July 16, 1946. H. M. SCARFF 2,404,146

PISTON RING SLOTTING MACHINE

Filed Aug. 16, 1944 5 Sheets-Sheet 1

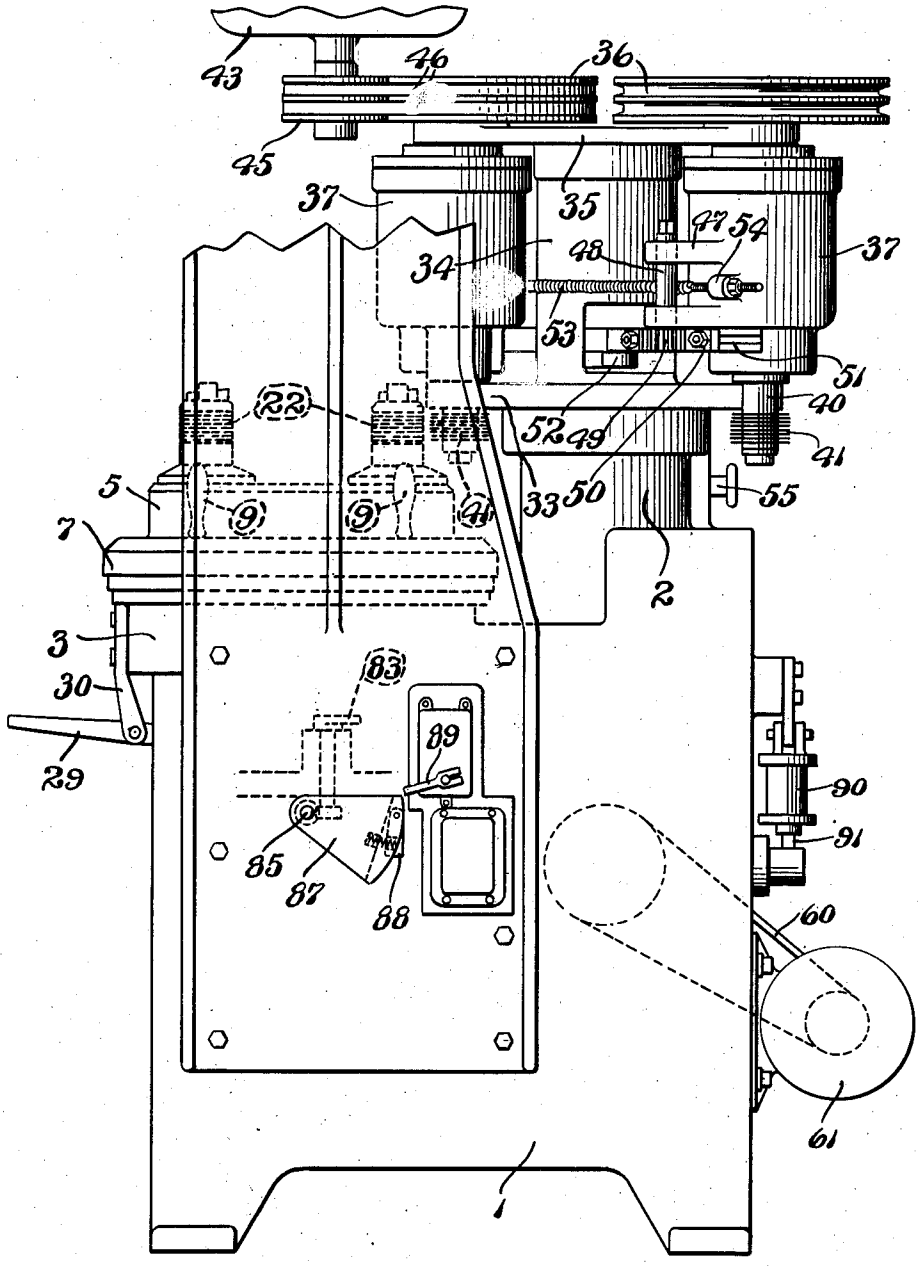

Fig. 1.

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Filed Aug. 16, 1944 5 Sheets-Sheet 2

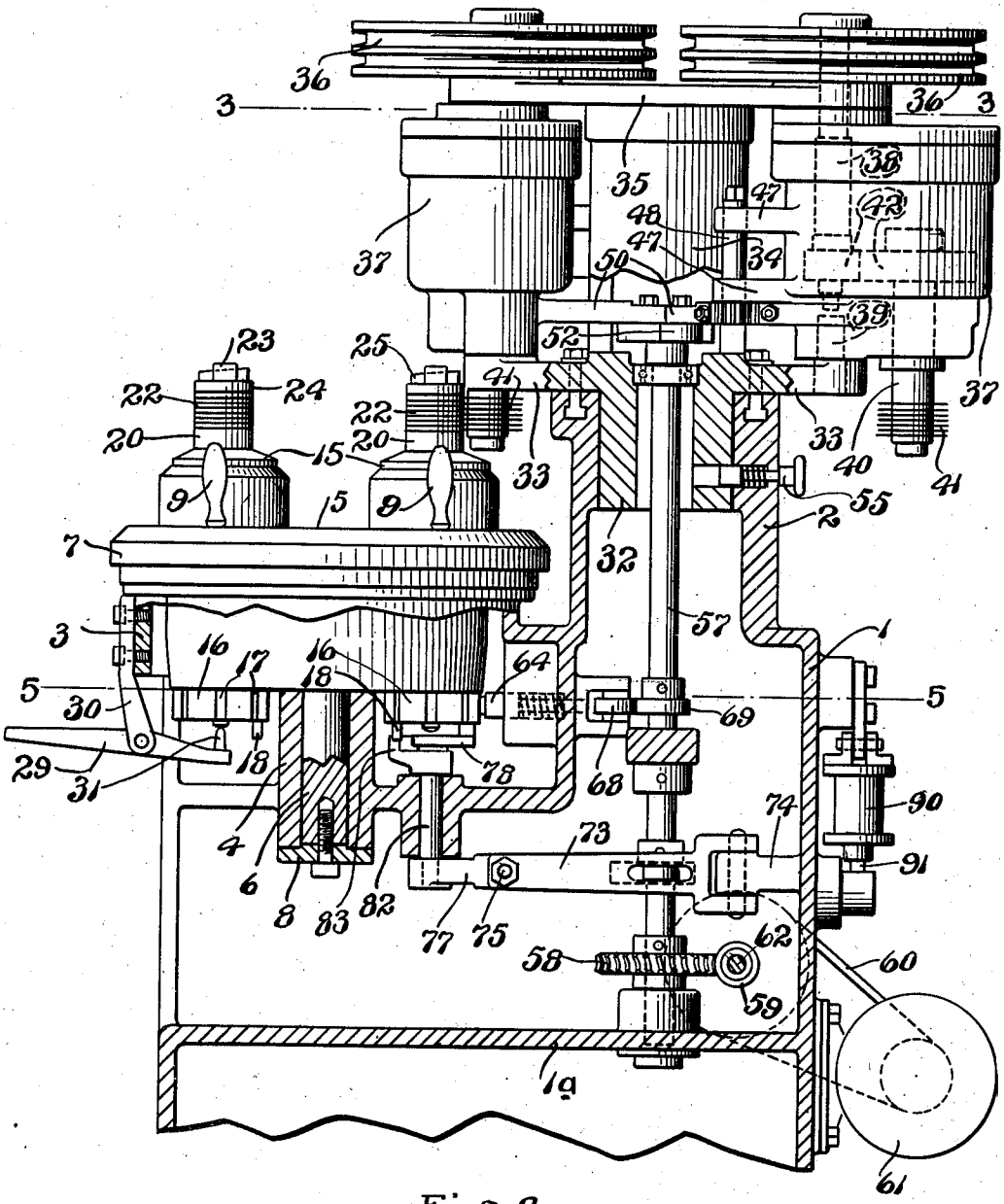

Fig. 2

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PISTON RING SLOTTING MACHINE

Filed Aug. 16, 1944 5 Sheets-Sheet 3

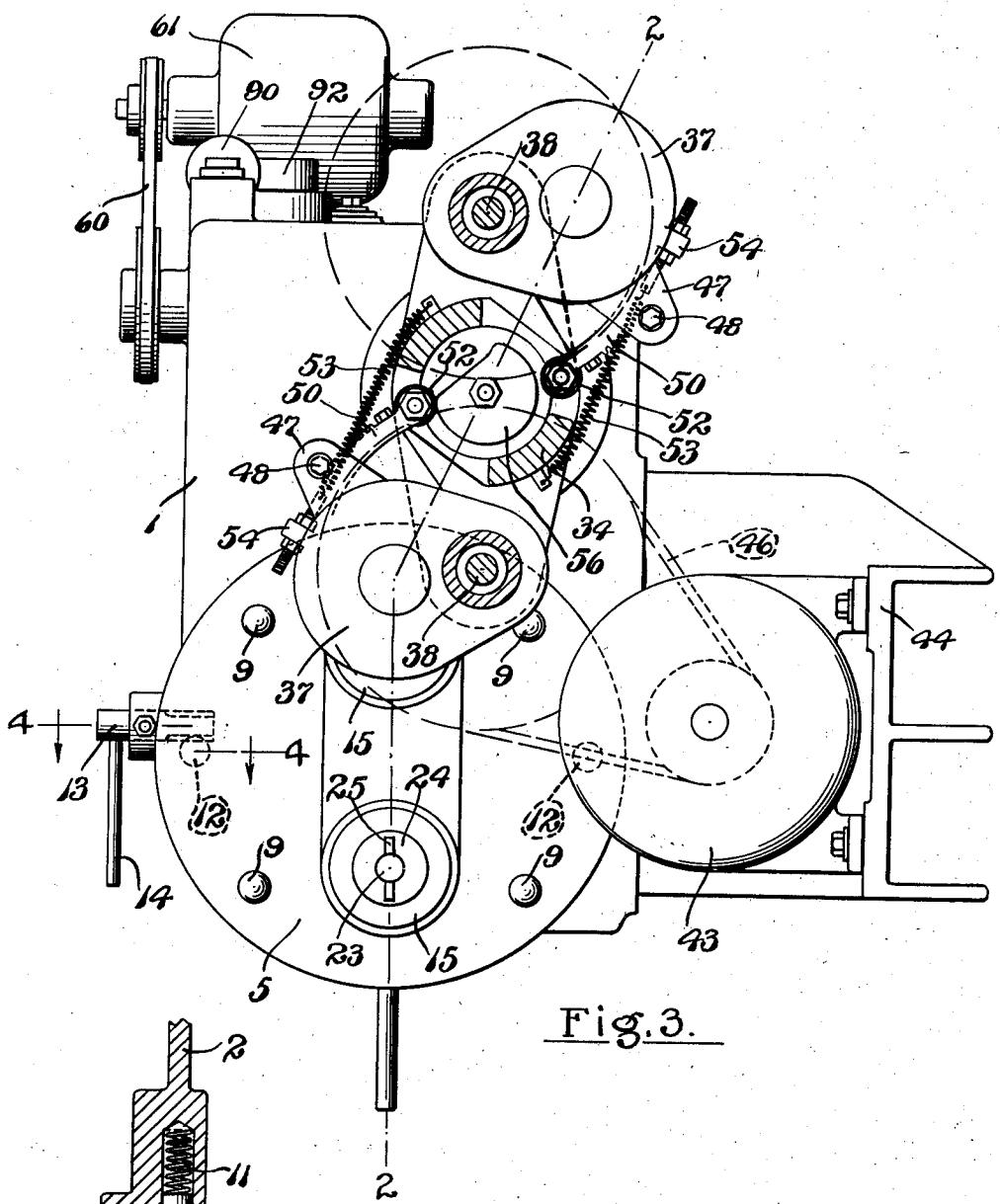

Fig. 3.

Fig. 4.

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July 16, 1946. H. M. SCARFF 2,404,146

PISTON RING SLOTTING MACHINE

Filed Aug. 16, 1944 5 Sheets-Sheet 4

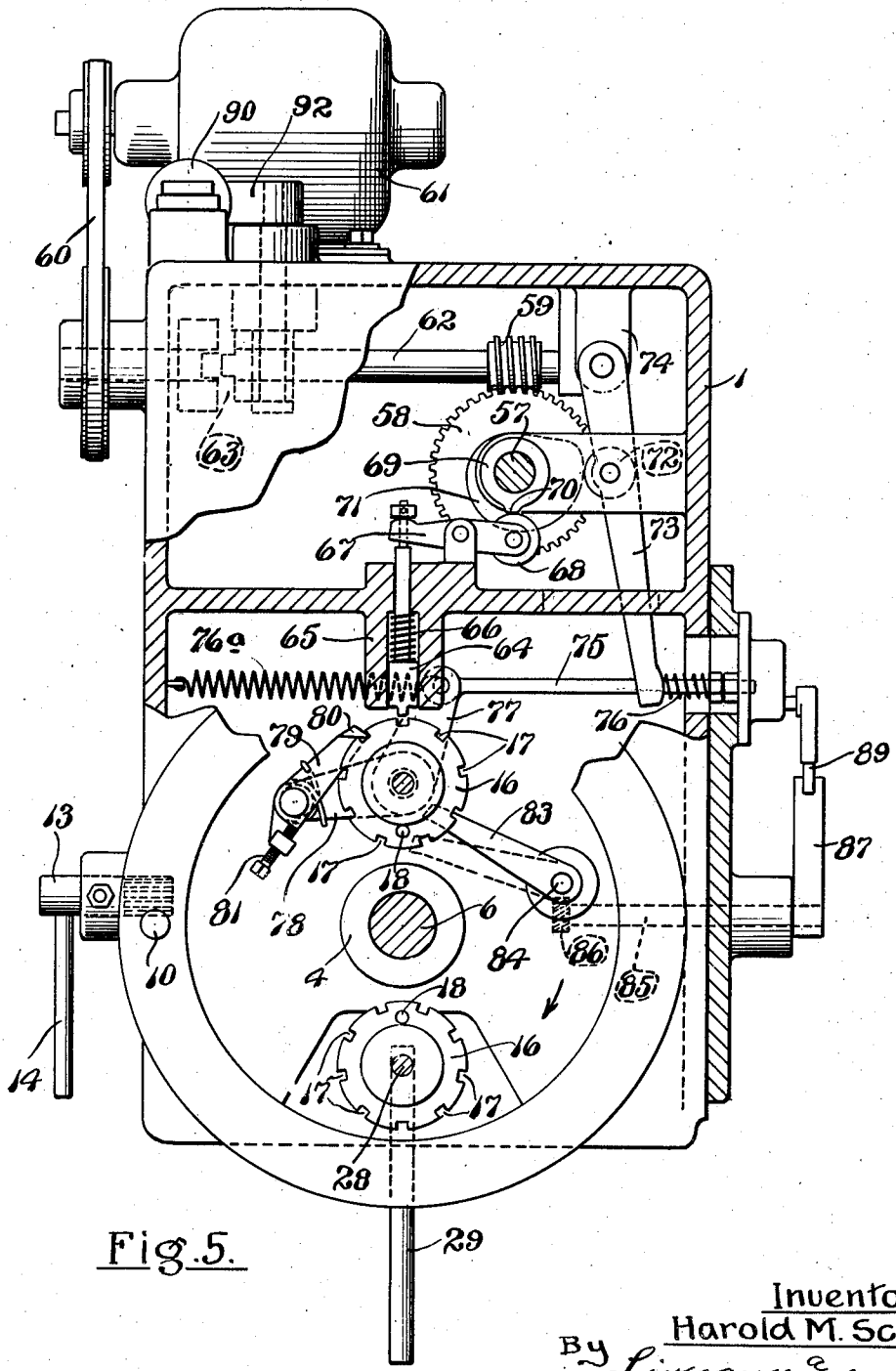

Fig. 5.

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July 16, 1946. H. M. SCARFF 2,404,146

PISTON RING SLOTTING MACHINE

Filed Aug. 16, 1944 5 Sheets-Sheet 5

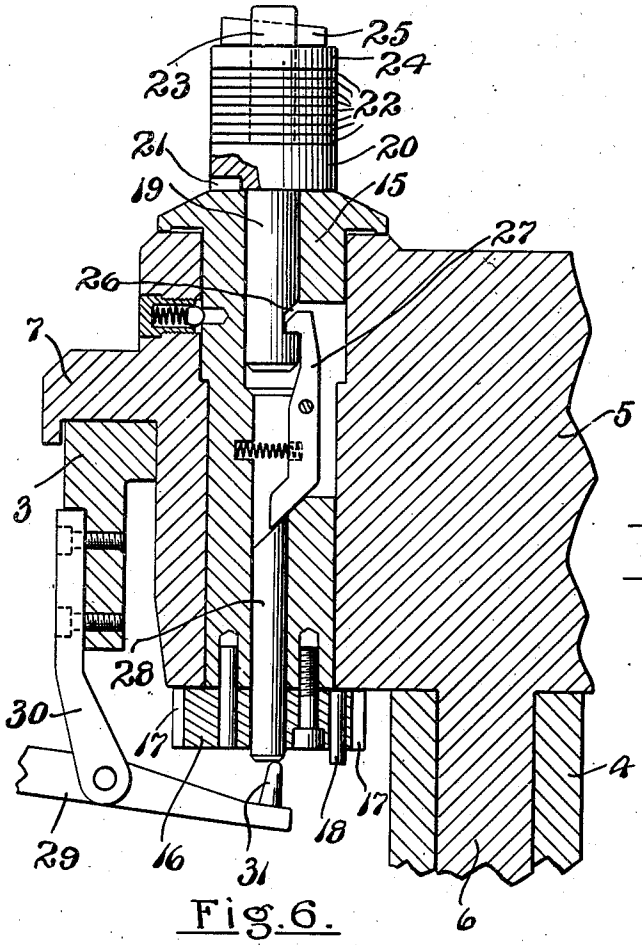

Fig. 6.

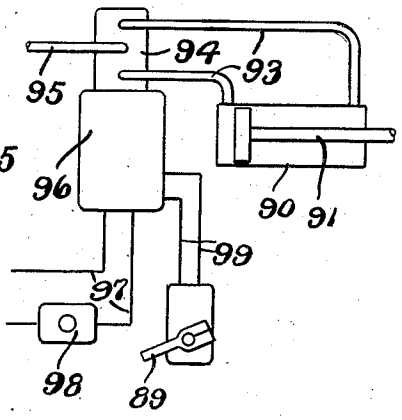

Fig. 8.

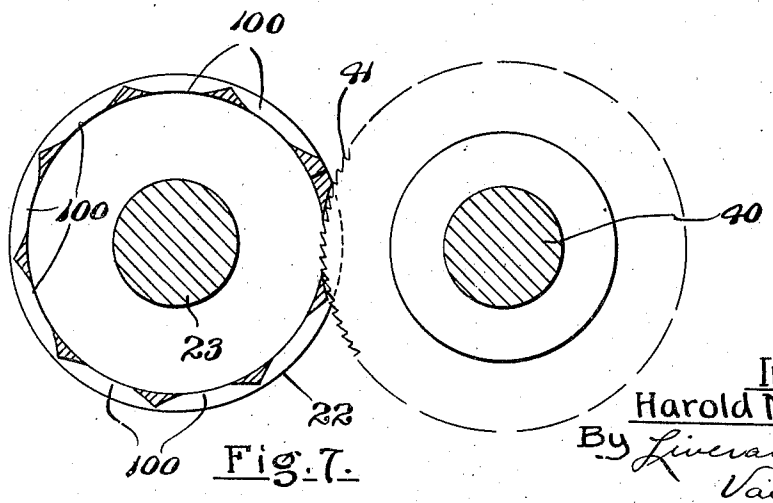

Fig. 7.

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Patented July 16, 1946

2,404,146

UNITED STATES PATENT OFFICE

2,404,146

PISTON RING SLOTTING MACHINE

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Application August 16, 1944, Serial No. 549,707

6 Claims. (Cl. 90—15.1)

1

This invention relates to a piston ring slotting machine. Piston rings used in the lower groove or grooves of pistons in internal combustion engines are in many cases provided with slots cut by saws, such slots being located between the opposed flat sides of the rings and extending their outer curved bearing faces to the inner sides thereof. The slots are spaced from each other around the ring and in the circumference of a ring a plurality of the slots are cut, the number of which may vary. The present invention is directed to a machine by means of which a number of piston rings may be simultaneously slotted, one slot after another, until all of the slots in the rings are completed, the processed rings removed and replaced by others, and during such time of removal and replacement a second plurality of rings be undergoing the slotting process. This provides a very rapid production machine and one with which the slotting operation is performed rapidly and accurately so that with the machine and one operator therefor, large quantity production is obtained at low cost.

Another feature and object and purpose of the present invention is to provide the machine with at least two slot cutting or sawing units either of which may be used in slotting the rings. The other is idle and is conveniently located for access so that the cutting saws may be sharpened or replaced if necessary, the work which the machine is doing not being interrupted. This makes it possible for the machine to be continued in production operation all of the time without need for it to be idle in the event that a saw or saws have teeth broken therefrom or become dull and need resharpening.

Many other novel constructions and useful results coming therefrom will be apparent upon an understanding of the invention had from the following description, taken in connection with the accompanying drawings, in which

Fig. 1 is a side elevation of a machine made in accordance with my invention.

Fig. 2 is a vertical section and partial side elevation, the section being on the plane of line 2—2 of Fig. 3.

Fig. 3 is a horizontal section substantially on the plane of line 3—3 of Fig. 2, looking in a downward direction.

Fig. 4 is a fragmentary enlarged vertical section on the plane of line 4—4 of Fig. 3, looking in the direction indicated.

Fig. 5 is a horizontal section on the plane of line 5—5 of Fig. 2, looking in a downward direction.

Fig. 6 is a fragmentary enlarged vertical section, showing the mounting of one of the ring arbor carrying units and the manner in which the ring arbor and rings thereon are detachably connected.

2

Fig. 7 is a fragmentary horizontal section through a piston ring showing the manner in which the slots are cut therethrough, and

Fig. 8 is a diagrammatic view of the electrical controls used in connection with the machine.

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

The machine has a supporting cast frame 1 from the upper rear portion of which a sleeve 2 extends upwardly. At the front the frame has a ring support and guide 3, within and below which is a vertical sleeve 4 (Fig. 2), for the mounting and support of a turntable 5. The turntable has a downwardly extending vertical stem 6 passing substantially through and rotatable in the bearing provided by the sleeve 4 and at its lower end a retaining plate 8 is detachably connected as shown in Fig. 2. The table at its upper peripheral portions has an outwardly extending annular ledge 7 resting upon and movable over the upper edges of the ring 3 (Fig. 6). The table at its upper side is provided with a plurality of upwardly extending handles 9 which may be grasped to turn the table about its vertical axis of movement.

The turntable is adapted to occupy two positions and be releasably held in such positions. A locking bolt 10 (Fig. 4) is normally pressed outwardly by a spring 11 to enter an opening 12 in the underside of the ledge 7, said bolt 10 being mounted vertically underneath the ledge on the support 3. There are two of the bolt receiving openings 12 (Fig. 3) thereby governing the two positions in which the turntable is held. The bolt is manually retracted by means of a short horizontal stub shaft 13, having gear teeth at its inner end and engaging with a rack at one side of the pin 10, and with a handle 14 connected with the shaft for manual operation to retract the bolt and lift it out of the recess 12 with which it is engaged.

At diametrically opposed places on the table vertical openings are made therethrough for the mounting of two sleeves 15 which are rotatable therein and which are flanged at their upper ends to bear against adjacent upper portions of the turntable. At the lower end of each of the sleeves 15 an indexing wheel 16 is permanently secured, provided at its periphery with spaced apart radial notches 17 (Fig. 5). A pin 18 is

secured to each of the indexing wheels 16 and extends below the lower side thereof.

In the upper end portion of the sleeve 15 a vertical stem 19 of a ring holding arbor is adapted to be inserted. At the upper end of the stem a fixed collar 20 is formed as a part of the arbor, being notched at its lower side to engage with a key 21 at the upper end of the sleeve 15 to hold the arbor against rotation with respect to the sleeve 15 on which it is mounted. Above the collar 20 a plurality of piston rings 22 which are to be slotted are located in superimposed relation and clamped with their partings at one side closed between the upper side of the collar 20 and a removable ring collar 24. A stem 23 extends upwardly from the collar 24 through the piston rings and is provided at its upper end portion with a slot to receive a key 25 therethrough which bears with a considerable wedging force against the upper side of the collar 24 to hold the rings in closed clamped position. The structure of the arbor need not be entered into in detail as it is shown in the pending application, Serial No. 503,097, filed September 20, 1943.

The stem 19 near its lower end has a notch or recess 26 in a side thereof in which the upper end of a spring actuated retaining dog 27 is adapted to be received to releasably retain the arbor in place. The dog 27 is pivotally mounted between its ends and at its lower end is provided with an angularly disposed tail piece, as shown in Fig. 6. A rod 28 passes freely upward through the indexing wheel 16 and the lower part of the sleeve 15, and has a beveled upper end bearing against the inclined lower side of the tail piece of the dog 27. A lever 29 is pivotally mounted between its ends on a bracket 30 depending from the support 3, and at its inner end is provided with a projection 31 which bears against the lower end of rod 28. A downward push upon the outer end of rod 29 (Figs. 2 and 6) moves the rod 28 upwardly and shifts the dog 27 to a position to release the arbor so that it can be removed. On replacing an arbor which has been removed with a new arbor loaded with unslotted piston rings, the lower end of the stem 19 engages the upper end portion of the dog 27, pressing at its one side until notch 26 has reached a position to receive the upper end of the dog, it being moved into retaining position by the spring acting thereon.

The sleeve 2 of the main supporting frame casting receives within it and provides a bearing for a downwardly extending sleeve 32 (Fig. 2) from the upper part of which oppositely extending horizontal arms 33 project. Above the arms the sleeve is extended as shown at 34 and immediately over said arms said sleeve is slotted at opposite sides (Fig. 3). The upper end of the sleeve is closed by a head 35, likewise having oppositely extending arms, adjacent the outer end of each of which a belt pulley 36 (preferably grooved as shown, Figs. 1 and 2), is mounted for rotation. Between the ends of each pair of arms 33 and 35 a housing 37 of the form shown in Fig. 3 is located. A shaft 38 connected with each belt pulley 36 extends downwardly through the arms of the head 35 into each housing 37. The vertical axes of shafts 38 are coincident substantially with the axes of pins 39 (Fig. 2) projecting upwardly from arms 33. The pins 39 extend into openings in the lower sides of the housings 37 so that said housing may be rocked about the common vertical axes of shafts 38 and pins 39. A saw arbor shaft 40 is mounted in each housing 37, and extends below it, the axes of each of said shafts being offset from the axis of its associated shaft 38. Each saw arbor shaft at its lower end carries a plurality of thin saws 41, spaced from each other, there being one of the saws for each of the rings 22, carried by a ring holding arbor. It is, of course, to be understood that the saws 41 are releasably connected with their arbor shafts 40, the detail not being shown as it is old and well known. The saw arbor shafts 40 are driven by the shafts 38 through gearing indicated at 42, in Fig. 2.

An electric motor 43 is supported on a suitable bracket support 44 at the upper side of the supporting casting 1, the shaft of the motor being equipped with a grooved driving pulley 45, around which and the adjacent pulley 36 endless belts 46 are adapted to be placed for driving the saws continuously, that is, the saws on one arbor shaft 40. One of the pulleys, as shown in Fig. 1, will be driven and the other idle. But when the pulleys and saws are interchanged in position, as later described, the belts 46 are removed from the pulley 36 which has been driven and are placed around the other pulley 36 for the driving of it and the slotting saws 41 associated therewith.

From each of the housings 37, upper and lower arms 47 extend outwardly (Figs. 1 and 2) through which a shaft 48 extends. A pinion 49 is at the lower end of the shaft below the lower arm 47, and the upper end of the shaft is shaped to receive a wrench for turning it. A curved arm 50 is adjustably mounted at a side of each housing 37, below the lower arm 47 on suitable ways 51 (Fig. 1) with bolts as shown for securing the arm in any position to which adjusted longitudinally of said ways. The adjustment is effected by releasing the bolts and turning the shaft 48, each arm being provided with rack teeth (Fig. 3) with which an associated pinion 49 engages. Each arm at its free end is provided with a roller 52. Two tension springs 53 are connected each at one end to the upper sleeve extension 34, and at their opposite ends to rods adjustably extending through lugs 54 projecting from the housings 37. Said springs under tension normally tend to pull the housings in a clockwise direction (Fig. 3) about the axes of the shafts 38 and pins 39.

The unit described and which is mounted upon the central sleeves 32, 34 with their outwardly extending arms 33 and 35 may be turned as a whole about the vertical axis of the sleeve portion 32 which is within the bearing sleeve 2, and be held in either of two positions by a spring actuated lock bolt 55. In one position one gang of saws will be over the inner portion of the turntable 5 and will be driven by the motor 43. The other gang of saws will be diametrically opposite and back of the main supporting casting 1 (Fig. 2) accessible for inspection, repair, removing and replacement.

The rollers 52 drawn inwardly by springs 53 pass through the slots in the sleeve extension 34 (Fig. 3) and normally bear against a cam 56 at the upper end of a vertical shaft 57 which extends through the lower sleeve 32 and is rotatably mounted at its lower end on a horizontal portion 1a of the main casting frame (Fig. 2). The unit which is idle may be held at an outer position in any suitable manner so that the spring 53 associated with it is maintained in a stretched condition, with the roller 52 out of engagement with the cam 56 as shown in Fig. 3. With a roller

52 bearing against the edge of cam 56 and with shaft 57 continuously rotating, the housing 37 with which such roller 52 is associated is rocked back and forth about the axis of the shaft 38 so that the saws 41 are moved back and forth with such rocking movements.

Shaft 57 carries a worm wheel 58 driven by a worm 59 on a shaft 62 (Figs. 2 and 5). In alignment with the shaft 62 is a second shaft (not numbered, Fig. 5) having a pulley driven by a belt 60 which in turn is driven by an electric motor 61 mounted at the back of the machine. Between the shaft 62 and its aligned shaft is a clutch 63 (Fig. 5) so that though the motor 61 may be continuously operating, shaft 62 is driven only when the clutch at 63 is connected.

The index wheel 16 of the sleeve 15 which carries a loaded arbor of rings which are to be acted upon by the saws has a locking dog 64 engaging successively in the notches 17 to hold the sleeve 15 and the rings associated therewith from rotative movement while the slot sawing takes place. The dog 64 is guided in a sleeve guide 65 (Fig. 5) and normally pressed outward by a spring 66. A lever 67 is pivotally mounted between its ends and connected with the dog at one end, the other end carrying a roller 68 bearing upon a collar 69 fixed on and rotatable with shaft 57 and which has a projection 70 at one side, so that with each rotation of the shaft 57, lever 67 is actuated to withdraw the locking dog 64 from a notch 17 in the index wheel 16 with which it has been engaged, as shown in Fig. 5.

A second cam 71 (Fig. 5) is secured to the shaft 57 below the collar 69 bearing against which is a roller 72 mounted between the ends of a lever arm 73 pivotally mounted at one end on a lug 74 extending inwardly from a side of the main supporting frame 1. A rod 75 passes freely through the other end of the lever arm 73 and has nuts at its outer end between which and the arm 73 a coiled spring 76 is located. The opposite end of the rod 75 is pivotally connected to the outer end of an arm 77 which, as shown in Fig. 2, is located below a part of the main casting support and is connected by a vertical shaft 82 with a second arm 78, the two arms 77 and 78 providing in effect a bell crank lever. A tension spring 76a (Fig. 5) acts upon the arm 77 to normally pull it to the left. At the outer end of arm 78 a spring actuated finger 79, with a dog 80 thereon projecting laterally, is pivotally mounted, the spring acting to turn the arm clockwise (Fig. 5) for the dog to ride against the peripheral edge of the index wheel 16 and at times enter the notches 17 therein. The dog is limited in its movement by an adjustable stop provided by the screw 81 (Fig. 5).

A finger 83 has its free end portion normally interposed in the path of movement of the pin 18 extending downwardly from the inner index wheel 16. Finger 83 is secured at its opposite end to a short vertical rock shaft 84 between which and a horizontal shaft 85 extending through a side of the machine gearing connections, as indicated at 86, are interposed, whereby the movement of the finger 83 from its full line to its dotted line position shown in Fig. 5 rocks the shaft 85 a limited distance. At the outer end of the shaft 85 a sector-like weighted block 87 is secured at the curved edge of which a spring actuated member 88 is pivotally suspended (Fig. 1). When the pin 18 engages against the finger 83 in the movement of the indexing wheel 16 to which the pin is connected and moves said finger

from the full line to dotted line position shown in Fig. 5, the member 87 is lifted to a position above a switch lever 89 (Fig. 1), the member 88 passing thereby, whereby when it is released and the weight of the member 87 causes it to return to its initial position, the lower side of the part 88 engages the switch lever 89 to turn it as is evident, said lever 89 returning to initial position after release.

The switch lever 89 is a part of the control mechanism for the clutch 63 for its connection and disconnection through a fluid pressure operated cylinder and piston 90 and 91. Said cylinder 90 is located at the back of the machine (Fig. 5) and the piston rod connected with a lever 92, the movement of which shifts the movable member of clutch 63 into or out of engagement with the driven clutch members. Cylinder 90 (Fig. 8) has pipes 93 leading to opposite ends thereof, which pipes are connected with a valve housing 94 to which a fluid pressure medium is conducted through a pipe 95. Within the housing 94 is a valve which selectively opens either of the pipes 93, at the same time closing the other. Associated therewith is a housing 96 which carries an electrical appliance, for example, a solenoid construction connected with the valve, with electric wires 97 in one of which a manual switch 98 is interposed, and other wires 99 in which the switch controlled by the lever 89 is interposed. The detail of this construction is not set forth as it is not in itself new and is known to those skilled in the electrical field.

In operation, with the motor 43 continuously running, therefore driving the saws 41 at the front of the machine; and with the motor 61 continuously running but with clutch 63 disconnected, an arbor loaded with rings 22 is moved into processing position as indicated in dotted lines in Fig. 1. The switch at 98 is manually closed which effects a flow of liquid pressure to the proper end of the cylinder 90 to move the piston and the rod 91 and connect the clutch at 63. When this occurs the rotation of the shaft 57 causing a turning of cam 56 (Fig. 3) moves the operating housing 37 and with it the operating saws 41 toward and into sawing engagement with the rings 22 to cut one of slots 100 (Fig. 7) in all of the rings 22. With a continuation of movement of cam 56 and when the roller 52 reaches the proper position on said cam, the spring 53 which has been stretched withdraws the housing 37 and the saws associated therewith.

During this time that such withdrawal has taken place the projection 70 on the collar 69 comes to the roller 68 and operates lever 67 to withdraw the locking dog 64 to the position shown in Fig. 5 and thereby release the indexing wheel with which it has been engaged. The cam 71 moves to release the lever arm 73 which will then permit the movement of rod 75 and lever 77 by spring 76a counterclockwise (Fig. 5) so that the dog 80 will move in a counterclockwise direction about the indexing wheel 16 from one notch 17 to the next one and upon cam 71 moving still farther so that it draws the rod 75 and arm 77 to the right (Fig. 5) the indexing wheel will be moved one step to bring the next succeeding notch in position to be engaged by the released dog 64.

This operation is repeated until the indexing wheel has made a complete revolution. With each repetition the position of the rings 22 is changed so that succeeding slots 100 are cut

through the rings until the final slot is cut which completes the process on all of the rings carried by the arbor. It is at this time that pin **18** operates against the finger **83** and moves the switch lever **89** as previously described, causing a change of the position of the fluid pressure control valve and the reversal of the fluid pressure movement to the opposite end of the cylinder **90**, the piston rod **91** in its return movement operating to disconnect the clutch **63** and stop the machine when a plurality of the ring castings have been completely processed.

The turntable **5** is then released by pushing down upon the handle **14** and is turned through 180°, as indicated by the arrow in Fig. 5, to bring the arbor loaded with unprocessed rings, which previously was at the front of the turntable, into position to be slotted. The switch at **98** is manually closed and the clutch **63** reengaged for repetition of the cycle described. While the second plurality of ring castings is being slotted, those which have been processed are removed by manually operating lever **29** to free the arbor of processed rings, it being replaced by another arbor loaded with unprocessed rings. This operation is repeated indefinitely, it being necessary for the machine operator merely to remove the arbors carrying processed rings and replace with arbors loaded with unprocessed rings, unlock and turn the turntable between the successive automatic stoppings of the machine, and close the switch for connecting clutch **63** at the times after the machine has been stopped to cause it to again operate.

The construction described is practical and effective and with it in practice very high quantity production of the slotted oil rings is obtained. As previously mentioned no stopping of the machine operation is required for reconditioning of the slotting saws, or their replacement. The turntable having two stages, one for loading with unprocessed rings and the other stage the place at which they are slotted, provides for a rapid continuous quantity production. The invention has proven very successful in practical operation. It is defined in the appended claims and is to be considered comprehensive of all forms of structure coming within their scope.

I claim:

1. In a machine of the class described, a horizontal substantially ring-like support, a horizontal turntable mounted within said support and extending over the upper side and bearing thereon, means for mounting said turntable to turn about a vertical axis, two sleeves rotatably mounted upon and extending vertically through said turntable inside said support, a piston ring carrying arbor having a downwardly extending stem to pass into the upper end portion of each sleeve, said stem having a notch in a side thereof, a spring actuated dog mounted on each sleeve to enter said notch at one end of the dog, a rod in each sleeve having a cam upper end mounted lengthwise of the lower portion of said sleeve and extending therebelow, said dog at its lower end having a cam edge to engage the cam end of the rod, a lever pivotally mounted between its ends and carried by said support at one end extending underneath either of said rods in a predetermined position of the turn table, whereby one of said rods may be moved upwardly on operation of the lever to disengage said dog from said arbor stem.

2. In a machine of the class described, a support mounted to turn about a vertical axis, a vertical driven shaft extending into and partly through said support, a cam at the upper end of the shaft, two housings mounted on said support for rocking movement each about a vertical axis, a cam follower on each housing to bear against said cam, a saw arbor shaft mounted to turn about a vertical axis carried by each housing and extending therebelow, each saw arbor at its lower portion carrying a plurality of spaced horizontal saws, said arbor shaft being offset from the axis about which the housing is rocked, and means for driving said saw arbor shafts, said driving means being in a fixed position and adapted to drive one of said saw arbor shafts when said support is in one position and the other of said saw arbor shafts when the support is turned about a vertical axis to another position.

3. A construction having the elements defined in claim 2, and means for mounting a plurality of horizontally located piston ring castings in superimposed relation one against the other and clamped together in a position for engagement by the saws of the driven saw arbor shaft, said saws being moved inwardly to saw slots through the piston ring castings and then outwardly to disengage therefrom through the rocking of the housing which carries said shaft controlled by said cam, and means controlled by said first mentioned vertical shaft for periodically turning said piston rings about a central vertical axis a preselected distance at the times that the saws have been moved away from said castings.

4. A construction having the elements defined in claim 2, and means for mounting a plurality of horizontally located piston ring castings in superimposed relation one against the other and clamped together in a position for engagement by the saws of the driven saw arbor shaft, said saws being moved inwardly to saw slots through the piston ring castings and then outwardly to disengage therefrom through the rocking of the housing which carries said shaft controlled by said cam, and means controlled by said first mentioned vertical shaft for periodically turning said piston rings about a central vertical axis a preselected distance at the times that the saws have been moved away from said castings, combined with means for automatically stopping said vertical driven shaft from rotation after said piston rings have been turned by step by step movements so as to saw a plurality of equally spaced slots through said rings therearound.

5. A machine for slotting piston rings comprising, a support, a second support mounted on the first support to be turned about a vertical axis, housings substantially diametrically opposite each other, each mounted upon the second support to rock about a vertical axis spaced from the axis of the second support, a vertical saw arbor shaft mounted on each housing and extending below it, each saw arbor shaft at its lower end portion being adapted to carry a plurality of spaced horizontal saws, a driven shaft mounted vertically in each housing and about the axis of which the housing is rocked, driving connections between said vertical shafts and the saw arbor shafts, a driving means mounted upon the first support adapted to have selective connection with said vertical shafts, one at a time, said second support being turnable about its vertical axis of rotation to bring either of said shafts into position for connection with the driving means, a driven vertical shaft mounted upon the first support and extending into the second support having an axis substantially coincident with the ver-

tical axis about which said second support is turnable, a cam on said last mentioned shaft, a cam follower on each housing adapted to bear against the cam, and means normally drawing said rollers into engagement with the cam, whereby on rotation of the last mentioned shaft a housing is rocked to shift the piston of the saw arbors and the saws thereon.

6. A machine for slotting piston rings comprising, a support, a second support mounted on the first support to be turned about a vertical axis, housings substantially diametrically opposite each other each mounted upon the second support to rock about a vertical axis, spaced from the axis of the second support, a vertical saw arbor shaft mounted on each housing and extending below it, each saw arbor shaft at its lower end portion being adapted to carry a plurality of spaced horizontal saws, a driven shaft mounted vertically in each housing and about the axis of which the housing is rocked, driving connections between said vertical shafts and the saw arbor shafts, a driving means mounted upon the first support adapted to have selective connection with said vertical shafts, one at a time, said second support being turnable about its vertical axis of rotation to bring either of said shafts into position for connection with the driving means, a driven vertical shaft mounted upon the first support and extending into the second support having an axis substantially coincident with the vertical axis about which said second support is turnable, a cam on said last mentioned shaft, a cam follower on each housing adapted to bear against the cam, means normally drawing said rollers into engagement with the cam whereby on rotation of the last mentioned shaft a housing is rocked to shift the position of the saw arbors and the saws thereon, a vertically positioned piston ring arbor having a plurality of piston rings located horizontally thereon in superimposed relation, rotative means for carrying said piston rings to a position to be processed by the saws on rocking movement of the housing carrying them toward adjacent sides of the piston rings, said saws disengaging from the piston rings on continuation of the rocking movement carrying them away from the piston rings, and means to turn said piston rings a predetermined distance to present another portion of said rings to the saws, said turning occurring when the saws are away from the rings.

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