Fig. 3

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5 Sheets-Sheet 4

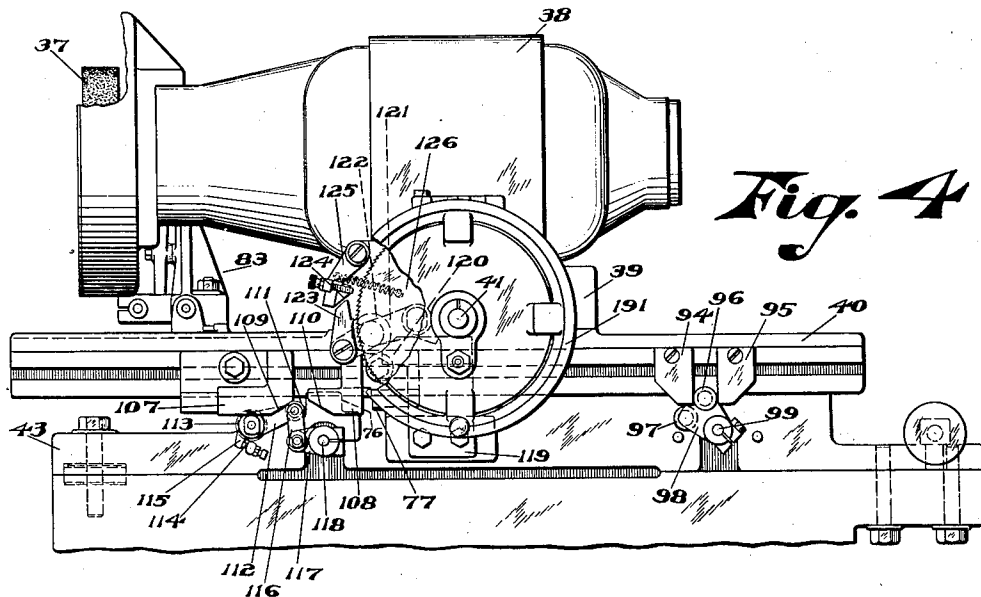


Fig. 4

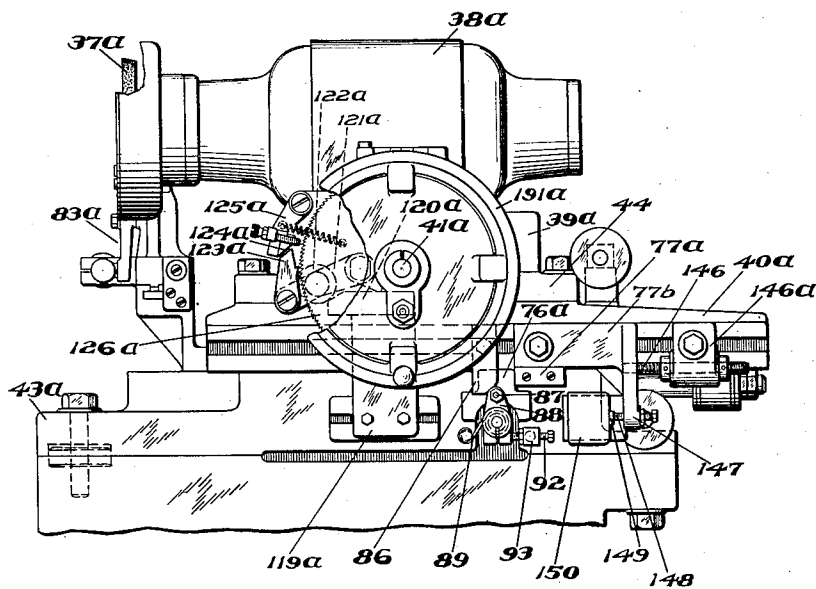


Fig. 5

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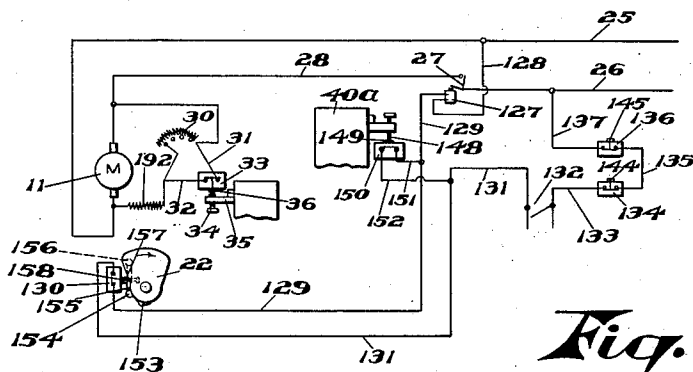
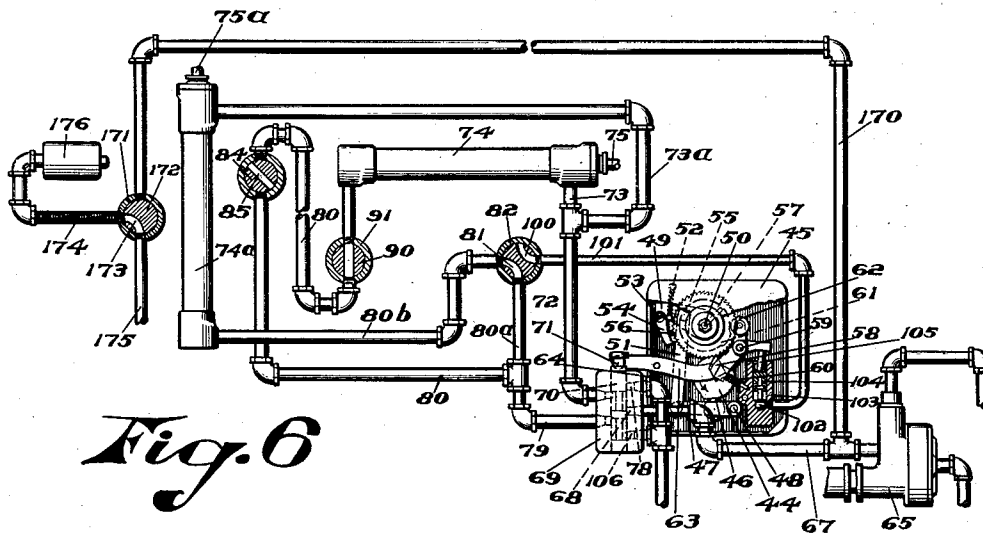
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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GRINDING MACHINE

Application filed January 11, 1929. Serial No. 331,833.

The invention relates to grinding machines adapted for the external grinding of small objects such as roller bearing race ways, and in certain aspects the invention is one of improvement on the grinding machine of Heald et al. Patent No. 1,841,809, dated January 19, 1932, although many features of the present invention might be applied to other and different machines.

In the operation of automatic or semi-automatic machines, such as that shown in the aforesaid patent, in which several machine elements work in timed relation with each other, it is of vital importance that each of the elements come into operating position at precisely the right time in order to avoid interference. Especially is this so in machines that involve purely mechanical means for operating some of the moving parts and hydraulic means for operating other parts.

In such a machine the mechanical elements derive their power from a prime mover, such as a motor, while the hydraulic elements derive their power from a suitable source of pressure such as a pump, which in turn derives its power from a separate source. Where the separate prime movers are independent of each other, or where the mechanically actuated elements merely set in operation the hydraulic mechanism, it will be readily seen that if the source of power to the pump fails the hydraulic elements will stop in their cycle without affecting the continued action of the mechanical elements, and under certain conditions the continued action of the latter will cause damage to the work or the machine or both.

The principal object of the present invention resides in such an organization of a machine of this general class as will eliminate the possibility of having a mechanically operated element continue to function after a hydraulic element has failed to function, or vice versa.

The drawings depict the dual control of this invention as applied to a grinding machine having a work carrying slide, operated by mechanical means, and two wheel supporting tables or carriages, each moved in a

predetermined sequence to the other, and hydraulically actuated in timed sequence to the work carrying slide.

As a machine having two types of mechanisms which obtain their motion and power from different sources presents the problems above outlined, another object of this invention is to make the two main sources of power interdependent in such a manner that when one mechanism has performed its cycle or cycles it will cause the other mechanism to start through its own cycle, whereupon the movement of the first mechanism is arrested until the completion of the cycle of the second mechanism, at which time the first mechanism is caused to again start through its cycle or cycles.

The grinding machine as shown in the drawings provides a shaft which has a cam on one end for operating the vertical slide, and a cam on the opposite end to cause mechanism in a counting box to operate a piston valve whereby the wheel carrying tables are caused to move by hydraulic pressure. The vertical slide may go through one or more cycles before the wheel carrying tables or carriages are caused to move by the hydraulic means, the number of cycles between movements of the wheel carriages being governed by the setting of the counting mechanism. When the wheel carriages start to move one of an alternate pair of circuits is broken but the work carrying slide cam continues to revolve until it is approximately on the point of causing the work carrying slide to descend, whereupon the other circuit is broken, thus stopping the cam from further movement by cutting off the power to its driving motor. The wheel carriages continue through their cycle and on completion thereof the first circuit to be broken is again made, starting the motor, and the work slide cam starts to revolve allowing the said slide to again go through its cycle or cycles.

It will thus be seen that the mechanical elements are responsible for the putting into operation of the hydraulic mechanism but this in no wise interferes with the action of the two mechanisms, owing to the fact that having put the hydraulic mechanism in mo-

tion said mechanical elements thereupon put themselves under control of instrumentalities operated by said hydraulic mechanism.

In a machine in which the movements of the various elements are automatic there is one point in the cycle of operations in which its is desirable that the movement be slowed down to permit the loading of the machine. In the machine of the aforesaid patent it was found that a predetermined period of time was required for an operator to load and unload the work spindle, and as this time is disproportionately long in relation to the time needed to complete the balance of a single cycle of operation, it has been found desirable to periodically slow down the speed of rotation of this operating cam in order that the machine may operate at its maximum speed during the remainder of the cycle. This slowing down also makes it possible to use an automatic device for feeding the work to the spindle, as there is a definite period of time required by such a device within which it can function efficiently, and this period is invariable regardless of the speed of the rest of the machine.

In other words there is a certain portion of the cycle of operations that must be a great deal slower than the rest of the cycle and it is another object of this invention to provide electrical means in the form of a rheostat, automatically placed in series with the field circuit of an adjustable speed direct current motor, by means of a switch actuated by the mechanically operated element, to cause the said element to slow down to allow time for loading and unloading.

In grinding machines there is a wearing away of the wheel due to grinding and dressing, and there is a point in the reduction of the diameter of a grinding wheel beyond which it is inefficient to go, due to the fact that the surface speed of the wheel becomes less as its diameter diminishes when run at a given number of revolutions per minute. Stated in another way, when a new wheel of the required diameter is run at a surface speed proper for its size, its diameter can be reduced only by a given amount before its cutting efficiency is lost, and when that amount of reduction has been made it is necessary to change the wheel. When the grinding wheel is reduced to too small a diameter, there is danger of spoiling the workpieces, and also the wheel spindle itself, if some means is not provided to stop the relative feed between work and wheel when the latter has become reduced to a predetermined size. In view of the above conditions to be coped with in the operation of grinding on an automatic grinding machine, the present invention provides electrical means to interrupt the functioning of the machine as soon as the wheel reaches its smallest allowable diameter.

A still further object of this invention is to operate the work chuck by means of a hydraulic unit under the control of the mechanically operated mechanism, thereby insuring the releasing and gripping of the work being accomplished in a positive manner at the correct time.

Further and ancillary objects within the scope of this invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a front elevation of a grinding machine constructed in accordance with the present invention.

Figure 2 is an elevation of the left hand side of the said machine.

Figure 3 is a plan view of the machine.

Figures 4 and 5 are fragmentary elevations of the grinding wheel heads of the machine, together with the tables or carriages upon which they are mounted.

Figure 6 is a fluid pressure diagram.

Figure 7 is a wiring diagram.

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

The machine is mounted upon a suitable frame 1 and provides a workhead 2 carried by a slide 3, which is adapted to be vertically reciprocated in slide ways 4 provided by the frame. Journalled in the workhead 2 is a work carrying spindle 5; by means of an expansible collet 6, actuated by a rod 6a slidably received within the spindle 5, the workpieces may be clutched to and released from the spindle. The rod 6a may be actuated automatically as will hereinafter appear.

Referring now to Fig. 2, the work spindle 5 is rotated from a pulley 7 by means of a belt 8 which passes around said pulley and a pulley 9 fastened to the spindle. By means of an adjustable tightener 10, which is held against the belt 8 by means of a heavy spring, not shown, the belt is kept at constant tension despite the rise and fall of the slide 3.

The workhead 2 is given a vertical reciprocatory motion with a long dwell at the upper position, in order that ground workpieces may be removed from the work spindle 5 and unground workpieces placed thereon. The lower position is the grinding position, and the upper position is the work changing position, as already explained, the spindle dwells at the upper position, and the expanding and contracting collet 6 is contracted at that time, while as will be hereinafter described, automatic means is provided to stop the rotation of the spindle 5 long enough so that the ground workpiece may be readily removed and an unground one placed in position.

Referring now to Fig. 2, the machine provides a motor 11, the shaft of which provides a pulley 12 which, by means of a belt 13 drives a pulley 14. Said pulley 14 is fastened to a shaft 15, to which is also fastened

a spur gear 16, in mesh with a spur gear 17 on a shaft 18. Shaft 18 has a worm 19 fastened thereto which meshes with a worm wheel 20 mounted on a horizontal shaft 21, the right hand end of which carries a cam 22. Attached to the slide 3 by means of a stud 23 is a cam roller 24 which rides on the periphery of the cam 22, and thus the rotation of this cam causes the vertical reciprocation of the slide hereinbefore mentioned. These parts can be seen in Figs. 1 and 2. The present machine being shown as an improvement on the machine of the aforesaid Heald et al. patent is also adapted to have incorporated therein an automatic work loading mechanism such as that disclosed in the copending application Serial No. 359,617 of Ralph A. Quimby, filed May 1, 1929. Whether automatic work loading mechanism of this or any other type is used in connection with this machine or not, it is desirable that the slide 3 should be at its upper or work loading position for a substantial and determinate period of time during each phase in the cycle of operation of the machine intended for the change of workpieces. This is so because even in the case of workpieces changed manually, a sufficient length of time must be allowed for the proper accomplishment of this change; a large dwell has been shown on the cam 22, but this is not sufficient, for the reason that under varying conditions the machine may be run at different speeds, and therefore this dwell, while representing a definite fractional amount of the complete cycle of the machine, would nevertheless represent different periods of absolute time. The present invention, therefore, contemplates means for lengthening this period of dwell which will now be described.

Referring to the wiring diagram of Fig. 7, 25 and 26 are electric current power mains; the former connects directly one armature brush of the motor 11, while the other brush is connected to the main 26 via a switch 27 and lead 28. The field coils of the said motor, are shunted into these mains, and in series with them is a rheostat 30 which, however, can be cut out of the field coil by means of leads 31 and 32 terminating in contacts which are adapted to be closed by a switch 33. The switch 33 is normally closed in order that the current may pass through the field coils of the motor unimpeded by the resistance offered by the rheostat 30, but when the slide 3 has substantially arrived at its upper or work loading position, an adjustable screw 34, carried by an arm 35 attached to the slide, engages a button 36 provided by the switch and opens the circuit through the leads 31 and 32, thus compelling the current to flow through the rheostat 30 and therefore causing the motor to be slowed down to a regulated adjustable speed.

Referring now to Fig. 3, the machine pro-

vides a grinding wheel 37 adapted to grind a cylindrical or conical surface α on each of the several workpieces upon which it operates. The machine also provides a grinding wheel 37a adapted to grind a flat or conical surface on the workpieces, such as an under cut portion on a flange b . To these ends the grinding wheel 37 is carried by a wheelhead 38 which, in this embodiment of the invention is a motor, said wheelhead or motor being angularly and horizontally adjustable, and transverse feeding means being also provided to adjust the grinding wheel to the size of the workpieces and to compensate for wear and truing by dressing, as will be hereinafter described. The grinding wheel 37a is carried by a wheelhead or motor 38a which, as in the case of the motor 38 is angularly and horizontally adjustable and can be positioned relative to the work by transverse feeding means. Additionally, however, the wheelhead 38a is given a regular reciprocating motion on the line of said transverse feed, in order that the aforesaid flange b be not destroyed when the workhead rises. In the respects just enumerated, the machine does not differ in any material manner from that of the Heald et al. patent hereinbefore referred to, and consequently the construction and mode of operation of these parts will not be gone into in detail in this specification.

In connection with both wheelheads 38 and 38a, there is, as in the case of the machine of said Heald et al. patent fluid pressure means for withdrawing them on the line of horizontal adjustability, in order that the grinding wheels may be trued by relatively stationary dressing devices. This operation of dressing is inaugurated in the interval between grinding of successive workpieces, or only after a predetermined plurality of workpieces have been ground, according as a certain counting mechanism to be described is set. Referring now to Fig. 4, the wheelhead 38 is mounted upon a cross slide 39 that is slidable in transverse ways, not shown, provided by a table or carriage 40. Said table 40 provides journals or bearings for a screw shaft 41 which passes through a nut, not shown, attached to the cross slide 39, and by turning the screw shaft 41 said cross slide and consequently the wheelhead 38 may be fed toward or away from the axis of rotation of the workpiece. The table 40 is in turn slidable longitudinally in ways 42, Fig. 2, provided by a base 43, the latter being angularly adjustable upon the machine frame 1 as fully described in the aforesaid Heald et al. patent.

In similar fashion, the wheelhead 38a is mounted upon a cross slide 39a that is slidable transversely in ways, not shown, provided by a turret 44. The latter is carried by a table 40a that is, in turn, slidable in longitudinal ways provided by a base 43a which,

as in the case of the base 43, is angularly adjustable upon the frame 1. A screw shaft 41a is provided to position the cross slide 39a transversely of the turret and consequently on a line which bears a variable angular relation to the table or carriage 40a. The mounting of the separate motor wheelheads 38 and 38a upon the machine has been only briefly described herein, since the construction practically follows that of the Heald et al. patent aforesaid, and the present invention relates to the control of the reciprocatory movement of the several tables or carriages, including the vertically reciprocable carriage or slide 3, together with other features, as already indicated, which will be described in detail, and so far as the present invention is concerned any desired construction of tables or carriages and cross slides might be substituted for that herein shown.

In the machine of the present invention, in common with that of the aforesaid Heald et al. patent, provision is made for dressing each grinding wheel periodically. This is done in order to keep the said grinding wheels sharp and free cutting and to preserve the proper contours thereof, the necessity of which in the grinding of workpieces having flanges b and c as shown in Fig. 3, will be readily apparent to those skilled in this art. Besides these reasons for dressing, the machine of the present invention, like that of the aforesaid Heald et al. patent makes use of the dressing operation to maintain the cutting surfaces of the grinding wheels in a known plane; by the movement of separate workpieces tangentially in respect to the grinding wheels to grinding position uniformity of the finished product is secured.

The dressing operations consist in relative motion between grinding wheels and dressing devices, and in the present machine it is found convenient to move the grinding wheels past the dressing devices mounted on the underlying bases 43 and 43a, and the reciprocable tables 40 and 40a are provided for this purpose. Naturally the reciprocations of carriages 40 and 40a which cause the grinding wheels to be trued, must take place when the work carrying slide 3 is in its upper position, since the grinding wheel 37, during the grinding operation, is located between the flanges b and c on the workpiece and to move it in a direction parallel to its axis would result in cutting off one or the other of said flanges. Also the equally obvious necessity of preventing the moving of a workpiece into grinding position until the wheels 37 and 37a have fully resumed their original grinding positions, requires the positive and fool-proof synchronization of the motions of the three tables, carriages, or slides, which ever they be termed, 3, 40, and 40a. Before describing the means for moving the tables 40 and 40a and the various means of control therefor

and of synchronization of these three tables, the apparatus for causing the dressing operation to take place after a predetermined and variable number of grinding operations, substantially as shown in the aforesaid Heald et al. patent will be briefly described.

As shown in Fig. 2, the shaft 21 which carries the cam 22 that raises and lowers the workhead, provides a cam 44 that sets in operation the dressing instrumentalities. Said cam is shown in Fig. 6 located in a box-like structure 45 that is provided on the back of the machine. Once during each revolution of the cam 44 it depresses a roller 46, carried by a lever 47 pivoted at 48 to the machine frame. An arm 49, pivotally mounted on a shaft 50, is connected by means of a link 51 to the lever 47, and consequently the lever and arm move together, the arm 49 providing a spring 52 which tends to raise these parts and to keep the roller 46 against the periphery of the cam 44. Pivotally mounted at 53 on the arm 49 is a pawl 54, which is pressed by means of an internal spring, not shown, reacting against the pivot stud, toward a ratchet wheel 55, which is mounted on the shaft 50. Except when the parts are drawn downwardly, the pawl 54 is kept from contact with the ratchet wheel by means of a pin 56, but when the pawl moves downwardly, it is allowed to contact the ratchet wheel by reason of configuration of said pawl, and the motion imparted to the ratchet wheel is just sufficient to move the latter by the distance of one tooth.

As indicated in dotted lines in Fig. 6, and as illustrated more completely in the aforesaid Heald et al. patent, the ratchet wheel 55 is fastened to a cam member 57 mounted on the shaft 50. Counter clockwise movement of the ratchet wheel in response to the actuations of the pawl 54 is opposed by a coil spring, not shown herein, which surrounds part of the hub of the cam member 57, one end of said coil spring being fastened to a stationary part of the casing 45 and the other end being secured to said cam member. However, retrograde or clockwise movement of the ratchet wheel 55 is normally prevented by means of a hold pawl member 58, pivoted on a stud 59 in the casing 45 and urged against the ratchet wheel by means of a compression spring 60.

The cam member 57, which to all intents and purposes is integral with the ratchet 55, is for the greater part of its periphery circular in form, but provides a cam projection 61 which, when moved into engagement with a roller 62, provided by a lever 63 pivoted on the aforesaid stud 59, moves said lever clockwise against the tension of a spring 64. This action inaugurating the dressing operations, causes movement of the tables 40 and 40a in the following manner.

Referring to Figs. 2 and 6, the machine pro-

vides a pump 65 of the usual sort provided by machines of this character, said pump being adapted to create a pressure on a suitable fluid such as oil, and said pump being driven desirably by an electric motor 66. From the discharge end of the pump the fluid is led by piping 67 to an entrance port 68 in a valve casing 69. In the valve casing is a slide valve 70, which is connected at 71 to the lever 63. In one position of the valve member 70 (the position shown in dotted lines) the pressure fluid is admitted to piping 72, which branches into two parts 73 and 73a that lead to the right hand end of cylinders 74 and 74a. (The cylinders 74 and 74a are considered to be viewed in the position in which they would appear were they shown in the views of Figs. 4 and 5, and in which fluid admitted to the right hand end of the cylinders, as viewed in said figures, tends to urge the said tables to the left and vice versa.) Said cylinders are located in the bases 43 and 43a respectively, and contain pistons, not shown, connected by piston rods 75 and 75a to the tables or carriages 40 and 40a respectively.

In the position of parts shown in Fig. 6 which is the normal condition, the pressure fluid is made active against the right hand end of each piston, holding both carriages to the left so as to maintain the grinding wheels 37 and 37a in contact with a workpiece or at least in position for immediate grinding. Accurate positioning of the tables is obtained by stops 76 and 76a located on the bases 43 and 43a, and co-operative adjustable stops 77 and 77a carried by the tables 40 and 40a respectively.

When, as already stated, the left hand end of the lever 63 is raised, the valve member 70 is lifted, which disconnects the piping 72 from the pressure supply port 68 in the valve casing 69, and connects it instead to an exhaust port 78, and at the same time allows the pressure fluid to flow from the supply port 68 into a pipe 79 that is adapted to supply fluid to the left hand ends of both cylinders 74 and 74a. To that end the pipe 79 branches into pipes 80 and 80a respectively, through the latter of which the fluid immediately flows by way of a valve port 81 in a valve 82, thus causing the table or carriage 40a to start outwardly carrying the grinding wheel 37 past a stationary dressing device 83, Fig. 3. However, the fluid does not immediately flow through the pipe 80 to cause the table 40 to immediately move outwardly in similar fashion because of the interposition of a valve 84 in the said piping 80, whose single valve passage 85 is at this time so disposed as to prevent the passage of any fluid therethrough. When, however, the table 40a has moved through a predetermined portion of its outward travel, a cam member 86 adjustably attached to said table 40a as shown in Fig. 5, engages a

pin 87 carried by an arm 88, thus rocking said arm against the tension of a coil spring 89. The arm 88 is fastened to the shaft of the rotatable valve member 84, and this action places the passage 85 in line with the entrance and exit ports of the valve casing, thus allowing the pressure fluid to flow into the left hand end of the cylinder 74, the fluid flowing through a port or passage 90 provided in a valve member 91, the purpose of which will hereinafter appear. In order to provide for the return of the arm 88 and consequently the valve member 84 to its initial position, and in order to provide for adjustment thereof, a screw 92 is provided, located in a block 93 attached to the base 43a, as shown in Fig. 5.

The foregoing action starts the table 40 controlled by the fluid pressure cylinder 74 outwardly, and the tables 40 and 40a continue to move to the right, the grinding wheels 37 and 37a being dressed by the dressing devices 83 and 83a respectively, which are fastened to some stationary portion of the respective bases 43 and 43a. The reversals of the said tables to carry them back to their initial position subsequent to the first passage of the wheels past said dressing device is under the control of the table 40 (which was the table that started its outward movement last, as just described) and this is effected in the following manner:—

A pair of stops or dogs 94 and 95 are attached to the table 40; in the path of the dog 94 is a roller 96, while in the path of the dog 95 is a roller 97, these rollers being both attached to a member 98 that is in turn fastened to a shaft 99 fastened to or integrally formed with the valve member 82.

When, in the outward travel of the table or carriage 40, the dog 94 comes in contact with the roller 96, the member 98 is rocked, thus turning the shaft 99, and with it the valve member 82. This turns the passage 81 angularly, and thus prevents the further passage of fluid through the piping 80a, and therefore stops the movement of the table 40a; at the same time a passage 100 in the aforesaid valve member 82 is moved so as to place in communication the piping 80a and piping 101, which causes the pressure fluid to flow into said piping 101. The piping 101 communicates through a port 102 with the interior of a cylinder 103 in which is a piston 104. The pressure fluid causes the piston 104 to rise, this motion being transmitted through the medium of a pin 105, to the hold pawl member 58, thus lifting the pawl portion thereof from the ratchet wheel 55. The coil spring not shown, which has been heretofore mentioned, immediately causes the ratchet wheel 55 to spring back to its initial position, where it is held by adjustable stops not necessary to be described herein. This action moves the cam portion 61 from the

roller 62, and thus causes the valve member 70 to be moved downward to its initial position, under the influence of the spring 64 acting upon the lever 63. At this phase of the cycle of machine operation, the fluid is allowed to flow from the pump through the piping 72 and 73 into the cylinder 74, thus causing the table 40 to start on its return motion carrying the grinding wheel 37 a second time past the dressing device 83. Likewise, the passage 100 still connecting the piping 80a and 101, and the piping 79 being connected to an exhaust port 106, the fluid is forced out of the cylinder 103 by the action of the spring 60 reacting on the hold pawl 58. The table 40a, however, does not move, the fluid being locked in the cylinder 74a by reason of the fact that a solid portion of the valve member 82 is interposed between the piping 80a and 80b.

The table 40 continues its return motion, and ultimately the dog 95 contacts with the roller 97, and this rocks the member 98 in a counterclockwise direction, revolving the shaft 99 and placing the valve member 82 in its initial position, as shown in Fig. 6. Fluid being now allowed to pass from the left hand end of the cylinder 74a through the piping 80b, passage 81, piping 80a, and 79, into the exhaust port 106, the pressure fluid, which is active through the pipings 72 and 73a moves the piston in the cylinder 74a to the left, thus starting the table or carriage 40a on its return motion, carrying the grinding wheel 37a a second time past the dressing device 83a. Both tables thus return to their original position where they are held by the engagement of the movable stops 77 and 77a with the stationary stops 76 and 76a.

It has been found desirable to cushion the return stroke of the table 40 as well as the outward stroke just prior to the reversal thereof. This could be done as shown in the copending application referred to, in which case both tables were cushioned on their return strokes; as herein shown only the table 40 is cushioned owing to the fact that it is not so important to keep the table 40a from rebounding since it is given a separate feed into the work in a line perpendicular to its axis, as described in the aforesaid Heald et al. patent, which causes the contact of the grinding wheel 37a with the workpiece, whereas in the case of the grinding wheel 37, rebound of the table carrying it must be prevented or the flange C would be destroyed.

Referring now to Fig. 4, a pair of cam blocks 107 and 108 are adjustably secured to the table 40. These cam blocks provide inclined cam surfaces 109 and 110 respectively; at the commencement of movement of the table or carriage 40 to carry the grinding wheel past the dressing device, surface 110 is in contact with a roller 111 provided by an arm 112, that is urged in a counterclockwise direction

to hold said roller against said cam surface, as by means of a coil spring 113, an adjustable stop 114, adapted to engage a projecting portion 115, being provided to prevent the movement of the roller 111 upward beyond a certain desired point. The arm 112 is connected by means of a link 116 to an arm 117 which is fastened to a shaft 118 fastened to the valve member 91. At the start of the movement of the table 42 to cause the grinding wheel 37 to be dressed and trued, the passage 90 in the valve member 91 bears such an angular relation to the entrance and exit ports of the pipe 80, that the fluid is considerably impeded in its flow therethrough. Consequently the table starts to travel at a throttled speed, but as it moves, the cam surface 110 gradually allows the roller 111 to rise, and this finally places the passage 90 in the position shown in Fig. 6, which corresponds to the position of parts shown in Fig. 4. After a short travel of the table 40 at its unthrottled speed, the roller engages the cam surface 109, and the cam block 108 is so set that this occurs just prior to the reversal of travel of the table by means of the mechanism just described, and consequently the reversing action takes place with the table traveling at a reduced speed. This is desirable as it prevents over run of the table 40 and thus increases the accuracy of functioning of the whole machine. It will be remembered that in the case of the table 40a that it is stopped altogether by the turning of the member 98 and no such means of cushioning its outward stroke is necessary.

On the return motion of the table 40 it will be readily seen that the table first travels slowly, and then at a higher speed, and ultimately is reduced in speed again by engagement of the cam surface 109 with the roller 111. This causes the table to be cushioned before the stop 77 strikes the stop 76 and this prevents the rebound of the table. It should be noted that the fact that the table 40 is brought to a stop slowly while the table 40a is stopped without any cushioning device, serves to synchronize the movement of the tables to cause them to complete this movement at the same time, the table or carriage 40a being the last to start on its return movement.

When the grinding wheels have been dressed and trued once, it is obvious that subsequent withdrawal motions of the tables will not cause any of the material of the wheels to be removed, unless some means is provided to cause the dressing devices and the wheels to approach each other. The machine of the present invention provides automatic means to compensate for wear and previous dressing of the grinding wheels, so that each dressing operation may remove some material from the wheels, and the latter be thereby kept to the exact required size in order to produce uniformly ground work-

pieces. As shown in Figs. 4 and 5, bases 43 and 43a provide adjustable brackets 119 and 119a upon which are mounted cams 120 and 120a respectively. Tables 40 and 40a provide 5 pivotally mounted arms 121 and 121a, providing rollers 122 and 122a that are adapted to engage the cams and ride thereon, when the tables start to move to the right. The arms 121 and 121a carry pawls 123 and 123a that 10 are spring pressed outwardly. Upon movement of the arms as above described, the pawls engage adjustable inclined surfaces 124 and 124a provided by pivotally mounted members 125 and 125a that are held in an ad- 15 justable position in any suitable manner. Said pawls are, thus directed inwardly toward ratchet wheels 126 and 126a and thus move said ratchet wheels through the distance of one or more teeth, depending upon 20 the setting of the members 125 and 125a. As the ratchet wheels are connected, directly or indirectly, to the screw shafts 41 and 41a, respectively, the said screw shafts are turned and the grinding wheels are caused to ap- 25 proach the plane of the dressing points.

It has already been intimated that the machine of the present invention is adapted for the application thereto of an automatic work- 30 loader, and when used in connection with such, it is essential that the machine stop its operation before the grinding wheels 37 and 37a have entirely disappeared under the periodically recurring dressing operations. The machine of the present invention is re- 35 signed to work automatically without any attention at all once the work-loading hopper has been filled, (said work-loading hopper being shown in the copending application S. No. 359,617 of Quimby referred to), and be- 40 sides the danger of dressing the wheels entirely away, as aforesaid, it is desirable that the wheels should be changed before they have become too small, as grinding efficiency is greatly impaired, and there is danger of spoiling 45 the workpiece and the wheel spindle, by reduction of the wheels to too small a diameter. Even in a manually loaded machine, which is all that the present application discloses since the work-loading mechanism forms no part 50 of this invention, it is desirable to warn the operator in some manner that the wheels have been reduced below the efficient cutting diameter. To these ends, the machine provides a mechanism for stopping the rotation of the 55 motor 11 when either wheel 37 and 37a reaches the minimum allowable diameter.

Referring now to Fig. 7, the switch 27 which connects the power main 26 to the con- 60 ductor 28 leading to one armature brush of the motor 11, is kept closed by means of an electromagnet 127. Electromagnet 127 is energized through the following circuit:—A lead 128 from the power main 25 runs to said magnet 127; the other terminal of said mag- 65 net is connected to a lead 129 that connects to

a switch 130 the purpose of which will be presently explained. Another lead 131 from said switch carries the said current through a switch 132 and then, by a lead 133 to a switch 134, by a lead 135 to a switch 136, and by a 70 lead 137 to the power line 26. It will be apparent that if either switch 134 or 136 is opened, the magnet 127 will be deenergized, and therefore the switch 27 opened, which will stop the motor 11. 75

Means is provided to open the switch 134 or 136 upon the movement of the cross slide 39 or 39a beyond a desired position. To that end, a bracket 138 is secured to the table 40, and a bracket 139 is secured to the turret 44, 80 and these brackets hold the switches 134 and 136 respectively. Adjustable screws 140 and 141 carried by the cross slides 39 and 39a respectively, these screws being located in bosses 142 and 143 respectively, fastened to 85 said cross slides. When, in the successive advancement of a cross slide it moves so far that its adjustable screw 140 or 141 contacts with button portions 144 or 145 respectively pro- 90 vided by the switches 134 or 136, one or the other of said switches is opened, and as they are in series this deenergizes the magnet 127, opens the switch 27, and stops the motor 11.

As heretofore stated, one of the main ob- 95 jects of the present invention is to so control the movement of the mechanically operated elements that there will be no possibility of their continuing to function in case the hydraulically operated elements fail to come to their proper position. As embodied in the 100 present machine, this involves the stoppage of the electric motor that raises and lowers the work slide 3 upon movement of the tables 40 and 40a as just described. However, in the interest of obtaining the maximum pro- 105 duction, it is desirable that the motor 11 be not stopped until the work carrying slide 3 is practically ready to descend; in other words, at that time when the long dwell on the cam 22 is just about ready to leave the 110 roller 24. To that end, I have provided a pair of electric circuits, the maintenance of one of which is necessary to the continued energization of the motor 11; when the table 40a first starts outwardly (the movement of 115 this table, as heretofore explained being a condition precedent to the movement of the table 40) it breaks one of these electric circuits while the rotation of the cam 22 breaks the other. 120

As shown in Figs. 1, 5, and 7, the stop 77a carried by the table 40a is incorporated in a block 77b, which may be held in any desired position by means of an adjustment screw 125 146 projecting from a block 146a, this expedient being adopted chiefly to facilitate accurate adjustment of the block 77b. A depending arm 147 carried by the block 77b carries an adjustable screw 148 that is normally in contact with a push button 149 of a switch 130.

device 150. When the table 40a starts on its outward travel the screw 148 leaves the push button 149, and this breaks the circuit through the switch 150 and opens the circuit through leads 151 and 152, which are shunted across the leads 129 and 131 and constitute an alternate path of travel for the current from the mains 25 and 26 to the magnet 127, the path leading through the leads 129 and 131 having already previously been described.

Since the current may still flow through leads 129 and 131 to energize the magnet 127, and thus to keep closed the switch 27 in the circuit leading to the motor 11, the said motor does not immediately stop, but continues to revolve until such time as, in the revolution of the cam 22, a small cam piece 153 attached thereto, engages a roller 154 provided by an arm 155 pivotally mounted at 156 to the machine frame. The arm 155 carries an adjustment screw 157, which is in engagement with a button 158 of the switch 130, already mentioned. When the cam portion 153 engages the roller 154, the button 158 is pushed inwardly, and this breaks the circuit through the switch 130 that connects the leads 129 and 131, as already explained. This shuts off the only remaining path for the current to the switch 27, and thus deenergizes the magnet 127, and as the switch 27 immediately opens, the motor 11 stops.

With the current to the motor 11 cut off, the cam 22 stops revolving, and indeed all mechanically actuated parts of the machine cease moving. As the motor 66, however, still rotates, the pump 65 continues to function and the tables or carriages 40 and 40a move through the dressing cycle as already described. It will be remembered that the table or carriage 40a was the first to start outwardly and the last to return. Consequently there can be no movement of the table 40 till the machine has been put in such a condition that the work carrying slide 3 can not possibly descend, and as the movement of the table 40a opens the switch 150 and therefore ultimately the switch 27, there can be no interference between the fluid pressure operated slide 40a and the mechanically operated slide 3, or any mechanism or parts carried by either of them. And inasmuch as the slide 40a is the last to return to its original position, both slides or carriages will be in a position of absolute rest when the circuit is remade through the switch 150, by the contact of the screw 148 with the button 149.

At this juncture the slide 40, which returned first and was cushioned in its movement has been brought to a stand still, and the slide 40a is about to stop or has stopped. With the remaking of the contact at 150, and the consequent establishment of the circuit through electromagnet 127, from power main 25, lead 128, through said magnet and by

way of leads 129, 151, switch 150, leads 152, 131, switch 132, lead 133, switch 134, lead 135, switch 136, and lead 137 to the power main 26; the switch 27 is closed, and the motor 11 immediately starts to function and the slide 3, without any lost time, to descend, because the dwell on the cam 22 is about to leave the roller 24. It will thus be seen that the machine is completely safeguarded from breakages due to malfunctioning or malfunctioning of any of its parts or motions, and at the same time there is no unnecessary delay in the operation thereof, the mechanically moved parts resuming their motion immediately upon the restoration of the carriages to their positions of rest.

As heretofore explained, the machine desirably provides automatic means to stop the rotation of the work spindle 5 and automatic means for actuating the expansible collet 6. As already described, the work carrying spindle 5 is rotated from a pulley 7, which is rotatably mounted on a stationary part of the machine frame. Said pulley 7 is driven from the motor 11 in the following manner:—As will be recollected, the pulley 12 on the motor shaft drives a pulley 14 by means of a belt 13. Upon the shaft 15 to which said pulley 14 is fastened is keyed another pulley 159 and the latter, by means of a belt 160, drives a pulley 161 fastened to a shaft 162 upon which the pulley 7 is mounted. The pulley 7 is free upon the shaft 162 but, by means of a friction clutch, the inner cone of which is keyed to said shaft 162, the pulley 7 is normally caused to rotate with the shaft. The means for holding the inner cone against the outer cone that is integral with the pulley 7, is a spring not shown herein, the details of this clutch mechanism being fully illustrated in the aforesaid Heald et al. patent; suffice it to note in the present machine that a cam member 163 fastened to the work carrying slide 3, engages, when said slide has moved to its upper position, a roller 164 carried by a lever 165, and through the medium of a link 166 causes a lever 167 to shift the clutch, a bifurcated member 168 engaging a collar 169 on one of the clutch parts serving to move it to disengaged position. In this manner the rotation of the spindle 5 is automatically stopped when the slide 3 arrives at its upper position as shown in Figs. 1 and 2.

In order to move the rod 6a, and thus actuate the collet 6, so that either the operator or a mechanically operated mechanism may remove the old workpiece and place an unground one on said collet, fluid pressure means is employed. As best shown in Fig. 2 taken in connection with Fig. 6, piping 170 is shunted into the main supply pipe 67 leading from the pump 65. This piping leads to a valve 171, the location of which on the machine is best shown in

Fig. 2. The valve member 172 of valve 171 has a passage 173 therethrough, which during the normal operation of the machine, connects a flexible tube or pipe 174 to an exhaust pipe 175. The piping 174 leads to one end of a cylinder 176 in which there is a piston 177. So long as the cylinder 176 is connected to the exhaust, as already described, the actuating rod 6a for the expanding collet 6 remains in its rearward position, the collet being kept in its expanded position to hold a workpiece by springs not shown, and rod 6a being maintained in its rearward position by means of a spring 178. When, however, the slide 3 rises, a lug or bar 179 carried thereby engages a roller 180, thus urging an arm 181 in a clockwise direction against the tension of a coil spring 182. The arm 181 is fastened to a shaft not shown, which is integral with the valve member 172, and thus partial rotation of this valve member induced as just set forth, turns the port 173 to connect the piping 170 to the piping 174. This makes the pressure fluid active in the cylinder 176, and thus forces the piston 177 to the right, Fig. 1, urging the pin 184 against a lever 185.

The lever 185 is a bell crank lever pivoted at 186 to the machine frame. The other end of said lever is attached as by means of a link 187 to a lever 188 pivoted at 189. The upper end of the lever 188 includes a bifurcated portion which presses against adjustable nuts 190 on a screw threaded portion of the shaft 6a; when, as aforesaid, the piston 177 is moved, the pin 184 rocks the bell crank lever 185 in a clockwise direction, and this forces the lever 188 in the same direction, and moves the rod 6a forwardly. The movement is a very powerful one, because the left hand end of the bell crank lever 185 together with the link 187 constitutes a toggle joint connection. The rod 6a being thus moved forwardly to unclutch the workholding device 6, it is so maintained until, in the subsequent downward movement of the slide 3, the lug 179 leaves the roller 180, which allows the valve member 172, under the influence of the spring 182, to resume its initial position as shown in Fig. 6, and this disconnects the cylinder 176 from the source of fluid pressure and connects it instead to the exhaust pipe 175; the parts are thus restored to their original position under the influence of the spring 178, and the collet 6 is expanded.

Although the operation of the machine has been indicated in the foregoing detailed description of the various parts and separate mechanisms thereof to a certain extent, it will nevertheless be briefly recapitulated. Having adjusted the dressing diamonds 83 and 83a or the holding devices therefor, which may be of any suitable type, and having properly adjusted the cross-slides 39 and

39a, as by means of the usual hand wheels 191 and 191a, the operator sets the machine in motion, as by closing the switch 132. Having set the mechanism in the counting box 45 so that the tables or carriages 40 and 40a will very presently undergo their reciprocatory movements to dress and true the grinding wheels 37 and 37a, which setting of the counting mechanism may readily be done in the manner set forth in the aforesaid Heald et al. patent, the operator allows the machine to go through one cycle of operation in order to insure the location of peripheries of the grinding wheels 37 and 37a in the proper respective vertical planes. The dressing operation having once occurred, the counting box mechanism may be reset so as to cause dressing in the future to take place only after the desired determinate number of separate workpieces have been ground; the operator will then set in operation the automatic means for placing workpieces on the expanding collet 6, in case such mechanism is employed, or, if the machine is to be manually operated in this respect he will wait until the slide 3 has risen, the spindle 5 come to a stop and said collet 6 contracted.

The operator will then place a workpiece *a* upon the collet 6; the cam 22 will continue its rotation at a reduced rate of speed, so long as the slide 3 is up, because the circuit from the power mains 25 and 26 through the shunt leads 31 and 32 has been broken, by reason of the actuation of the switch 33, thus compelling the electrical energy to flow through the field coils 192 of the motor 11 by way of the rheostat 30. Ultimately, however, the outer dwell of the cam 22 leaves the roller 24 thus allowing the slide 3 to commence its descent, and this action draws the adjustment screw away from the switch 33, allowing said switch to close, and short circuiting the rheostat 30. The motor 11 immediately picks up speed, and the mechanically actuated parts of the machine move at higher velocity. The workpiece *a* now contacts with the grinding wheels 37 and 37a, the conical surface of said workpiece approaching said grinding wheel 37 in a tangential path, and the grinding wheel 37a subsequently moving into contact with the underside of the flange *b* as set forth in the aforesaid Heald et al. patent. The grinding wheels 37 and 37a are held in positions indicated in Fig. 3 in a longitudinal direction by means of the fluid pressure in the cylinders 74 and 74a, the stops 77 and 77a being urged against the stops 76 and 76a, and the tables 40 and 40a carrying said grinding wheels being thus held stationary.

The grinding operation thus takes place during the location of the slide 3 at its bottom position (the dwell portion of small radius of the cam 22 may be slightly involute if it is desired to cause a gradual action) and ultimately the said slide is carried up-

ward again, the grinding wheel 37a first moving away from the flange b so that the workpiece a may move upwardly without said flange being destroyed. When the adjustment screw contacts the button of the switch 33, the motor 11 is again slowed down by reason of the incorporation of the rheostat 30 into the circuit through the field coil 192.

The grinding of individual workpieces thus continues, each revolution of the cam shaft 21, signifying a separate grinding operation, causing movement of the pawl 54, said pawl being moved substantially as the slide reaches the top of its stroke each time, until ultimately, after a determinate plurality of grinding operations, the cam member 61 moves the roller 62 to the right, thus raising the valve member 70, and causing the table or carriage 40a to move outwardly. This action, as already described, moves the adjustable screw 148 away from the contact button 149, and opens the switch 150. When, by reason of the operation of the arm 88 by the cam 86, the valve 84 is turned, the carriage 40 also moves outwardly. This ultimately causes resetting of the ratchet wheel 55 in the counting box, and return of the carriage 40, the reversal thereof occurring by reason of the contact of the dog 94 with the roller 96. As the slide 40 returns to its position of rest, the dog 95 contacts with the roller 97, and this turns the valve 82, and starts the carriage 40a on its return stroke. By this time the mechanical movements of the machine will probably have stopped, since the cam piece 153 on the cam 22 will have opened the alternate circuit through the leads 129 and 131, thus deenergizing the magnet 127 and opening the switch 27. At least it will be seen that the cam 22 can not possibly move beyond the point where the cam piece 153 contacts with the roller 154, and so the slide 3 is absolutely prevented from moving downwardly until such time as the carriages 40 and 40a have resumed their initial position, the last carriage to return, viz. 40a, being the one that makes the circuit at 150, thus completing one of the alternate paths of travel for the current that energizes magnet 127. Said magnet being thus reenergized, the switch 27 is closed, and the motor 11 starts up again. It should be noted that the automatic starting of the motor 11 takes place when the current through the field coils 192 is forced to go through the rheostat 30, and thus over loading of said motor 11 is prevented.

The machine now resumes its normal operation, going through the simple cycle first described in this description of operation, until such time as the cam member 61 again makes contact with the roller 62, whereupon the dressing cycle, to dress and true the grinding wheels 37 and 37a, is repeated. The dressing of the grinding wheels occurs re-

peatedly at the predetermined times until one or both of said wheels are reduced to a predetermined limit of size, at which time either one or both of the switches 134 and 136 are opened, thereby causing the main motor 11 to stop, due to the opening of the switch 27 in the power line 26.

From the foregoing description of operation it will be apparent that the machine presents two sets of mechanisms, one actuated through a mechanical train of movement, and the other actuated hydraulically, that is to say, by fluid under pressure, and that the machine further provides means for synchronizing these two operating mechanisms to prevent injury of one by the other. As shown in the illustrative embodiment of the invention, this synchronization is effected by an electrical coordinating mechanism, which, finding the machine operation automatically controlled and operated through the mechanical train of mechanism, shifts the control of the machine to the fluid pressure mechanism, and stops the mechanical movements, whereupon the fluid pressure operating mechanism continues its function, it alone then being the live element of the machine, and when the fluid pressure mechanism has completed its work, the coordinating electrical apparatus reshifts the control of the machine to the mechanically operated mechanism, the fluid pressure operating mechanism remaining in a passive state throughout the remainder of a single cycle of full operation of the machine.

It will be further apparent that the hydraulically operated mechanism of the machine is herein shown as embodied in two separate parts, which move separately but are controlled through a single fluid pressure system, the movement of one being a condition precedent to the movement of the other, and the reversal in direction of travel of the first being effected by movement of the second, so that neither may operate independently of the other and both will move in coordinated sequence. It will be further apparent that the hydraulically operated mechanism first to move and last to return is the element which takes control of the machine and ultimately restores control to the mechanically operated train. It will also be apparent that the machine will continue to go through its regular cycles of operation until one or the other of the grinding wheels becomes worn down to a predetermined limit of size; thereupon the machine is automatically brought to rest for the replacement of the worn out wheel or wheels. These several features of the invention present many advantages in that the separate operations of the machine can take place without danger to itself or to the operator thereof, and this, stated generally, is the crux of the present invention.

I claim,

1. In apparatus of the class described, a pair of tables or carriages, individual fluid pressure means to operate said carriages, means for setting in operation the fluid pressure to procure movement of one of said carriages, and means responsive to movement of said first carriage for setting the fluid pressure in operation to move the other carriage.
2. In apparatus of the class described, a pair of table or carriages, individual fluid pressure means to operate said carriages, means for setting in operation the fluid pressure to procure movement of one of said carriages, means responsive to movement of said first carriage for setting the fluid pressure in operation to move the other carriage, and means actuated by said second carriage to reverse its own movement.
3. In apparatus of the class described, a pair of tables or carriages, individual fluid pressure means to operate said carriages, means for setting in operation the fluid pressure to procure movement of one of said carriages, means responsive to movement of said first carriage for setting in operation the fluid pressure to move the other carriage, means responsive to movement of the second carriage to reverse the direction of movement of said second carriage, and means responsive to reverse movement of the second carriage for thereafter reversing the direction of travel of the first carriage.
4. In apparatus of the class described, a pair of tables or carriages, individual fluid pressure means to operate said carriages, means for setting in operation the fluid pressure to procure movement of one of said carriages, mechanically actuated elements in said apparatus, means responsive to movement of said first carriage to prevent the movement of said mechanically actuated elements of the apparatus beyond a certain desired point, other means responsive to movement of said first carriage for setting in operation the fluid pressure to procure movement of the other carriage, means responsive to movement of the second carriage to reverse its own movement, means responsive to the reverse movement of the second carriage for thereafter reversing the direction of travel of the first carriage, and means responsive to reverse movement of one of said carriages for thereafter setting in operation again the mechanically actuated parts of the apparatus.
5. In a grinding machine, a carriage or slide, mechanical means to reciprocate said carriage or slide, a table or carriage, fluid pressure means to move said table or carriage, means set in operation after one or more reciprocations of the slide for causing movement of the table, means operated by the movement of the table for setting a guard to prevent movement of the slide beyond a definite position, and means operated by return of the table or carriage for removing the guard.
6. In a grinding machine, a carriage or slide, means to reciprocate it, a table or carriage, means to move it, means set in operation after one or more reciprocations of the slide for causing movement of the table, means operated by the movement of the table for setting a guard to prevent movement of the slide beyond a definite position, and means operated by return of the table or carriage for removing the guard.
7. In a grinding machine, a carriage or slide, a revoluble cam to move said carriage or slide, an electric motor to revolve the cam, and means to cause said motor to be slowed down when said slide is near one end of its movement.
8. In a grinding machine, a carriage or slide, a revoluble cam to move said carriage or slide, an electric motor to revolve the cam, a rheostat, and means for placing the rheostat in circuit with one or more of the coils of the said motor to slow down the same when the slide is near one end of its movement.
9. In a grinding machine, a grinding wheel, a motor driving a slide adapted to move the work in relation to said grinding wheel, power mains conveying current thereto, a switch in said mains, electro-magnetic means for keeping said switch closed, a pair of alternate circuits for energizing said electro-magnetic means, a table or carriage movement of which breaks one of said circuits, and a mechanical element deriving movement from the said electric motor which at a certain predetermined position breaks the other of said circuits.
10. In a grinding machine, a grinding wheel, automatic means for periodically dressing said grinding wheel, and automatic means to prevent further operation of the machine when the said grinding wheel has been reduced to a definite minimum diameter.
11. In a grinding machine, a grinding wheel, automatic means for periodically dressing said grinding wheel, and means to stop the machine when the said grinding wheel has been reduced to a definite minimum diameter.
12. In a grinding machine, a grinding wheel, a wheel dressing device, means actuated automatically and periodically in the operation of the machine for causing said grinding wheel to move relative to the dressing device to dress and true the wheel, further means actuated automatically for causing relative movement between said wheel and dressing device in a line transverse to the aforesaid movement to insure successive dressing operations, and means operated by said last named means for stopping the machine upon the reduction of the wheel to a certain minimum diameter.

13. In a grinding machine, a grinding wheel, a wheel dressing device, means actuated automatically and periodically in the operation of the machine for causing said grinding wheel to move relative to the dressing device to dress and true the wheel, further means actuated automatically for causing relative movement between said wheel and dressing device in a line transverse to the aforesaid movement to insure successive dressing operations, and means operated by said last named means for indicating when the wheel has been reduced to a certain minimum diameter. 70
14. In a grinding machine, a grinding wheel, an expansible collet to hold a workpiece, means to cause said grinding wheel and said collet to approach and recede one relative to the other, the relative motion being at an angle to the axis of the collet, and automatic means for placing said collet in condition to receive a workpiece upon separation of said collet and the grinding wheel. 75
15. In a grinding machine, a grinding wheel, an expansible collet to hold a workpiece, fluid pressure means to open and close said collet to place it in condition to receive a workpiece or to hold it for grinding, means to cause said grinding wheel and said collet to approach and recede one relative to the other, the relative motion being at an angle to the axis of the collet, and automatic means for causing actuation of said fluid pressure means upon separation of said collet and the grinding wheel. 80
16. In a grinding machine, a grinding wheel, an expansible collet to hold a workpiece, fluid pressure means to open and close said collet to place it in condition to receive a workpiece or to hold it for grinding, means to cause said grinding wheel and said collet to approach and recede one relative to the other, the relative motion being at an angle to the axis of the collet, and means operated by said last named means for causing periodic actuation of said fluid pressure means. 85
17. In a grinding machine, a grinding wheel, work holding means, a wheel dressing device, means to cause relative movement between said workholding means and said grinding wheel in the normal operation of the machine whereby to grind a workpiece, means to periodically cause a relative movement between the grinding wheel and wheel dressing device to dress and true the wheel, and means to prevent approach between the grinding wheel and the workholding means while the wheel is being dressed. 90
18. An automatic grinder having a grinding wheel in combination with a shut-down device operative when the wheel wears away to any predetermined limit of size. 95
19. In a grinding machine, a grinding wheel, a dressing device therefor, means for producing successive relative approaching movements between said wheel and said device, and a shut-down device for the machine, made operative by a predetermined amount of relative approaching movement between said wheel and said dressing device. 100
- Dated Dec. 31, 1928.
- WALDO J. GUILD. 105
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DISCLAIMER

1,901,236.—*Waldo J. Guild*, Worcester, Mass. GRINDING MACHINE. Patent dated March 14, 1933. Disclaimer filed December 31, 1934, by the assignee, *The Heald Machine Company*.

Hereby enters this disclaimer to claim 1 in said specification which is in the following words, to wit:

"1. In apparatus of the class described, a pair of tables or carriages, individual fluid pressure means to operate said carriages, means for setting in operation the fluid pressure to procure movement of one of said carriages, and means responsive to movement of said first carriage for setting the fluid pressure in operation to move the other carriage."

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