

May 14, 1968

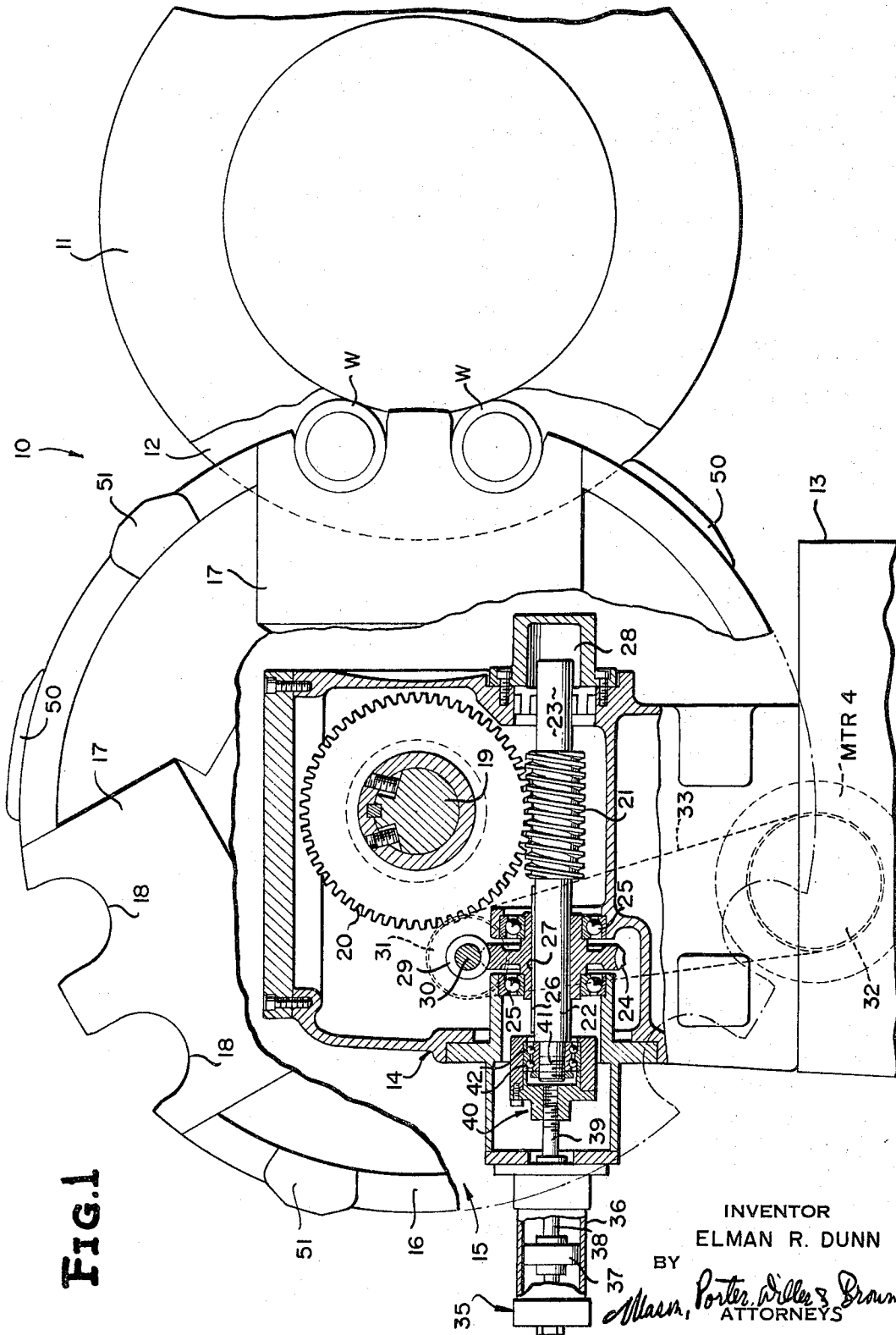
E. R. DUNN

3,382,622

DISC GRINDER

Filed May 28, 1965

2 Sheets-Sheet 1



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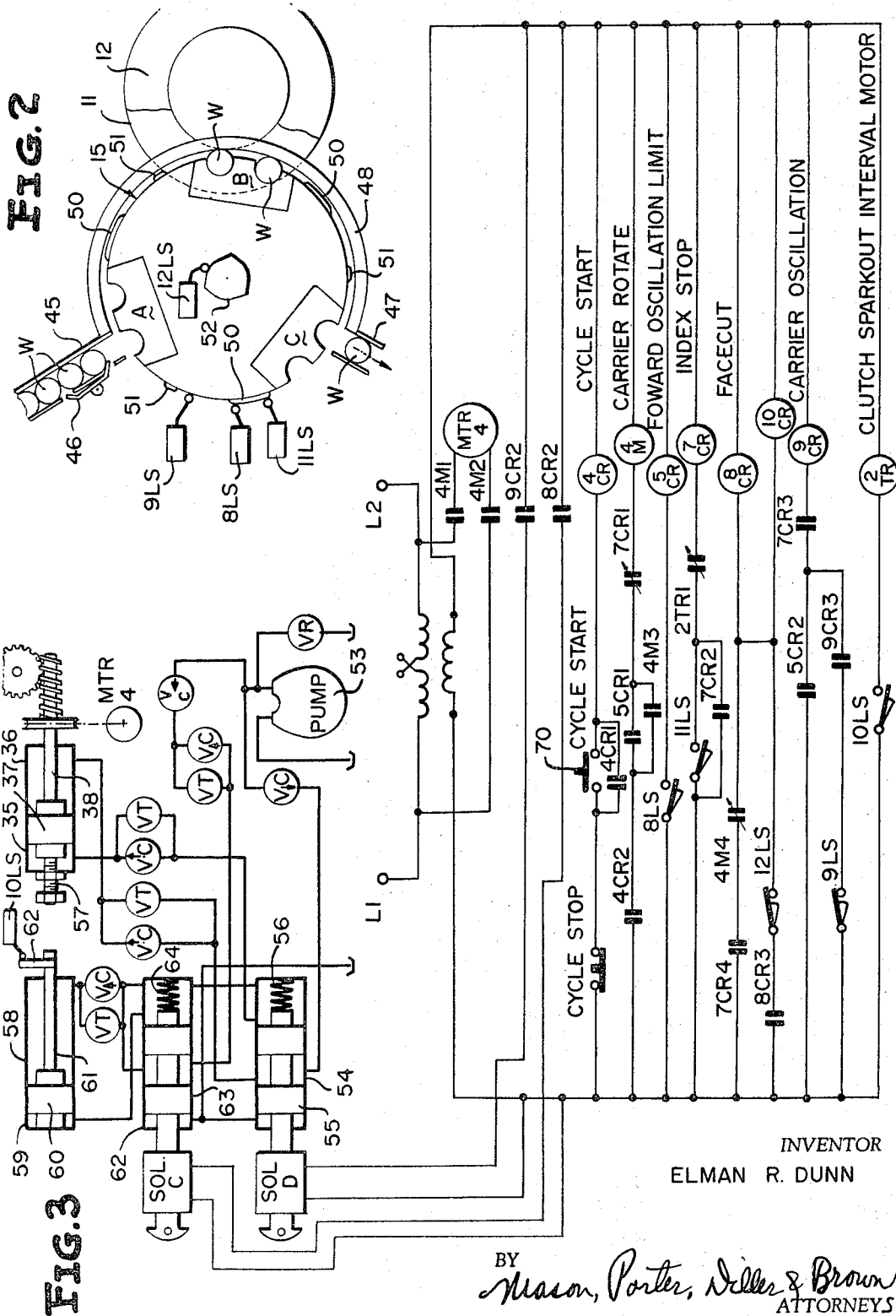
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2 Sheets-Sheet 2



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3,382,622

DISC GRINDER

Elman R. Dunn, Roscoe, Ill., assignor to Landis Tool Company, Waynesboro, Pa., a corporation of Pennsylvania

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ABSTRACT OF THE DISCLOSURE

The apparatus of this application relates to the rotary carrier mechanism of a disc grinder in which the carrier is rotated by means of a worm and worm wheel. The carrier performs two functions:

(1) It advances unground workpieces into grinding position and removes ground workpieces from the grinding position.

(2) In the grinding position, the carrier oscillates the workpieces during grinding.

This dual function of the carrier is provided by rotating the carrier intermittently, by rotation of the worm in engagement with the worm wheel on the carrier shaft, and by oscillating the carrier during grinding by axial reciprocating movement of the worm in engagement with the worm wheel on the carrier shaft. The movement of the carrier for both functions is effected without shifting the axis of the carrier.

This invention relates in general to new and useful improvements in face or surface grinders of the type known as disc grinders, and more particularly to a work carrier and its operation in conjunction with such grinders.

Disc grinders may be of several types. The grinders may have single or double abrasive discs and these abrasive discs may have vertical or horizontal spindles. There are generally three methods of subjecting workpieces to the abrasive discs of such grinders. These are the thru-feed method, the rotary carrier method and the gun-type carrier method. This invention particularly relates to the rotary carrier and the gun-type reciprocating carrier methods. The rotary carrier is generally used in conjunction with abrasive discs which are spaced apart a fixed distance with the rotary carrier carrying workpieces between the discs, once for each workpiece for a single pass or several times for a multiple pass operation.

Usually, in the single pass operation, a relatively small amount of stock is removed from the workpiece. In the single pass operation, unground workpieces are placed in the carrier in an upper position and after passing through the grinding zone, they are discharged from the carrier in a lower position thereof.

In the multiple pass operation, the space between the abrasive discs is gradually reduced by advancing one or both abrasive discs towards the carrier. In this operation, a substantial amount of stock is removed from each workpiece. However, after a carrier loaded with workpieces has been ground the ground workpieces must be removed and replaced with unground workpieces. The time required to load and unload workpieces is lost so far as machine production is concerned.

The gun-type carrier carries the work into the space between the abrasive discs in a straight line path. It may or may not reciprocate the workpiece while it is in contact with the abrasive discs. The abrasive discs usually are advanced towards the carrier to perform a face cutting or plunge grinding operation. The carrier must then be retracted from the grinding position, the ground work removed and replaced with unground work. As in the

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rotary carrier multiple pass operation, this unloading and loading of workpieces represents lost production time. It is, therefore, the primary object of this invention to provide a disc grinder with a rotary work carrier having certain advantages of the rotary type carrier and the gun-type carrier.

Another object of this invention is to provide the rotary work carrier with drive means of the indexing type to present one or more workpieces between the abrasive discs for a face cutting operation.

Still another object of this invention is to provide means for effecting the oscillation of the rotary carrier after it has been indexed and while the workpieces are engaged with the abrasive discs during face cutting operation.

A further object of this invention is to provide in a disc grinder of the rotary carrier type drive means for effecting the controlled movement of the rotary carrier in a manner wherein unground workpieces may be received from a feed trough in one position of the carrier, the carrier indexed to a grinding position, and then subsequent to the grinding of the workpieces, the carrier moved to a third position at which the ground workpieces are discharged.

Yet another object of this invention is to provide a novel drive unit for a rotary carrier of a disc grinder wherein the drive unit includes first and second power units, the first power unit being coupled to the drive unit for the automatic indexing of the rotary work carrier and the second power unit being coupled to the drive unit for imparting oscillatory movement to the work carrier after it has been indexed.

A still further object of this invention is to provide a novel disc grinder which includes one or more abrasive discs and a rotary work carrier for presenting workpieces to the disc or discs, the work carrier having drive means for periodically indexing the work carrier to move unground workpieces into alignment with the abrasive disc or discs, and there being provided additional means for effecting the oscillation of the work carrier after the indexing thereof whereby during the grinding operation, the workpieces are oscillated across the face of the abrasive disc so that the full effective width of the face of the abrasive disc is utilized in each grinding operation.

It will be apparent from the foregoing that by utilizing a rotary carrier, the loading and discharge of workpieces with respect to the carrier can be accomplished during the time required for the indexing of the carrier so as to eliminate lost production time. It will also be apparent that by oscillating the work carrier after it has been indexed to position workpieces relative to the abrasive disc, instead of only a certain portion of the face of the abrasive disc being effective to produce a grinding operation, the entire width of the face of the abrasive disc, which is annular in outline, may be utilized, thus providing for the even wearing of the entire face of the abrasive disc.

Briefly describing the invention, the rotary work carrier is provided with an actuating mechanism in the form of a drive unit which consists of a worm wheel secured to the carrier for rotation therewith and a worm gear suitably positioned for engagement with the worm wheel. First power means are connected to the worm gear for rotating the worm gear periodically to effect the indexing of the work carrier. The worm gear is mounted for both rotary and reciprocating movement and a second power unit is connected to the worm gear for effecting the reciprocation thereof after the indexing of the work carrier to provide oscillating movement of the work carrier so that the workpieces carried by the work carrier and positioned in the grinding zone facing one or more

abrasive discs will be oscillated across the annular face width of the abrasive disc or discs in an appropriate manner. Spaced and suitably shaped cam members are mounted on the carrier for rotation therewith to engage sensing elements, such as limit switches, for controlling the indexing and oscillating movements of the work carrier.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a fragmentary end elevational view of a disc grinder with parts broken away and shown in section and showing the mechanism for providing the indexing and oscillating movements of the carrier.

FIGURE 2 is a schematic elevational view of the work carrier and shows the relative positions of the feed and discharge means and the various control switches and cams.

FIGURE 3 is a combined hydraulic and electric circuit for the components of the disc grinder which are features of this invention.

Referring now to the drawings in detail, it will be seen that there is illustrated in FIGURE 1 a disc grinder which is generally referred to by the numeral 10. At this time it is pointed out that only those components of the disc grinder 10 to which this invention relates are illustrated and no attempt has been made to illustrate features such as the housing of the grinder, the specific supports for the abrasive discs, feed chute, discharge chute, etc. It is also pointed out at this time that although the illustrated disc grinder 10 is of the double disc type having a horizontal spindle, this invention is applicable to single or double disc grinders with vertical or horizontal spindles.

The disc grinder 10 includes a pair of opposed abrasive discs 11 and 12 which are mounted in a conventional manner for rotation about a horizontal axis and for movement towards and away from one another in unison. The disc grinder 10 functions by having workpieces, such as the workpieces W positioned between the abrasive discs 11 and 12, after which the abrasive discs 11 and 12 are moved towards one another and into face-to-face contact with the workpieces to effect the necessary grinding operations.

The disc grinder 10 includes a suitable frame structure 13 of which a housing 14 is a part. The frame structure 13 supports for rotation a work carrier which is generally referred to by the numeral 15. The work carrier 15 is formed of a plate 16 having positioned thereon work holders 17. Each work holder 17 is illustrated as having a pair of pockets 18 for the reception of the workpieces W. However, it is to be understood that while it is preferred that each work holder 17 holds two workpieces W for simultaneous grinding operations, the design of the work holders 17 may be varied to accommodate a different number of workpieces.

The work carrier 15 is supported by a horizontal shaft 19 which is suitably journaled in the frame structure 13 for rotation. The shaft 19 extends through the housing 14 and has secured thereto for rotation therewith a worm wheel 20. The worm wheel 20 is in meshing engagement with a worm gear 21 which extends through the lower portion of the housing 14. The worm gear 21 has shaft portions 22 and 23 extending to opposite sides thereof. The shaft portion 22 has mounted thereon a worm wheel 24 which is supported by a pair of bearings 25 carried by the housing 14. The bearings 25 support the worm wheel 24 and the worm wheel 24, in turn, supports the shaft portion 22. The shaft portion 22 is provided with a key 26 which is slidably received in a keyway 27 formed in the hub portion of the worm wheel 24 whereby while the worm wheel 24 is fixed against axial move-

ment, the shaft portion 22, together with the shaft portion 23 and the worm gear 21, is axially movable.

It is to be noted that the free end of the shaft portion 23 is also suitably journaled within a bearing 28 which is carried by a portion of the housing 14. The shaft portion 23 is mounted within the bearing 28 for both rotary and axial movement.

The worm wheel 24 is driven by means of a worm gear 29 which is meshed therewith. The worm gear 29 is part of a horizontal shaft 30 which is disposed parallel to the shaft 19 and which is suitably journaled in portions of the housing 14. The shaft 30 is provided at one end thereof with a drive element 31 which is coupled to a drive element 32 of a motor MTR4 by a flexible drive unit 33. It will be apparent that when the motor MTR4 is operated, the worm gear 29 will be rotated to drive the worm wheel 24. The worm wheel 24 will, in turn, drive the shaft of the worm gear 21 with the result that the worm gear 21 will drive the worm wheel 20 to rotate the shaft 19 and the work carrier 15 carried thereby.

It is to be understood that the motor MTR4 will be periodically operated so as to effect the indexing of the work carrier 15.

The housing 14 has mounted thereon in projecting relation and in axial alignment with the shaft portion 22 a double acting extensible fluid motor 35. The fluid motor 35 includes a cylinder 36 which is suitably fixedly secured to the housing 14 and in which there is mounted for reciprocatory movement a piston 37. A piston rod 38 is carried by the piston 37 and has a projecting end portion 39 on which there is mounted a coupling 40. The shaft portion 22 has a reduced threaded end portion 41 which projects into the coupling 40 and which has suitable bearings 42 secured thereon. The bearings 42 are seated in the coupling 40 for movement therewith. Thus, it will be seen that the coupling 40 provides a connection between the shaft portion 22 and the piston rod 38 which secures the shaft portion 22 to the piston rod 38 for axial movement therewith while permitting relative rotation.

It will be apparent from FIGURE 1 that when the fluid motor 35 is actuated, the worm gear 21 will be axially reciprocated. This axial reciprocation of the worm gear 21 will impart oscillatory movement to the worm wheel 20 so as to oscillate the work carrier 15.

Reference is now made to FIGURE 2 where there is schematically illustrated the work carrier 15 and the control switches for controlling the rotation and oscillation thereof. It is to be noted that the illustrated work carrier 15 has three of the work holders 17, and for purposes of identification, the work holders are referred to by the letters A, B and C. The work carrier 15 is illustrated in a final grinding position with the work holder B positioned between the abrasive discs 11 and 12.

The work holder A is positioned relative to a supply chute 45 through which workpieces W move by gravity. The supply chute 45 is provided with a suitable gate mechanism 46 for periodically releasing two workpieces W.

The work holder C is positioned adjacent a discharge chute 47. It is to be understood that the ground workpieces previously carried by the work holder C have been discharged down the discharge chute 47. At this time it is pointed out that the workpieces are retained in the several work holders between the supply chute 45 and the discharge chute 47 by means of a guide 48.

Between each two adjacent work holders there is positioned on the work carrier 15 a pair of cams 50 and 51. The cams 50 and 51 are adjustably mounted on the work carrier 15 in any desired manner. A pair of limit switches 8LS and 11LS are positioned adjacent the periphery of the work carrier 15 for engagement by the cam 50. A limit switch 9LS is spaced in a clockwise direction from the limit switches 8LS and 11LS for engagement by the cam 51.

The work carrier 15 also carries for rotation therewith a cam 52 which operates a limit switch 12LS.

Referring now to FIGURE 3 in particular, it will be seen that the hydraulic system for effecting the operation of the fluid motor 35 includes a pump 53 and a spool type valve 54 which includes a valve member 55. The spool type valve 54 is spring loaded to the left by means of a spring 56 and is moved to the right by means of a solenoid D. The fluid supply system for the fluid motor 35 also includes the usual check valves and throttling valves which will not be described in detail here inasmuch as they play no part in this invention. It is, however, pointed out that the cylinder 36 may be provided with an adjustable stop screw 57 so as to limit the movement of the piston 37 to the left. The movement of the piston 37 to the right is automatically limited by the cylinder 36. In this manner, the effective stroke of the piston 37 and its associated piston rod 38 may be accurately controlled so as to limit the amount of oscillation imparted to the work carrier 15.

Each of the abrasive discs 11 and 12 is advanced and retracted towards the workpieces W by means of a double acting fluid motor which is generally referred to by the numeral 58. The fluid motor 58 includes a cylinder 59 in which there is mounted a piston 60. The piston 60 has coupled thereto a piston rod 61 which is suitably coupled to the associated abrasive disc 11 or 12 to effect the positioning thereof. The piston rod 61 carries a switch actuator 62 which is engageable with a limit switch 10LS.

The fluid motor 58 is also operated by the pump 53 and the operation thereof is controlled by means of a spool type valve 62 which includes an axially movable spool valve member 63. The spool valve member 63 is spring loaded to the left by means of a spring 64 and is selectively movable to the right by means of a solenoid C.

OPERATION

The operation of the disc grinder 10 is started by manually closing the cycle start push button 70 which completes a circuit to energize relay 4CR. When the relay 4CR is energized, contact 4CR1 thereof closes to hold the circuit to the relay 4CR after the release of the push button 70. At the same time contact 4CR2 closes in a circuit to energize a motor relay 4M. This circuit includes normally open relay contact 5CR1 and normally closed contact 7CR1. The holding circuit for relay 4M includes a normally open contact 4M3 thereof.

The energization of the motor relay 4M results in the closing of the normally open contacts 4M1 and 4M2 to energize the motor MTR4. The motor MTR4 drives the drive unit for the work carrier 15 to rotate the work carrier 15 in a clockwise direction to advance the work holder A from its position in FIGURE 2 to the position of work holder B.

The work carrier 15 rotates until the cam 50 adjacent the work holder B actuates the limit switch 11LS and completes a circuit through normally closed contact 2TR1 to energize index stop relay 7CR. The energization of the relay 7CR results in the closing of the normally open contact 7CR2 thereof to form a holding circuit. At the same time, normally closed contact 7CR1 opens to de-energize motor relay 4M to open contacts 4M1 and 4M2 in the motor circuit and thus stop the motor MTR4 with the work holder A in the position previously occupied by work holder B. It is to be noted that in this position of the work holder A, the first workpiece carried thereby is intersected by the outer edge of each of the abrasive discs 11 and 12 and the second workpiece carried thereby is intersected by the inner edge of each of the abrasive discs 11 and 12.

Prior to the stopping of the rotation of the work carrier 15, normally open contact 7CR4 is closed to complete a circuit through normally closed contact 4M4 to energize relay 8CR and escapement relay 10CR. These relays are held energized by contact 8CR3 in a circuit

with normally closed limit switch 12LS. The relay 10CR through a circuit (not shown) actuates the escapement gate 46 to release two workpieces. The position of carrier 15 at this time is such that the first workpiece drops into the second notch in work holder A. The first notch has already passed the opening of the chute. However, on the first oscillating stroke which is counter-clockwise, the second workpiece, which is still in the chute, drops into the first notch during this counter-clockwise oscillation of carrier 15.

The relay 8CR operates through contact 8CR2 to energize solenoid C, shifting the spool valve member 63 to the right and directing fluid under pressure to the left end of the fluid motor 58. This results in the movement of the piston 60 to the right to advance the abrasive disc 11 towards the two workpieces carried by the work holder A. At the same time, the abrasive disc 12 may be advanced by a similar mechanism if the nature of the grinding operation requires it. The advance of the abrasive discs 11 and 12 towards the workpieces W held by the work holder A continues until the limit switch 10LS is actuated.

It is to be understood that the work carrier 15 continues to rotate a limited distance after the normally open limit switch 11LS is closed and just before the work carrier 15 reaches its fully indexed position, cam 50 actuates the limit switch 8LS energizing relay 5CR. The energization of relay 5CR results in the closing of the normally opened contact 5CR1 in the circuit to the carrier motor relay 4M. However, this circuit remains open due to the opening of the normally closed contact 7CR1 by the energization of the relay 7CR and the carrier motor MTR4 remains deenergized.

The contact 5CR2 closes in a circuit through contact 7CR3 to energize carrier oscillation relay 9CR. This results in the closing of contact 9CR3 disposed in a holding circuit in series with normally closed limit switch 9LS.

The contact 9CR2 closes when the relay 9CR is energized to energize solenoid D, thereby shifting the valve member 55 to the right against the spring member 56 and directing fluid under pressure to the left end of the fluid motor 35 to move the piston 37 thereof to the right. This results in the movement of the worm 21 to the right. When the worm 21 moves to the right, it results in the rotation of the worm wheel 20 and the work carrier 15 in a counterclockwise direction so that the second workpiece carried by the work holder A moves to a position where it is intersected by the outer edge of each of the abrasive discs 11 and 12 and the first workpiece is intersected by the inner edge of each of the discs 11 and 12. As indicated above, it is during the counterclockwise movement of the work carrier that the second workpiece in the chute drops into the first notch of work holder A.

When the work carrier reaches the limit of its counterclockwise oscillation, the cam 51 disposed adjacent the work holder C opens the normally closed limit switch 9LS, opening the holding circuit to relay 9CR and opening contact 9CR2 to deenergize the solenoid D. This results in the spool valve member 55 to be returned to its left hand position by the spring 56 and the directing of fluid under pressure to the right end of the piston 37. As the piston 37 moves to the left, the worm 21 is moved to the left with the result that the worm wheel 20 and the work carrier 15 are caused to oscillate in a clockwise direction.

The clockwise rotation of the work carrier 15 continues until cam 50 again closes limit switch 8LS to reverse the oscillation of the work carrier 15.

When the abrasive discs 11 and 12 reach the end of the feed movement, the limit switch 10LS is actuated and the spark out timer relay 2TR is energized. After a predetermined interval, the relay 2TR times out and normally closed contact 2TR1 in the circuit of relay 7CR opens, deenergizing relay 7CR. When the relay 7CR is deenergized, contact 7CR3 in the circuit to relay 9CR opens to

deenergize relay 9CR. Contact 9CR2 now opens, deenergizing solenoid D, permitting the valve member 55 to be shifted to the left by spring 56, directing fluid under pressure to the rod end of piston 37 and turning the work carrier 15 in a clockwise direction to the limit of the oscillating movement thereof in that direction. With the work carrier in this position, the limit switch 8LS is closed by the cam 50, energizing relay 5CR.

The energization of relay 5CR results in the closing of contact 5CR1. Inasmuch as normally closed contact 7CR1 is now closed, the closing of the contact 5CR1 results in the energization of motor relay 4M, starting the carrier motor 4MTR to repeat the indexing cycle, followed by the automatic repeating of the oscillating and grinding cycles.

When the work carrier 15 rotates to index the work holder carrying the unground workpieces to a grinding position, the cam 52 rotates and opens the normally closed limit switch 12LS to open the circuit to relays 8CR and 10CR. When the relay 10CR is deenergized, the gate or escapement mechanism 46 is reset in preparation for delivering two more workpieces into the next two empty pockets 18 when the work carrier reaches the proper position during the next indexing movement.

When the relay 8CR is open, the contact 8CR2 opens to deenergize solenoid C to permit the return of the valve member 63 to the left under the influence of the spring 64, directing fluid under pressure to the rod end of the feed cylinder 58, shifting piston 60 to the left and retracting the abrasive disc 11. The abrasive disc 12 may be retracted in the same manner.

Although the work carrier and its associated components have been illustrated in only a preferred embodiment of the disc grinder, it is to be understood that variations may be made in the utilization of the work carrier and the operation thereof without departing from the spirit and scope of the invention, as defined by the appended claims.

I claim::

1. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,
 - (c) means for rotating said work carrier comprising
 - (d) a worm wheel on said work carrier,
 - (e) a worm in operative relation with said worm wheel,
 - (f) means for rotating said worm to index said work carrier to place workpieces in operative relation to said abrasive disc,
 - (g) means to reciprocate said worm to oscillate said work carrier and said workpieces,
 - (h) means for advancing said abrasive disc axially against said oscillating workpieces to effect a grinding operation thereon,
 - (i) means to discontinue said oscillating movement at the end of said advancing movement,
 - (j) means operable thereafter to resume rotation of said work carrier to remove ground workpieces and to bring unground workpieces into grinding position,
 - (k) and control means for actuating said advancing means and said work carrier rotating means.
2. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a work carrier rotatable about an axis,
 - (c) means for rotating said work carrier,
 - (d) means for actuating said work carrier rotating means to index said work carrier to place workpieces in operative relation to said abrasive disc,
 - (e) means to actuate said work carrier rotating means to oscillate said work carrier about said axis,
 - (f) and means for advancing said abrasive disc axially against said workpieces.
3. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,

- (c) means for rotating said work carrier comprising
- (d) a worm and worm wheel,
- (e) means for actuating said work carrier rotating means to effect an indexing movement of said work carrier to place workpieces in operative relation to said abrasive disc,
- (f) means to actuate said work carrier rotating means to oscillate said workpieces,
- (g) means for advancing said abrasive disc axially against said oscillating workpieces,
- (h) and means to discontinue the oscillating movement after a workpiece has been ground.
4. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,
 - (c) means for rotating said work carrier,
 - (d) means for actuating said carrier rotating means for indexing said carrier to place workpieces in operative relation to said abrasive disc,
 - (e) means to actuate said carrier rotating means to oscillate said workpieces,
 - (f) means for advancing said abrasive disc axially against said oscillating workpieces,
 - (g) and means to discontinue said oscillating movement in response to said disc advancing means.
5. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,
 - (c) means for rotating said work carrier,
 - (d) means for actuating said carrier rotating means for indexing said carrier to place workpieces in operative relation to said abrasive disc,
 - (e) means to actuate said carrier rotating means to oscillate said workpieces,
 - (f) means for advancing said abrasive disc axially against said oscillating workpieces to effect a grinding operation thereon,
 - (g) and means to discontinue said oscillating movement,
 - (h) and means operable thereafter to resume rotation of said carrier to remove ground workpieces and to bring unground workpieces into grinding position.
6. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,
 - (c) means for rotating said work carrier,
 - (d) means for actuating said carrier rotating means for indexing said carrier to place workpieces in operative relation to said abrasive disc,
 - (e) means to actuate said carrier rotating means to oscillate said workpieces,
 - (f) means for advancing said abrasive disc axially against said oscillating workpieces to effect a grinding operation thereon,
 - (g) and means to discontinue said oscillating movement,
 - (h) and means operable thereafter to resume rotation of said carrier to remove ground workpieces and to bring unground workpieces into grinding position,
 - (i) and control means for initiating operation of said advancing means and said carrier rotating means.
7. In a disc grinder,
 - (a) at least one rotatably mounted abrasive disc,
 - (b) a rotatable work carrier,
 - (c) means for rotating said work carrier,
 - (d) means for actuating said carrier rotating means for indexing said carrier to place workpieces in operative relation to said abrasive disc,
 - (e) means to actuate said carrier rotating means to oscillate said workpieces,
 - (f) means for advancing said abrasive disc axially against said oscillating workpieces to effect a grinding operation thereon,
 - (g) and means to discontinue said oscillating movement,
 - (h) and means operable thereafter to resume rotation

- of said carrier to remove ground workpieces and to bring unground workpieces into grinding position,
 (i) and control means including switching means for controlling operation of said advancing means and said carrier operating means. 5
8. In a disc grinder,
 (a) at least one rotatably mounted abrasive disc,
 (b) a rotatable work carrier,
 (c) means for rotating said work carrier,
 (d) means for actuating said carrier rotating means for indexing said carrier to place workpieces in operative relation to said abrasive disc, 10
 (e) means to actuate said carrier rotating means to oscillate said workpieces,
 (f) means for advancing said abrasive disc axially against said oscillating workpieces to effect a grinding operation thereon, 15
 (g) control means operable in response to said disc advancing means to discontinue said oscillating movement, 20
 (h) and means operable thereafter to resume rotation of said carrier to remove ground workpieces and to bring unground workpieces into grinding position,
 (i) and control means including switching means for controlling operation of said advancing means and said carrier operating means, 25
 (j) and means on said carrier for actuating said switching means.
9. A work carrier unit for a surface grinder comprising:
 (a) a rotatable work carrier, 30
 (b) a drive unit connected to said work carrier for rotating said work carrier,
 (c) a rotating power unit connected to said drive unit for effecting intermittent rotation of said work carrier in one direction on its axis, 35
 (d) and a reciprocating power unit connected to said drive unit for effecting oscillatory movement of said work carrier about said axis.
10. A work carrier unit for a surface grinder comprising: 40
 (a) a rotatable work carrier,
 (b) a drive unit connected to said work carrier for rotating said work carrier,
 (c) said drive unit including a worm wheel fixedly connected to said work carrier for rotation therewith and a worm meshed with said worm wheel, 45
 (d) means mounting said worm for both rotation and axial movement,
 (e) a first power unit drivingly coupled to said worm for rotating the same and effecting rotation of said work carrier, 50
 (f) and second power unit connected to said worm for axially reciprocating the same and effecting oscillatory movement of said work carrier.
11. A work carrier unit for a surface grinder comprising: 55
 (a) a rotatable work carrier,
 (b) a drive unit connected to said work carrier for rotating said work carrier,
 (c) a first power unit connected to said drive unit for effecting controlled rotation of said work carrier, 60

- (d) a second power unit connected to said drive movement of said work carrier,
 (e) first control means coupled to said first power unit for effecting limited rotation of said work carrier to periodically index said work carrier,
 (f) and second control means coupled to said second power unit and responsive to the indexing of said work carrier to effect the operation of said second power unit.
12. The work carrier unit of claim 11 together with control means including,
 (a) said first and second control means being interconnected,
 (b) and said second control means including a timer for rendering said second control means ineffective in the operation of said second power unit and operative to again energize said first control means.
13. The work carrier unit of claim 11 together with control means including:
 (a) said first and second control means being interconnected,
 (b) and said second control means including a timer for rendering said second control means ineffective in the operation of said second power unit and operative to again energize said first control means,
 (c) said first and second control means including cams and control switches operable by said cams,
 (d) and means effecting relative movement of said cams and said control switches upon rotation of said work carrier.
14. A work carrier unit for a surface grinder comprising:
 (a) a rotatable work carrier,
 (b) a drive unit connected to said work carrier for rotating said work carrier,
 (c) said drive unit including a worm wheel fixedly connected to said work carrier for rotation therewith and a worm meshed with said worm wheel,
 (d) means mounting said worm for both rotation and axial movement,
 (e) a first power unit drivingly coupled to said worm for rotating the same and effecting rotation of said work carrier,
 (f) and second power unit connected to said worm for axially reciprocating the same and effecting oscillatory movement of said work carrier,
 (g) said first power unit including a rotary motor,
 (h) and said second power unit being in the form of a reciprocating motor.

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LESTER M. SWINGLE, *Primary Examiner.*