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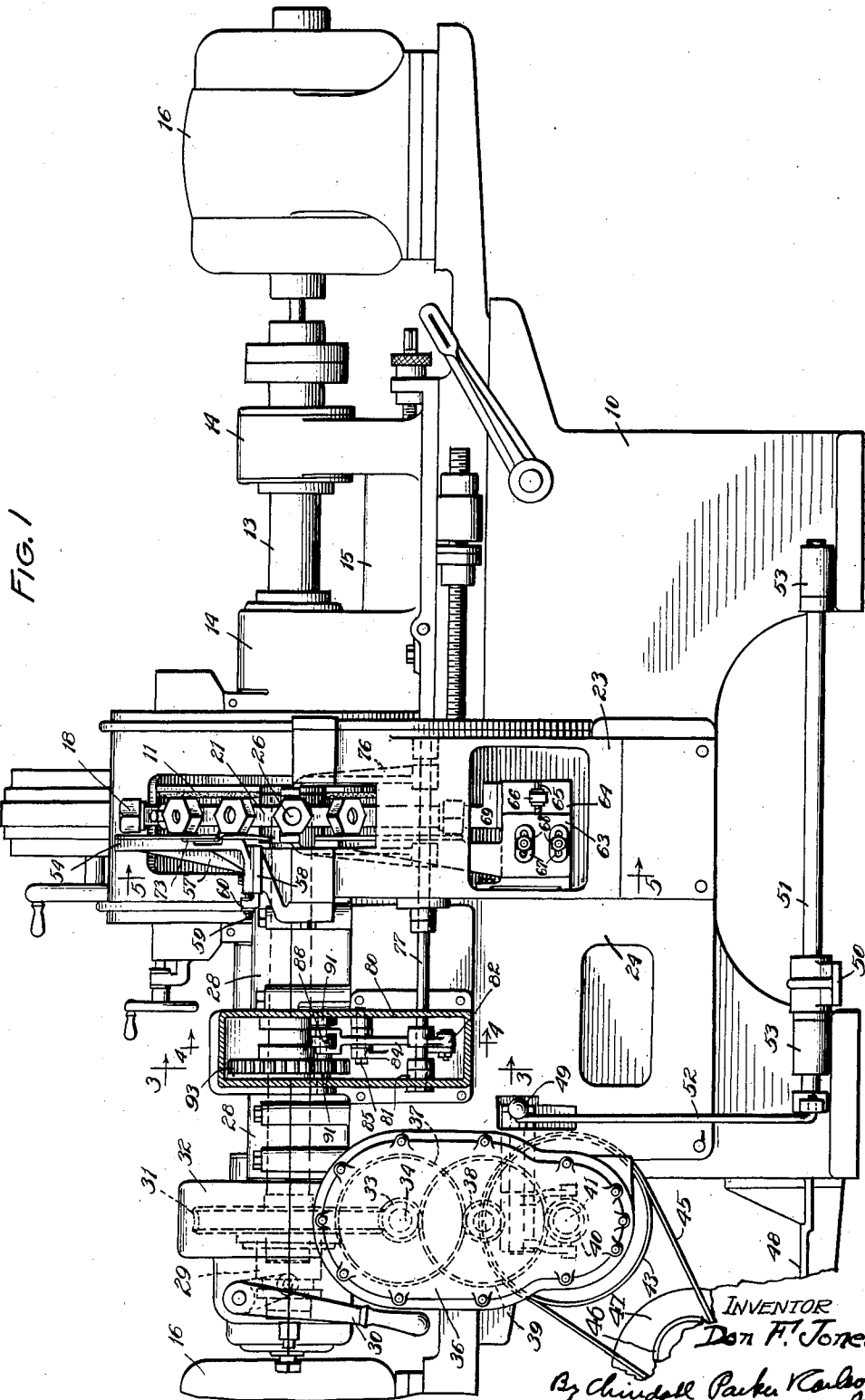
D. F. JONES

1,923,931

GRINDING MACHINE

Filed Nov. 17, 1928

4 Sheets-Sheet 1



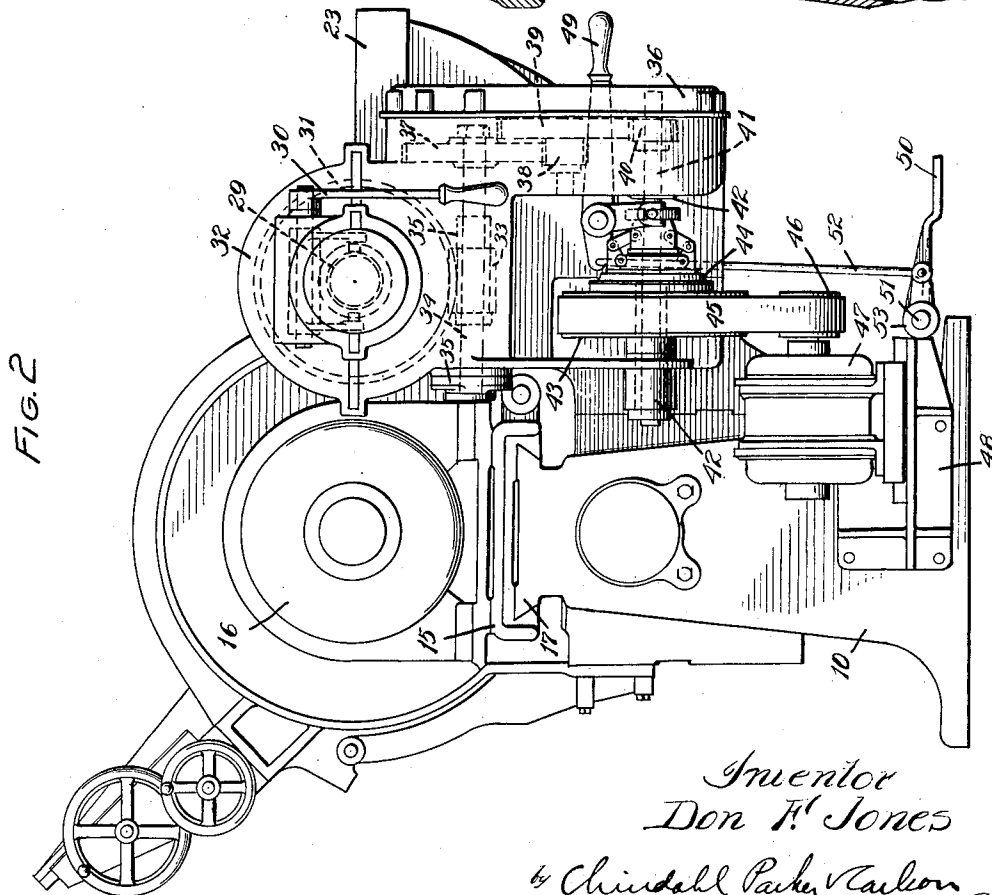
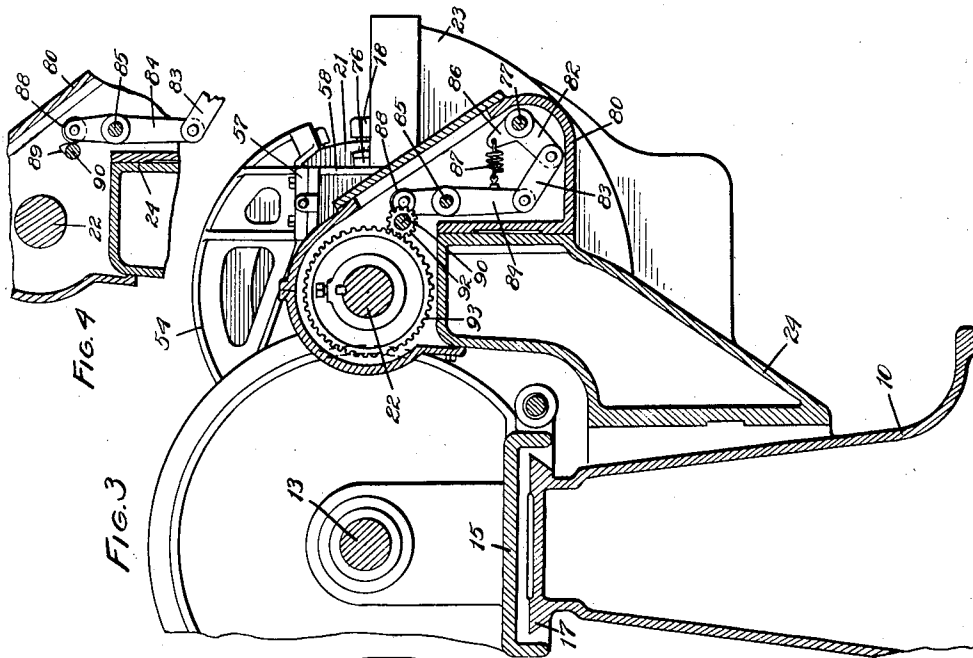
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4 Sheets-Sheet 2



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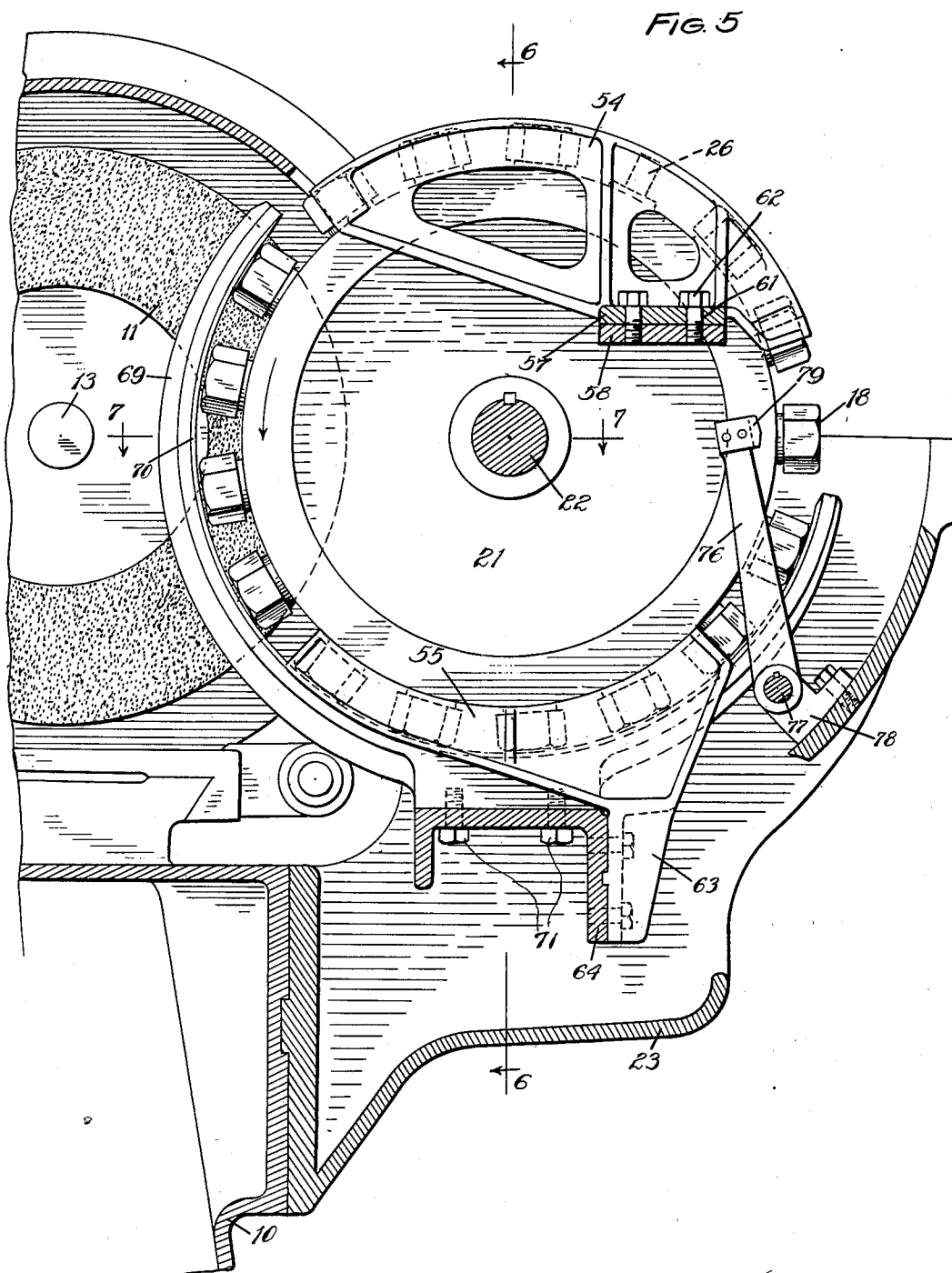
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4 Sheets-Sheet 3



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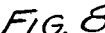
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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GRINDING MACHINE

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Application November 17, 1928
Serial No. 320,091

9 Claims. (Cl. 51—118)

The present invention relates to improvements in grinding machines, and particularly grinding machines having flat-faced grinding elements.

The primary object of the present invention resides in the provision of a novel grinding machine for automatically grinding objects having a plurality of flat surfaces disposed at different angles, such as nuts, and spark plug bodies.

The surfaces to be ground may be spaced or contiguous, may be odd or even in number, and may be provided in different arrangements, for example, in parallel relation, as in hexagon nuts, or in non-parallel relation, as in five-sided nuts. Where parallel-sided work pieces are to be ground, it is desirable to provide opposed parallel grinding elements defining a grinding zone through which the work pieces are to be carried in series. For odd-sized work pieces, a single grinding element is employed. In either event, the flat grinding area serves to locate the work pieces properly while passing through the grinding zone.

An important object resides in the provision of a novel power-driven carrier for carrying a plurality of work pieces in series through the grinding zone, and of novel guide means for retaining the pieces on the carrier and for properly positioning the same thereon when out of the grinding zone.

Another object resides in the provision of new and improved means for automatically indexing the work pieces so as to present different surfaces thereof for grinding contact in successive movements through the grinding zone.

A further object resides in the provision of novel means operable in timed relation to the movement of the carrier to discharge the finished work pieces therefrom. Preferably, the operation of the discharge means in timed to discharge every Nth work piece, where N equals the number of times that the piece must be carried through the grinding zone to grind all of its surfaces, and the number and arrangement of the work loading positions on the carrier are such that the discharge means will act at each position.

Another object is to provide a single drive for the carrier and the discharge means and a friction clutch in the drive operable at will to start or stop the carrier without disturbing the timing between said carrier and said means.

Various general objects of the invention reside in the provision of a new and improved grinding machine which permits of grinding work pieces of the foregoing character accurately, quickly

and at a nominal expense, which is efficient and fool-proof in operation, and which is relatively simple and inexpensive in construction.

Further objects and advantages will become apparent as the description proceeds.

In the accompanying drawings, Fig. 1 is a front elevation of a grinding machine embodying the features of my invention.

Fig. 2 is a left end view of the machine.

Fig. 3 is a fragmentary sectional view taken along line 3—3 of Fig. 1.

Fig. 4 is a fragmentary sectional view taken along line 4—4 of Fig. 1.

Fig. 5 is a fragmentary sectional view taken along line 5—5 of Fig. 1.

Fig. 6 is a fragmentary sectional view taken along line 6—6 of Fig. 5.

Fig. 7 is a fragmentary sectional view taken along line 7—7 of Fig. 5.

Fig. 8 is a fragmentary detail view of the means for indexing the work pieces.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more specifically to the drawings, the grinding machine constituting the exemplary embodiment of the invention comprises a base 10 of suitable construction. Mounted on the left end of the base 10 is a rotary grinding element 11 having a flat grinding end face. Preferably, a second grinding element 11 is mounted on the right end of the base 10, and the two elements are arranged in parallel opposed relation, preferably in axial alignment, to define a grinding zone 12 (see Fig. 7). The grinding elements 11 are suitably mounted on spindles 13 which are suitably journaled in bearings 14 on carriages 15 and which are adapted to be connected to a suitable source of power, such as motors 16 mounted on the outer ends of the carriages. The carriages 15 are slidably adjustable, axially of the spindles 13, on suitable guides 17 formed on the base 10.

The grinding machine is adapted to grind a large variety of work pieces, and is especially adapted to grind a plurality of flat peripherally arranged surfaces. These surfaces may be odd or even in number, contiguous or spaced, and parallel or non-parallel. If an odd number of surfaces,

or non-parallel surfaces, are to be ground, only one of the grinding elements 11 is employed, the other element being adjusted out of operative position. If the surfaces to be ground are formed in parallel pairs, both grinding elements 11 may be employed. Selective engagement of the work pieces with one or both of the grinding elements serves to hold the work pieces accurately in grinding position.

For illustration, a plurality of hexagon nuts 18 are shown as the work pieces. Each nut 18 has a central bore 19, smooth or threaded, and peripheral side surfaces 20 to be ground.

Any suitable means may be provided for carrying the work pieces in series through the grinding zone 12. In the present instance, this means comprises a rotary carrier 21 in the form of a thin circular disc which is mounted on a shaft 22 extending parallel to the spindles 13, and which projects peripherally into the grinding zone 12. The lower portion of the carrier 21 is enclosed in a suitable housing 23 formed integral with a bracket 24 secured to the front of the base 10, and the shaft 22 is journaled in a bearing 25 formed in one side of the housing. The carrier 21 is provided with suitable work supporting means adapted to the specific character of the work pieces to be ground. In the present instance, this means comprises a plurality of radial studs 26 mounted in uniformly spaced relation on the periphery of the carrier 21, and adapted to fit closely in the bores 19 of the work pieces 18. Preferably, each stud 26 is threaded into the carrier 21, and has a shoulder 27 against which the inner face of the work piece is adapted to seat. Obviously, different work carriers 21 of different widths, and/or with different types and/or sizes of work supporting means may be substituted for different work pieces.

Any suitable means may be provided for rotating the carrier 21. In the present instance, the shaft 22 is journaled in suitable bearings 28 on the bracket 24, and is adapted to be connected through a jaw clutch 29, manually operable by a lever 30 to a worm wheel 31 freely rotatable thereon in a housing 32 on the bracket. The worm wheel 31 meshes with a worm 33 on a transverse shaft 34 suitably journaled in bearings 35. The forward end of the shaft 34 extends into a gear housing 36 on the bracket 24 in which it is connected through speed change gears 37, 38, 39 and 40 to a shaft 41 suitably journaled in bearings 42. Rotatably mounted on the shaft 41 is a pulley 43 adapted to be connected thereto by a friction clutch 44, and connected by a belt 45 to a pulley 46 on a motor 47. The latter is suitably mounted on a bracket 48 secured to the left end of the base 10. The friction clutch 44 is manually operable by means of a hand lever 49, and may be opened quickly by means of a foot lever 50 operatively connected through a rock shaft 51 and a link 52 to the hand lever. The shaft 51 is suitably journaled in bearings 53 on the base 10.

Suitable means is provided for positioning the work pieces 18 on the studs 26 and more particularly for holding the work pieces against rotation when outside of the grinding zone, and presenting the surfaces to be ground squarely to the grinding elements 11. This means comprises upper and lower side guide members 54 and 55 preferably arcuate in form and mounted closely to one side of the carrier 21 to align the adjacent sides of the work pieces with the grinding areas. Each of the guide members 54 and 55 is provided

with an arcuate liner 56 disposed next to the work pieces 18.

The upper guide 54 is formed integral with a bracket 57 mounted for adjustment toward and from the carrier 21 on a supporting bracket 58 secured to the housing 23. Preferably, this adjustment is effected by means of an adjusting screw 59 rotatably anchored in an upstanding lug 60 on the bracket 58, and having a threaded engagement with the bracket 57. To guide the bracket 57 in its adjustment, it is formed with a pair of elongated parallel slots 61 through which bolts 62 are threaded into the bracket 58.

The lower guide 55 likewise is formed integral with a bracket 63 mounted for adjustment toward and from the carrier 21 on a bracket 64 secured to one end wall of the housing 23. The adjustment may be effected by means of an adjusting screw 65 journaled in a lug 66 on the bracket 64, and having threaded engagement with the bracket 63. To guide the bracket 63 in its adjustment, it is provided with a pair of parallel elongated slots 67 through which bolts 68 are threaded into the bracket 63. Thus, the guides may be adjusted to accommodate work pieces of different sizes.

Suitable means is provided for holding the work pieces on the studs 26. This means comprises an end guide member 69 (see Fig. 5) arcuate in character and extending substantially around the under side of the carrier 21 and through the grinding zone 12, leaving only the upper forward portion of the carrier exposed to permit loading and removal of the work pieces. The end guide 69 is substantially the same in width as the carrier 21 and is provided with a liner 70 adapted to extend closely over the ends of the work pieces. The end guide 69 is secured to the bracket 64 as by means of bolts 71.

The work carrier 21 is rotated downwardly through the grinding zone 12 as indicated by the arrow in Fig. 5, and the studs 26 are loaded as they move upwardly out of the housing 23. To facilitate loading, the forward end of the upper liner 56 is deflected from the carrier 21 as shown in Figs. 1 and 8. It will be understood that the studs 26 may be loaded substantially at any point along the guide 54.

Means is provided for automatically indexing the work pieces 18 so as to present different surfaces to the grinding elements in successive movements through the grinding zone 12. To permit this indexing, the upper liner 56 is broken as indicated at 72 (see Fig. 8). In the present instance, the indexing means comprises a spring 73 secured at one end between the guide 54 and the liner 56, and bent at its other end to form a finger 74 extending through the opening 72 into the path of the work pieces 18. The guide 54 is recessed back of the free end of the spring 73 as indicated at 75 to permit lateral deflection of the latter. As each work piece passes the opening 72, the finger 74 engages one corner thereof to index the next surface to be ground into position.

Means is provided for automatically removing the finished work pieces from the carrier, and in the present instance this means is operable in timed relation to the rotation of the carrier. In the preferred form, this means comprises a pair of knock-off levers 76 which are secured at the lower ends to a rock shaft 77 journaled in bearings 78 in the housing 23 and which are disposed at opposite sides of the carrier to engage opposite sides of the work pieces. Suitable plates

79 are removably secured to the free ends of the levers 76. One end of the shaft 77 extends into a gear housing 80 secured to the bracket 24, and is journaled in a bearing 81 therein. Rigidly secured to the shaft 77 in the housing 80 is a lever 82 connected through a link 83 to the lower end of a lever 84 mounted intermediate its ends on a pivot shaft 85 suitably supported in the housing 80. The lever 82 has a heel 86 connected by a tension spring 87 to the lower portion of the lever 84. The upper end of the lever 84 is provided with a cam roller 88 which engages a suitable cam 89 on a cam shaft 90 journaled in bearings 91 in the housing 80. A pinion 92 on the shaft 90 meshes with a gear 93 on the shaft 22. It will be evident that the spring 87 serves to hold the cam roller 88 in engagement with the cam 89, and tends to hold the levers 76 away from the work pieces 18.

The cam 89 is designed to actuate the levers 76 at predetermined intervals. These intervals are such that each work piece 18 will be removed when it has been carried through the grinding zone 12 a sufficient number of times to be ground completely. Obviously, the intervals are determined by the number of sides 20 to be ground on the work pieces, and the number of cuts to be taken on each side. Different cams 89 may be substituted for different work pieces requiring different intervals for actuation of the levers 76. In the present instance, where the work pieces comprise three pairs of parallel sides and where but a single cut on each side is to be taken, the levers 76 are actuated to remove every third work piece. Obviously, any desired number of work pieces may be mounted on the carrier 21, and preferably the number is such that in continuous rotation of the carrier, the levers 76 will be actuated at the proper time at each loading position. In the present instance, seventeen work loading positions are provided so that the actuation of the levers 76 will be relatively advanced one position for each rotation of the carrier.

In operation, a carrier 21 suited to the work pieces to be ground, and a cam 89 for actuating the levers 76 at the desired intervals are provided. One or both of the grinding elements 11, as desired, are adjusted relatively to the carrier 21 to make the desired cut. The guides 54, 55 and 69 are adjusted to suit the work pieces. Assuming that hexagon nuts are to be ground, in starting up operation, the first nut is positioned on a stud 26 at which the levers 76 have just been actuated. Thereafter, a nut is positioned on every third stud. The levers 76 will not be actuated at a loaded stud until the carrier 21 is fully loaded, and thereafter will remove the nuts in the same sequence in which they were positioned on the carrier. As each stud 26 is unloaded, another nut is positioned thereon during its movement toward the grinding zone 12.

The carrier is rotated in the direction of the arrow in Fig. 5 to carry the work pieces in series through the grinding zone 12. The side guides 54 and 55 serve to position the work pieces correctly on the studs 26 so as to hold the surfaces to be ground parallel to the grinding elements 11 except when the work pieces are in the grinding zone. In the grinding zone 12, the grinding elements serve to hold the work pieces in position. The end guide 69 serves to hold the work pieces on the studs 26 in their movement from the loading position to the unloading position. As each work piece passes the finger 74, it is indexed thereby to position the next surface in the line of

grinding contact. After each work piece has been carried through the grinding zone 12 three times it is removed by the levers 76. If for any reason, it becomes desirable to stop the carrier 21 quickly, this can be accomplished by depressing the foot lever 50, and without disturbing the timed relation between the carrier and the kick-off levers 76.

It will be evident that I have provided a novel and advantageous grinding machine for polygonal sided work pieces. The operation is expeditious, and entirely automatic. The work pieces are ground accurately at a nominal expense. The machine is relatively simple and inexpensive in construction, and can be readily adjusted for different types and sizes of work pieces.

I claim as my invention:

1. A grinding machine for polygonal sided work pieces comprising, in combination, a grinding element, a work carrier for moving a plurality of the work pieces in series and in recurrent movements relatively over said grinding element, fixed guide means adjacent said carrier for holding the work pieces against turning as they approach and return from said grinding element, means for automatically indexing the work pieces after each recurrent movement, and means for automatically removing the finished work pieces.

2. A grinding machine for polygonal sided figures comprising, in combination, a grinding element defining a grinding field, a work carrier having a plurality of fixed peripherally spaced pins for rotatably supporting the work pieces and carrying them in series and in recurrent movements relatively across said grinding element, fixed guide means before and beyond said element for holding the work pieces against rotation when passing in and out of the grinding field, means for automatically indexing the work pieces to present different surfaces to the grinding element in successive recurrent movements, means for removing the finished work pieces, and means for driving said carrier and said last mentioned means in timed relation.

3. A grinding machine for polygonal sided work pieces comprising, in combination, a grinding element, a carrier having a plurality of work loading positions and adapted to carry the work pieces in series through the grinding zone in recurrent movements, the work loading positions on said carrier being other in number than a multiple of the number of recurrent movements necessary to grind the polygonal surfaces of the work pieces, means for indexing the work pieces to present different surfaces to the grinding element in successive recurrent movements, means for removing the finished work pieces from the carrier, and means for actuating said last mentioned means each time said carrier has moved a distance equal to the number of recurrent movements times the spacing between adjacent work loading positions.

4. A grinding machine for polygonal parallel sided work pieces comprising, in combination, a pair of opposed parallel flat faced rotary grinding elements, a rotary work carrier projecting peripherally into the space between said elements and adapted to carry a plurality of the work pieces in series through said space in recurrent movements, the number of work loading positions being other than a multiple of one-half of the polygonal sides of the work pieces, means for automatically indexing the work pieces on said carrier, means for removing the finished work pieces, and means for actuating said last men-

tioned means in timed relation to the movement of said carrier so as to unload every Nth work piece, where N equals one-half of the number of polygonal sides.

- 5 5. A grinding machine for polygonal sided work pieces comprising, in combination, a grinding element, a carrier having a plurality of work loading positions and adapted to carry the work pieces in series through the grinding zone in
- 10 recurrent movements, the work loading positions on said carrier being other in number than a multiple of the number of recurrent movements necessary to grind the polygonal surfaces of the work pieces, means for indexing the work pieces
- 15 to present different polygonal surfaces to the grinding element in successive recurrent movements, means for removing the finished work pieces from the carrier, and means for actuating said last mentioned means in timed relation to
- 20 the movement of said carrier so as to unload every Nth work piece, where N equals the number of recurrent movements necessary to grind all of the polygonal surfaces.
- 25 6. A grinding machine for polygonal sided work pieces comprising, in combination, a grinding element, a carrier disk having a plurality of equally spaced fixed work supporting means on its periphery, the work pieces being rotatable
- 30 on said means, fixed brackets mounted at one side of said disk to guide the work pieces, said brackets being effective to hold the work pieces against rotation before movement thereof into engagement with said element and after movement
- 35 thereof from engagement with said element, said brackets being adjustable toward and from said grinding element, and a fixed end bracket peripherally encircling the underside of said carrier and the portion of said carrier overlapping with said element.
- 40 7. A grinding machine for polygonal sided pieces comprising, in combination, a grinding element, a carrier having a plurality of work loading positions for carrying a series of work pieces successively through the grinding zone in
- 45 recurrent movements, the work loading positions

on said carrier being other in number than a multiple of the number of recurrent movements necessary to grind the polygonal surfaces of the work pieces, means for indexing the work pieces to present different sides to the grinding element in successive recurrent movements, a rock shaft, a pair of knock-off levers secured to said rock shaft and projecting across opposite sides of said carrier into position for selective engagement with the inner ends of the work pieces as they are moved into a predetermined position, and cam means operable in timed relation to the rotation of said carrier for actuating said knock-off levers to eject every Nth work piece, where N equals the number of recurrent movements necessary to grind all of the polygonal surfaces.

8. A grinding machine for polygonal sided work comprising, in combination, a grinding element, a rotary work carrier having peripheral work holders for recurrently moving a plurality of work pieces in succession over said grinding element, segmental guides beside and corresponding in arcuate shape to the periphery of the carrier for preventing turning of the work pieces as they approach and after they leave the grinding element, and means for automatically indexing the work pieces after each recurrent movement.

9. A grinding machine for polygonal sided work comprising, in combination, a pair of grinding wheels, a rotary work carrier projecting between said wheels and having peripheral work holders for recurrently moving a plurality of work pieces in succession between said grinding wheels, segmental guides extending beside the periphery of the carrier at diametrically opposite sides of the carrier, to prevent turning of the work pieces as they approach and after they leave the space between the wheels, a segmental end guide extending outside of the work holders and between the grinding wheels, and means for automatically indexing the work pieces after each recurrent movement.

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