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J. L. PERKINS ET AL

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FIG. 1.

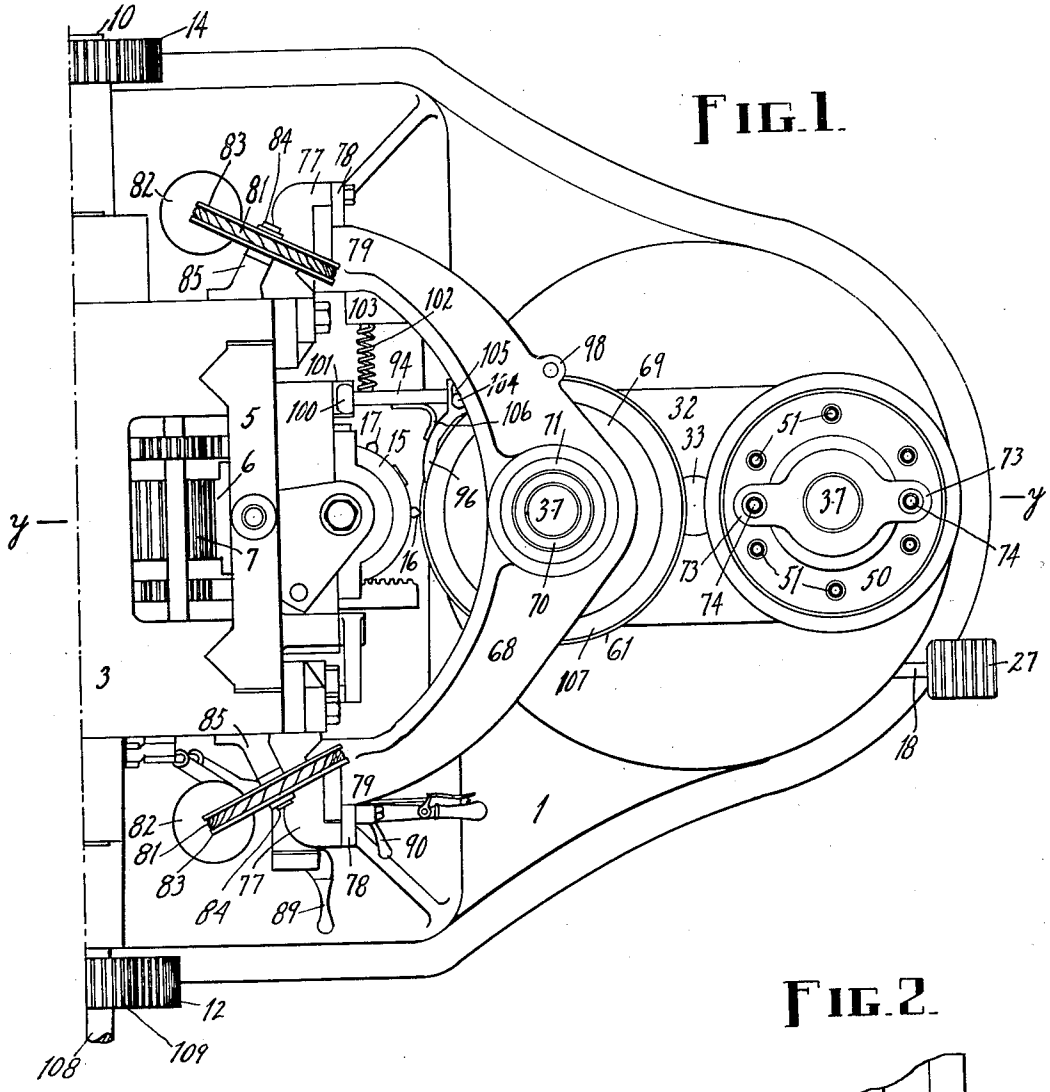
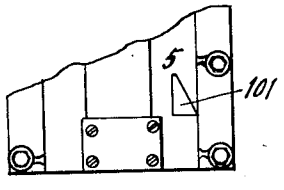


FIG. 2.



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FIG. 3.

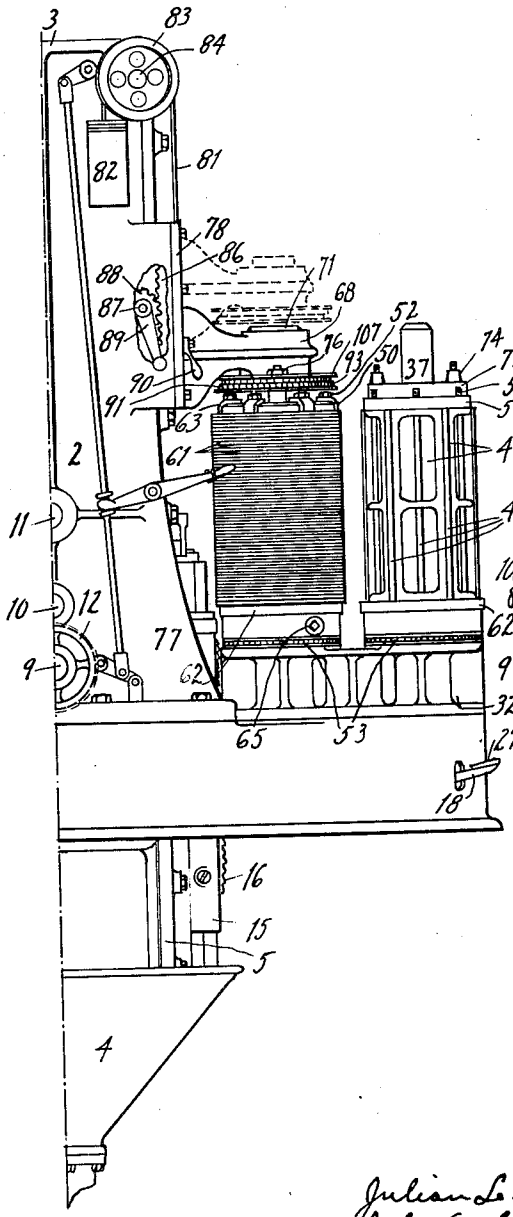
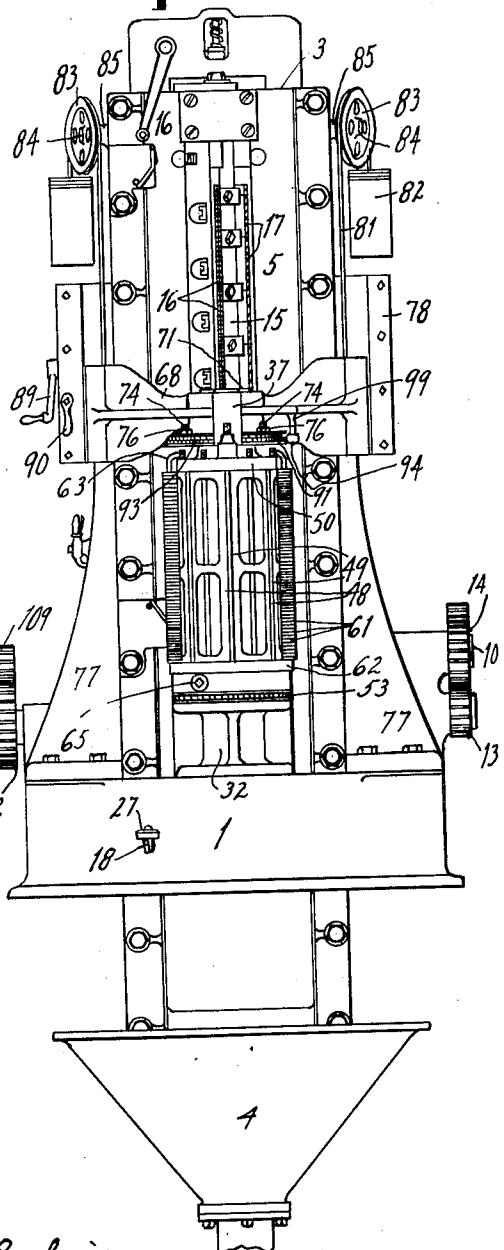


FIG. 4.



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FIG. 5.

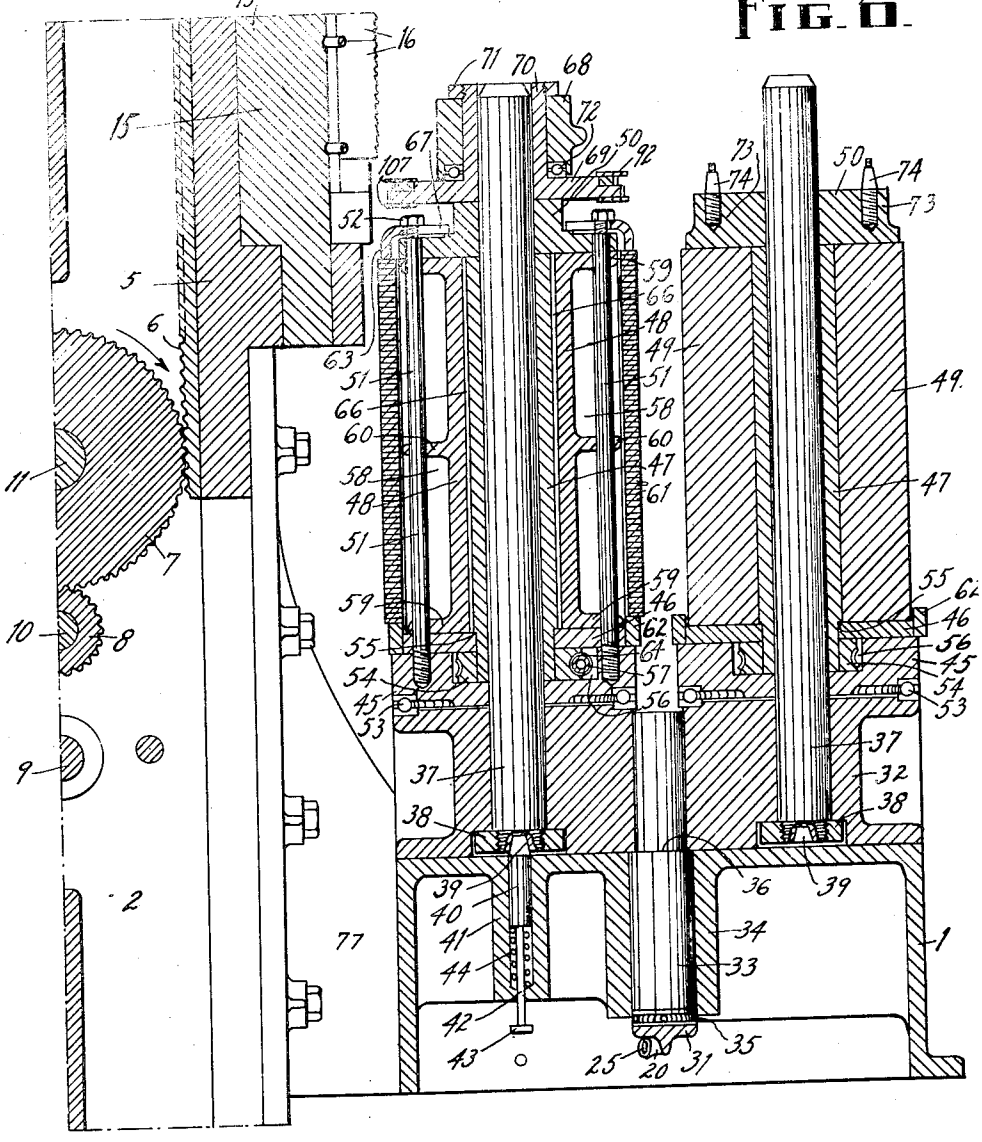
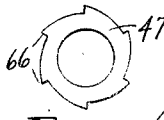


FIG. 6.



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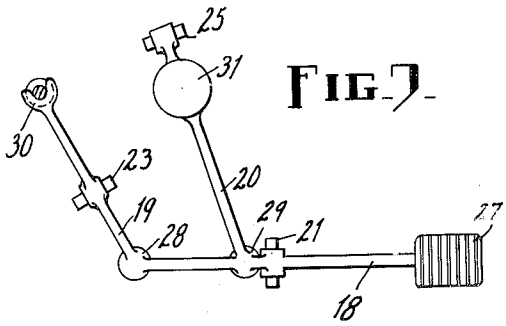


FIG. 7.

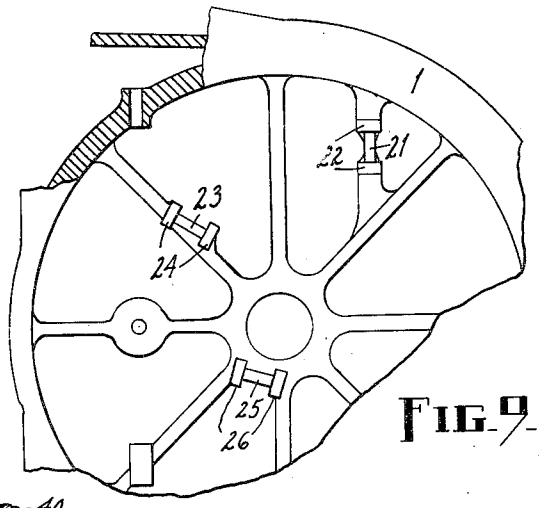
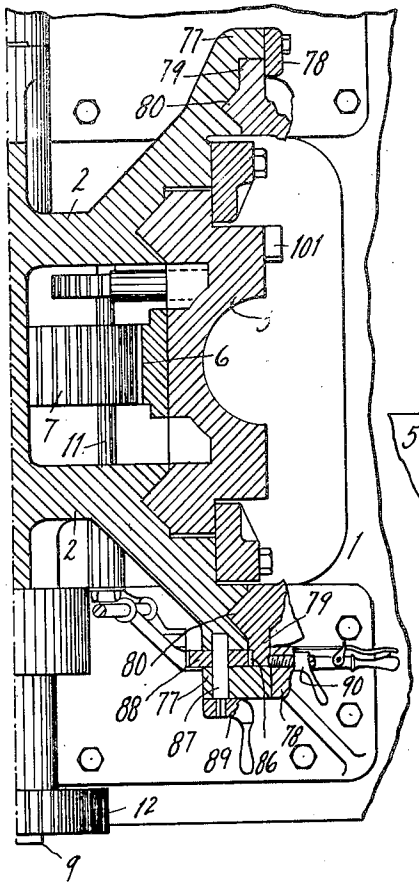


FIG. 9.

FIG. 8.



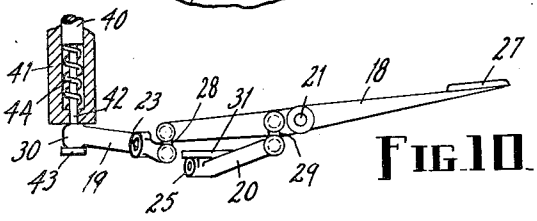


FIG. 10.

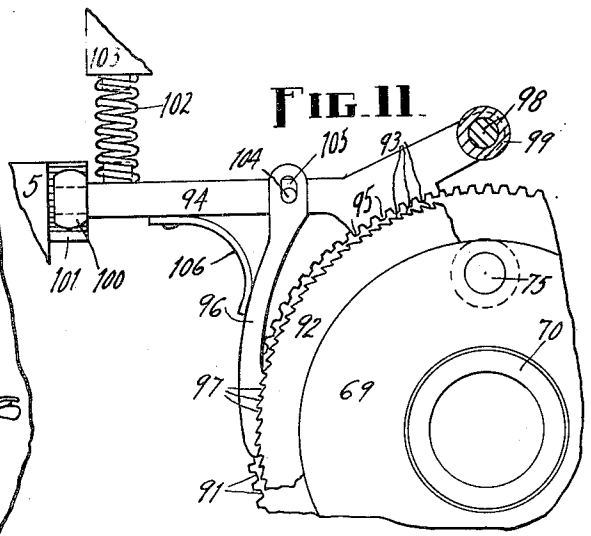


FIG. 11.

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BY Hiram M. Croft,

Frank A. Cutter, ATTORNEY.

Patented Nov. 25, 1924. 1,516,984

UNITED STATES PATENT OFFICE.

JULIAN L. PERKINS, OF WEST SPRINGFIELD, AND JOHN OAKLEY, ROBERT A. WILSON, AND HIRAM D. CROFT, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNORS TO PERKINS APPLIANCE COMPANY, OF SPRINGFIELD, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

INDEX.

Original application filed February 13, 1922, Serial No. 536,160. (Patent No. 1,486,604.) Divided and this application filed July 9, 1923. Serial No. 650,404.

To all whom it may concern:

Be it known that we, JULIAN L. PERKINS, JOHN OAKLEY, ROBERT A. WILSON, and HIRAM D. CROFT, all citizens of the United States of America, said PERKINS being a resident of West Springfield, in the county of Hampden and State of Massachusetts, and said OAKLEY, WILSON, and CROFT being residents of Springfield, in said county and State, have jointly invented a new and useful Index, of which the following is a specification.

Our invention relates to improvements in automatic indexing mechanisms for work holders, and comprises a certain novel arrangement and combination of indexing elements carried by removable supporting means for a work holder in operative position, and means to attach said indexing elements to and detach them from said work holder, this mechanism being usually employed in connection with a pair or plurality of work holders mounted on a turn-table whereby said work holders can be located alternately in said operative position, all as hereinafter set forth.

This index is especially well adapted for a vertical broaching machine, such as that which forms the subject of Letters Patent of the United States issued March 11, 1924, No. 1,486,604, of which this application is a divisional part, although said index is not limited to machines of that type.

The primary object of our invention is to provide comparatively simple means for indexing vertical, rotary work holders, and to provide such means that are applicable or adaptable for use in connection with work holders which are arranged in pairs or pluralities and sequentially moved into operative position.

Another object is to produce an index of this character which is automatic in action on the connected work holder, and which can be readily connected with and disconnected from either or any work holder, raised above or out of engagement with the same, and lowered into engagement therewith.

Other objects and advantages will appear in the course of the following description.

A preferred embodiment of the invention, whereby we attain the objects and secure the advantages of the same, is illustrated in the accompanying drawings, and we will proceed to describe the invention with reference to said drawings, although it is to be understood that the form, construction, arrangement, etc. of the parts in various aspects are not material, and may be modified without departing from the spirit of the invention.

In the drawings, in which similar reference characters designate similar parts throughout the several views, Figure 1 is an enlarged, top plan of an index which embodies our invention as aforesaid, showing the same applied to a broaching machine; Fig. 2, an enlarged, fragmentary detail of the broach carrier with the index cam-block affixed thereto; Fig. 3, a side or what may be termed front elevation of said machine and index, with a part of the frame broken out to disclose interior elements; Fig. 4, an end elevation of said machine and index; Fig. 5, an enlarged, vertical section through the machine and index, with top and bottom portions omitted, such section being approximately in the vertical, longitudinal center or work plane of the machine; Fig. 6, a top plan of the cam sleeve; Fig. 7, an enlarged, top plan of the manually-operated and pedally-operated lever mechanism with which the machine is equipped; Fig. 8, an enlarged, transeverse section through a portion of said machine showing details of said indexing; Fig. 9, an enlarged, bottom plan of a portion of the base of the frame of the machine, showing the pivots and their bearing lugs or certain of the elements in said manually-operated and pedally-operated lever mechanism; Fig. 10, a side elevation of said mechanism as shown in Fig. 7, and, Fig. 11, an enlarged detail, in top plan, of certain of the indexing parts and members.

The cutting or work plane hereinbefore referred to is on lines y—y in Fig. 1.

The machine illustrated in the aforesaid application is a double or duplex machine throughout, and the mechanism on either side of the transverse center of said machine forms a complete unit. In the present case we have shown only one of such units, the same being the right-hand unit.

It will be desirable, not to say necessary, to describe briefly the broaching machine to which our index is applied, and also to describe quite fully the work-holding elements

with which said index is closely associated, before describing the index itself.

The frame of the machine comprises a base 1, and two uprights 2 mounted on said base, and connected at the top by a member 3. The uprights 2 extend below the floor line into a receptacle 4 for waste oil and chips. The frame also comprises bearing and other parts of which particular mention will be made as or when necessary.

For the sake of convenience in describing the machine, the side illustrated in Fig. 3 will be considered as the front and the opposite side as the rear.

The machine is provided with a vertical broach carrier 5 arranged to slide up and down in contact with the outer edges of the uprights 2. On the inside of the carrier 5 in the transverse center thereof is a rack 6 with which a gear 7 intermeshes. The gear 7 is driven by a gear 8. Journaled in the uprights 2 and in suitable bearings with which said uprights are provided, one above the other in the order named, are horizontal shafts 9, 10, and 11. Secured on the forward terminal of the shaft 9 is a main driving gear 12. Secured on the rear terminal of the shaft 9 is a pinion 13, and such pinion intermeshes with a gear 14 secured on the rear terminal of the shaft 10. The gears 8 and 7 are respectively secured to the shafts 10 and 11. Thus means are provided for reciprocating the rack 6 and the carrier 5.

A broach holder 15 is mounted to oscillate on its vertical axis in the carrier 5. Secured within the holder 15 in different radial planes thereof are pluralities of roughing and finishing broaches 16 and 17, respectively. The broaches 16 cut on their down stroke and the broaches 17 cut on their up stroke. Operatively either the roughing broaches or the finishing broaches are in the work plane *y—y*, the holder 15 being oscillated between strokes.

There are two supporting and carrying elements for the work, and provision is made for transposing the positions of the same so that either can be operatively located relative to the holder 15. Before describing these elements briefly, attention is called to an approximately horizontal treadle 18, and to two approximately horizontal levers 19 and 20. The treadle 18 is pivotally connected at 21 with a pair of lugs 22 with which the base 1 is provided on the inside; the lever 19 is pivotally connected at 23 with a pair of lugs 24 with which said base is also provided on the inside; and the lever 20 has its inner end pivotally connected at 25 with a pair of lugs 26 with which said base is further provided. The treadle 18 extends outwardly through a slot in the outer end of the base, and is provided at such outer terminal with a footpiece 27. The outer end of the lever 19 has a ball-joint connection 28 with the inner end of the treadle 18, and a ball-joint connection 29 is provided between the outer end of the lever 20 and said treadle adjacent to the pivot 21 and between said pivot and said first-named ball-joint connection. The lever 20 has an inner, forked terminal 30, and is provided on top adjacent to the pivot 25 with a plate or stirrup 31.

A normally-stationary turn-table 32 is mounted on the base 1. The turn-table has a central, vertical shaft 33 which is journaled directly above the stirrup 31 in a bearing 34 in the base 1, with a ball-bearing 35 between said stirrup and the bottom of said shaft. The portion of the shaft 33 that is in the bearing 34 is larger than that portion of said shaft in which the turn-table is directly mounted, so that a shoulder 36 is formed on said shaft. Normally the turn-table rests directly on top of the base, and the shoulder 36 is then in the same plane with said top. The axis of the shaft 33 is in the work plane of the machine.

Rising from the turn-table 32, on opposite sides of the shaft 33, are two vertical shafts 37. The shafts 37 have screw-threaded bases with which nuts 38 are connected to anchor said bases in the turn-table. Within the axial centers of the aforesaid bases of the shafts 37 are openings 39. The opening 39 in either shaft is adapted to receive the upper terminal of a lock pin 40. When either shaft 37 is engaged by the pin 40, such shaft and its companion are located with their axes in the work plane *y—y*. The pin 40 is in position to engage the inner shaft 37, the same being the shaft which is a part of the holder for the work actually being operated on.

The pin 40 is slidingly arranged in a hollow member 41 that depends from the top of the base 1 in the work plane *y—y* and at the left of the bearing 34, said pin is provided with a stem 42 that extends downwardly from the bottom of the pin and through the bottom of the member 41. The stem 42 has a head 43 at the lower end. A spring 44 is interposed between the bottom of the pin 40 and the bottom of the main passage in the member 41, and normally actuates said pin upwardly and retains it in engagement with the shaft 37 above. The fork 30 of the lever 19 engages the stem 42 above the head 43.

In order to rotate the turn-table 32 about its axis, for the purpose of changing the relative positions of the work holders, or, in other words, to interchange the positions of the shafts 37, it is first necessary to unlock said turn-table by withdrawing the pin 40 from the opening 39 in the left-hand shaft 37, and then raise said turn-table on the shoulder 36 from the base 1. These results are accomplished by placing

the foot on the part 27 and actuating the treadle 18 to rock upwardly the connected terminals of the levers 19 and 20. Since the connection 28 is farther from the pivot 21 than is the connection 29, and the fulcrum of the lever 19 is nearer said connection 28 than is the fulcrum of the lever 20, the forked terminal 30 of said lever 19 moves more quickly and through a greater space than does the stirrup 31 which is on the lever 20 quite near to the inner fulcrumed terminal of the same, when the portion of said treadle with which said levers are connected is elevated. Consequently, the first effect of the depression of the outer terminal of the treadle 18 is to rock the lever 19 in such a manner as to carry the fork 30 thereof downwardly and so withdraw the pin 40 from engagement with the shaft 37 above, through the medium of the head 43 and the stem 42, and against the resiliency of the spring 44. And the second effect of the movement imparted by the foot to the treadle is to raise the lever 20 and the stirrup 31. The upward movement of the stirrup 31 is transmitted through the ball-bearing 35 to the shaft 33, and the latter is elevated and carries up with it the turn-table 32 and all of the parts and members supported thereby. When the turn-table is thus elevated the same can be rotated on and with the shaft 33 on the ball-bearing 35.

After the turn-table 32 has been given by hand a half revolution, the treadle 18 is released, and said turn-table settles down again by gravity onto the base 1, and at the same time the spring 44 forces the pin 40 upwardly into the opening 39 into the base of the newly-presented shaft 37.

Each shaft 37 is the axis of the work holder which comprises, besides said shaft, a base 45, a disk 46, a cam sleeve 47, six segmental spacers or separators 48, the same number of friction bars 49, a head 50, and six rods 51 and nuts 52 therefor, together with certain other parts and members hereinafter mentioned, as illustrated more particularly in Fig. 5. A ball-bearing 53 is interposed between the turn-table 32 and the base 45. The cam sleeve 47 has a worm-wheel 54 secured to the base thereof, and said sleeve is shouldered at 55 to receive beneath the shoulder the edge of the opening in the plate 46 provided for the passage of that portion of the sleeve which is between said shoulder and said worm-wheel. The worm-wheel 54 operates in a central opening 56 in the top of the base 45. A worm 57 in the opening 56 intermeshes with the worm-wheel 54. The disk 46 rests on the base 45 above the worm-wheel 54, and the separators 48 and bars 49 rest at their lower ends on said plate. The head 50 is on top of the cam sleeve 47 and the separators 48. The separators consist in part of radial arms 58, and one of the rods 51 is located between such arms of each separator, and there are top and bottom webs 59 and an intermediate web 60 which connect the arms of each separator, and through which said rod passes. The rods also pass through a flanged portion of the cap 50 and the plate 46 to be tapped into the base 45. The bars 49 are slidingly arranged, between adjacent separators 48, on the plate 46 and under the head 50. The work, consisting in this case of a plurality or multiplicity of ring-gear blanks 61, is passed over the head 50 and down around the arms 58 and bars 49, with the bottommost blank resting on a supporting ring 62 that is secured to the periphery of the disk 46. The blanks 61, after being piled or stacked one on top of the other around the arms 58 and bars 49, are aligned and formed into a hollow cylinder which is concentric with the work holder, and frictionally secured by means of the cam sleeve 47, after which clamps 63, there being as many of such clamps as there are rods 51, are placed in position for the further security of the stack of blanks.

The worm 57 is mounted on a shaft 64 journaled at both terminals in the base 45, and has at one end a squared head 65, Figs. 3 and 4, to receive a wrench (not shown). Upon revolving the worm 57, through the medium of the shaft 64, the worm-wheel 54 is rotated with the cam sleeve 47. Formed on the periphery of the cam sleeve 47 are cams 66, Fig. 6, one such cam for each friction bar 49, and such cams are so arranged on their sleeve that they actuate said bar outwardly when said sleeve is rotated to the right, and permit said bars to move inwardly when said sleeve is rotated in the opposite direction. The depth of the bars 49 is sufficient to enable them to be forced hard against the blanks 61, when said bars are actuated outwardly by the cams 66, and firmly to engage said blanks and hold them securely in place, at the same time exactly aligning and disposing the same concentrically with the sleeve 47 and its shaft 37. The cams 66 clear the spacers 48.

Each clamp 63 is an angular member adapted to bear with the bottom edge of its vertical part on the uppermost blank 61, and with its horizontal part on the flange of the head 50, said horizontal part being slotted at 67 to accommodate the upper-terminal portion of one of the rods 51. After the blanks 61 have been stacked to the required height, or until approximately level with the tops of the separators 48, the clamps 63 are slipped into place beneath the nuts 52 on the rods 51, with the depending parts of said clamps bearing on the top of the uppermost blank, and said nuts

are screwed down tightly onto said clamps, thus forcing the latter hard against the blanks. Inasmuch as the rods 51 are screwed into the base 45, when the nuts 52 are screwed down tightly, all of the members through which said rods pass are securely tied together. The binding force now exerted by the clamps 63 on the blanks 61, added to the frictional engagement existing between the bars 49 and said blanks, causes the latter to be so secured and rigidly held in place on their supporting members that any movement of any blank independent of the holder is rendered impossible.

After the blanks 61 have been cut and formed into gears, they are released so that they can be removed from their holder, by loosening the nuts 52 and removing the clamps 63, and revolving the worm 57 in the direction to rotate the worm-wheel 54 to the left. The rotation of the worm-wheel 54 to the left, and the consequent rotation in the same direction of the cam sleeve 47, removes the pressure from the inner edges of the bars 49 and loosens said bars sufficiently to enable the completed gears to be lifted off of the holder.

After the blanks 61 have been placed in position on and secured to their holder, it is necessary to supply a bearing for the upper end of the shaft 37 of such holder, wherefore a horizontal, vertically-movable yoke 68 is provided. With this yoke is incorporated the indexing mechanism for the holder and its blanks below. Such mechanism consists in part of a disk 69 having an upwardly-extending sleeve 70. The disk 69 and its sleeve are bored to fit the upper terminal of the shaft 37, and said sleeve is screw-threaded at the top to receive a nut 71. The disk 69 when in operative position rests on the head 50. The central portion or hub of the yoke 68 is embraced between the nuts 71 above and a ball-bearing 72 below, which latter is interposed between the disk 69 and said hub. The disk 69 is, therefore, free to rotate beneath the hub of the yoke 68 and on or with the shaft 37. The above-mentioned parts and members can be seen to good advantage in Figs. 1 and 5. In the present example the shafts 37 are loosely journaled to enable them to rotate, and the parts and members mounted directly on said shafts are free thereon so that independent movement between them and the shafts is possible, but it is obvious that said shafts might be secured against rotation in their bearings, or said parts and members might be secured to said shafts, since the required results in any case would be obtained.

The head 50 has two oppositely-disposed lugs 73, from which rise two posts or studs 74. The protruding portions of the studs 74 are tapered in part and end in screw-threaded terminals at the top. Tapered openings, one of which appears at 75 in Fig. 11, are provided in the index disk 69 to receive the protruding portions of the studs 74. Nuts 76, Figs. 3 and 4, are screwed onto the studs 74 above the disk 69. It is now clear that rotary motion imparted to the disk 69 must be communicated to the head 50 and rigidly attached parts and members, including the blanks 61.

Referring more particularly to Figs. 3, 4, and 8, it will be seen that forwardly- and rearwardly-extending wings 77 are provided on the oblique webs at the outer ends of the uprights 2, and that these wings, together with gibs 78—78 which are bolted to the faces of said wings, afford vertical ways or guides for the inner terminals of the arms of the yoke 68, such terminals being indicated at 79—79 in Figs. 1 and 8, and there appearing also in Fig. 8 vertical, V-shaped guides 80—80 that fit and slide in corresponding grooves in said wings.

The yoke 68 is counterweighted. Two cables 81 are attached at their lower terminals to the arms of the yoke, and counterweights 82—82 are attached to the other terminals of said cables, the latter passing over idlers 83—83 that are loosely mounted on horizontal studs 84—84 supported at the proper angles by bearings 85—85 which project from the outer faces of the uprights 2, near the top and adjacent to the right-hand ends of said uprights. The counterweights 82 enable the yoke 68 to be moved up and down with the application of comparatively little power.

On the inner face of that portion of the front yoke arm 79 that slides between the front wing 77 and the front gib 78 a vertical rack 86 is provided, and a short, horizontal shaft 87 is journaled in the front-edge portion of said wing, and has secured thereon a pinion 88 which intermeshes with said rack, Figs. 3 and 8, said wing being recessed to accommodate said pinion. A crank 89 is secured to the front terminal of the shaft 87, which terminal extends forwardly beyond the front wing 77. When the crank 89 is turned in one direction, the yoke 68 is elevated, through the medium of the shaft 87, pinion 88, and rack 86, and when said crank is turned in the opposite direction said yoke is lowered, through the same medium as before.

In order to lock the yoke 68 at any desired elevation, or secure the same against possible accidental descent, a lock-screw 90 is tapped into the outer face of the front gib 78 and arranged to bear with its inner terminal against the corresponding face of the adjacent yoke terminal 79. This lock-screw 90 is provided with the usual handle. When the lock-screw is turned inwardly to bear forcibly against the yoke terminal 79,

it prevents the yoke from moving downwardly, but upon loosening said screw the yoke may be freely moved in either direction. The lock-screw 90 appears in Figs. 1, 3, 4, and 8.

After the blanks 61 have been placed in position on and secured to their holder, the yoke 68 with the indexing elements is let down, by means of the pinion 88 and rack 86, over the upper terminal of the shaft 37 and onto the head 50 of said holder, said shaft terminal being received in the disk 69 and its sleeve 70. The sleeve 71 is really a hub of the disk 69 for either shaft 37. It may be necessary partially to rotate the disk 69 in order to bring the openings 75 in said disk into line with the studs 74 below, enable said studs to enter said openings, as the yoke descends, and permit said disk to come to rest on the top of the head 50. Two of the nuts 76 are then screwed onto the studs 74 above the disk 69. After the yoke has been lowered into operative position, it is secured by means of the lock-screw 90.

After the blanks 61 have been broached and converted into gears, the nuts 76 are taken off, the lock-screw 90 is loosened, and the yoke 68 with the indexing elements is raised clear of the holder, upon which said gears are mounted, into position such as is indicated by dotted lines in Fig. 3. The turn-table 32 is then operated to move the aforesaid holder from beneath the yoke, and the gears are released and removed from the holder.

The yoke 68 is in a sense a work-holder element, and also in a sense an index element, inasmuch as the offices of said yoke are to center the upper terminal of either work-holder shaft, and to carry the indexing mechanism exclusive of said yoke itself, the latter with said mechanism being removable from and replaceable on either work holder.

The yoke supplements the associated lock-pin 40 in preventing the turn-table from rotating.

Having special reference to Fig. 11, it will be seen that there are therein illustrated a fragment of the disk 69, which disk is provided with peripheral lock-teeth 91, and a fragment of a ring 92 having on its periphery ratchet-teeth 93 that are set inwardly a little from said lock-teeth, a horizontal arm 94 provided on the front edge with teeth 95 that are adapted to intermesh with said first-named teeth, and a horizontal pawl 96 having on the right-hand edge near the free terminal thereof teeth 97 that are adapted to engage with said ratchet-teeth. The outer terminal of the arm 94 is pivotally connected at 98 with a bearing boss or lug 99 on the underside of the yoke 68, and said arm is provided at its inner terminal with a roll 100. The roll 100 is in the path of a cam-block 101 secured to the carrier 5—see Figs. 1, 2, 8, and 11.

The cam-block 101 is attached to the outer face of the carrier 5 adjacent to the rear edge and near the bottom of said carrier, so that, when the latter ascends and as it approaches the end of its upward travel, said cam-block encounters the roll 100 and swings the index arm 94 rearwardly on its pivot 98, against the resiliency of a spring 102 interposed between the rear edge of said arm and a lug 103 projecting inwardly from the rear arm of the yoke near the inner end thereof; and, when said carrier descends and said block passes away from said roll, said index arm is actuated forwardly on said pivot by said spring. The teeth 95 are located a short distance from the pivot 98, and between said teeth and the roll 100 is a vertical stud 104 which is set in the top of said arm. The pawl 96 extends forwardly from the arm 94, and is provided adjacent to its rear end with a slot 105 to receive the stud 104. A spring 106 is arranged between the arm 94 and the pawl 96 in such a manner as to actuate the latter toward the ring 92 and retain the teeth 97 in engagement with the ratchet-teeth 93. The ring 92 is let into an annular peripheral channel in the top of the disk 69, and secured therein to said disk. Two guard rings 107 are attached to the disk 69 and ring 92 above and below the lock-teeth 91 and the ratchet-teeth 93, respectively, and extend a short distance beyond said teeth to protect the same from chips and dirt that might otherwise come into contact with said teeth during the cutting operation of the machine.

Normally the stud 104 is somewhat remote from the rear end of the slot 105, consequently the first effect of the rearward movement imparted to the arm 94, by the cam-block 101, is to withdraw the teeth 95 from the lock-teeth 91 and thus unlock the disk 69. Then the stud 104 encounters the rear end of the slot 105, and, through the medium of the pawl 96 with its teeth 97, which latter engage the ratchet-teeth 93, causes the disk 69 with the work holder and work below to be partially rotated on the axis of said holder. The movement thus imparted to the disk and work holder is equal to the distance between two adjacent tooth slots cut or to be cut in the blanks 61. When the arm 94 swings forwardly again, under the influence of the spring 102, after being released by the cam-block 101, the teeth 95 first engage the lock-teeth 91 and so cause the disk 69 and the work holder and blanks below to be held against further rotation on the axis of said holder, and then the stud 104 is carried forwardly away from the rear end of the slot 105 and into contact with the front end of said slot, and

actuates the pawl 96 forwardly, the pawl teeth 97 clicking past the ratchet-teeth 93, until said teeth 97 have made a new engagement with said ratchet-teeth in readiness for the next indexing operation. The slot 105 must be of sufficient length to enable the teeth 95 to be disengaged entirely from the lock-teeth 91, at the time the arm 94 is swung rearwardly.

While the blanks on the holder in the cutting field are being cut, a stack of blanks is placed on the outermost holder, and secured by means of the cam sleeve 47 and the clamps 63 and nuts 52 of said holder.

At the end of the gear-cutting operation performed on the first stack of blanks, the yoke 68 with attached indexing parts and members is elevated by means of the crank 89, pinion or gear 88, and rack 86, after first loosening the lock-screw 90. Then the treadle 27 is operated to withdraw the lock pin 40 from engagement with the turn-table 32, and to raise said turn-table, when the latter is given a half revolution on its shaft 83 to remove the newly-formed gears from the cutting field, and to carry into such field the new set or stack of blanks. The turn-table is now permitted to descend onto the base 1, and the yoke 68 is actuated downwardly onto the inner work holder and the indexing members are connected with said holder. Finally the nuts 52 and friction bars 49 are loosened and the clamps 63 removed, and the gears are taken from the work holder which at this time is the outermost holder.

The carrier 5 is represented in its high position in Fig. 4, and in its low position in Figs. 3 and 5, but this difference in positions is immaterial so far as the present invention is concerned.

In Figs. 1 and 4 a fragment of a motor shaft and a pinion are respectively represented at 108 and 109, said pinion intermeshing with the main driving gear 12.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination, in an index, with a support, a turn-table mounted on and adapted to be rotated above said support, revoluble work holders mounted on said turn-table, and means to lock said turn-table with either of said work holders in operative position, of removable supporting means for the top of the work holder which is in operative position, and indexing mechanism carried by said last-named means, for the holder supported thereby.

2. The combination, in an index, with a support, a turn-table mounted on and adapted to be rotated above said support, revoluble work holders mounted on said turn-table, and means to lock said turn-table with either of said work holders in operative position, of removable supporting means for the top of the work holder which is in operative position, indexing mechanism carried by said means for the holder supported thereby, and means to attach said indexing mechanism to and detach it from said last-named work holder.

3. The combination, in an index, with a support, a turn-table mounted on and adapted to be rotated above said support, and revoluble work holders mounted on said turn-table, said turn-table being adapted to locate either of said work holders in operative position, of upright supporting means, a yoke having its arms slidingly connected with said supporting means, and adapted to engage the top of the work holder which is in operative position, and indexing mechanism carried by said yoke, and adapted to be attached to and detached from said last-named work holder.

4. The combination, in an index, with a support, a turn-table adapted to be mounted on and rotated above said support, and revoluble work holders mounted on said turn-table, said work holders consisting in part of shafts, of a yoke, supporting means for said yoke, indexing mechanism carried by said yoke, said yoke with said mechanism being adapted to fit over the shaft of the work holder which is in operative position, means to attach said mechanism to and detach it from said last-named work holder, and means to actuate said yoke with said mechanism out of and into engagement with said last-named work holder.

5. The combination, in an index, with a support, a turn-table mounted on and adapted to be rotated above said support, and revoluble work holders mounted on said turn-table, said work holders consisting in part of shafts, of a yoke provided with indexing mechanism adapted to engage the shaft of the work holder which is in operative position, and to be connected with and disconnected from said holder, supporting and guiding means for the arms of said yoke, one of said arms being provided with a rack, a shaft journaled in said supporting means, a pinion secured to said shaft and intermeshing with said rack, and a crank also secured to said shaft.

6. The combination, in an index, with a work holder consisting in part of a shaft, and having a head below the upper end of said shaft, a yoke, indexing mechanism carried by said yoke, and consisting in part of a disk receivable on said head, interlocking means between said head and disk, and means to raise said yoke and indexing mechanism from said head and shaft, and to lower said yoke and mechanism onto said shaft and head, the upper terminal of the shaft being receivable in the yoke.

7. The combination, in an index, of a work holder consisting in part of a shaft

and having a head, the latter being below the top of said shaft, a yoke, an index disk below said yoke, and having a sleeve that extends into said yoke and is revoluble therein, interlocking means between said head and disk, and means to raise and lower said yoke.

8. The combination, in an index, with a work holder consisting in part of a shaft, and having a head, the latter being below the top of the shaft, and studs set in said head, of a yoke, an index disk below said yoke and having a sleeve which extends into the yoke, said disk and sleeve being rotatable, and said disk having perforations to receive said studs, and means to raise and lower said yoke with said disk.

9. The combination, in an index, with a reciprocating cam-lug, of a supporting member, a rotatable member carried by said supporting member, and means for imparting a step-by-step movement to said rotatable member, said last-named means consisting in part of a member which extends into the path of said cam-lug.

10. The combination, in an index, with a reciprocating cam-lug, of a supporting member, a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, an arm pivotally connected with said supporting member, and having teeth to engage said lock-teeth, said arm extending into the path of said cam-lug, and a pawl pivotally connected with said arm, and having teeth to engage said ratchet-teeth.

11. The combination, in an index, with a reciprocating cam-lug, of a supporting member, a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, an arm pivotally connected with said supporting member, and having teeth to engage said lock-teeth, said arm extending into the path of said cam lug, and a pawl pivotally connected with said arm, and having teeth to engage said ratchet-teeth, the pivotal connection between said arm and pawl being of a nature to afford a limited amount of lost motion between the arm and pawl.

12. The combination, in an index, with a supporting member, and a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, of an arm pivotally connected with said supporting member, and having teeth to engage said lock-teeth, a spring arranged normally to retain said arm in locking engagement with said disk, a pawl pivotally connected with said arm, and having teeth to engage said ratchet-teeth, a spring arranged to retain said pawl in engagement with said disk, and means to actuate said arm against the resiliency of its spring out of locking engagement with said disk and cause said pawl to actuate said disk.

13. The combination, in an index, with a supporting member, and a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, of an arm pivotally connected with said supporting member, and having teeth to engage said lock-teeth, a spring arranged normally to retain said arm in locking engagement with said disk, a pawl pivotally connected with said arm, and having teeth to engage said ratchet-teeth, the pivotal connection between said arm and pawl affording a certain amount of lost motion, a spring arranged to retain said pawl in engagement with said disk, and means to actuate said arm out of locking engagement with said disk and cause said pawl to actuate said disk.

14. The combination, in an index, with a reciprocating cam-lug, of a supporting member, a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, an arm pivotally connected with said supporting member, and having teeth to engage said lock-teeth, a spring adapted normally to retain said arm in locking engagement with said disk, and a spring-pressed pawl pivotally connected with said arm, and having teeth to engage said ratchet-teeth, the pivotal connection between said arm and pawl affording a certain amount of lost motion, and the arrangement of parts being such that said cam-lug in its movement in one direction actuates said arm, against the resiliency of said spring, out of locking engagement with said disk, and causes said pawl to actuate said disk.

15. The combination, in an index, with a supporting member, a rotatable disk carried by said supporting member, and provided with lock-teeth and ratchet-teeth, and guard rings on said disk for said lock- and ratchet-teeth, of an arm pivotally connected with said supporting member, and adapted to engage and release said lock-teeth, a pawl pivotally connected with said arm, and adapted to engage said ratchet-teeth, and means to actuate said arm on its pivot.

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