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2,600,960

INDEX FIXTURE

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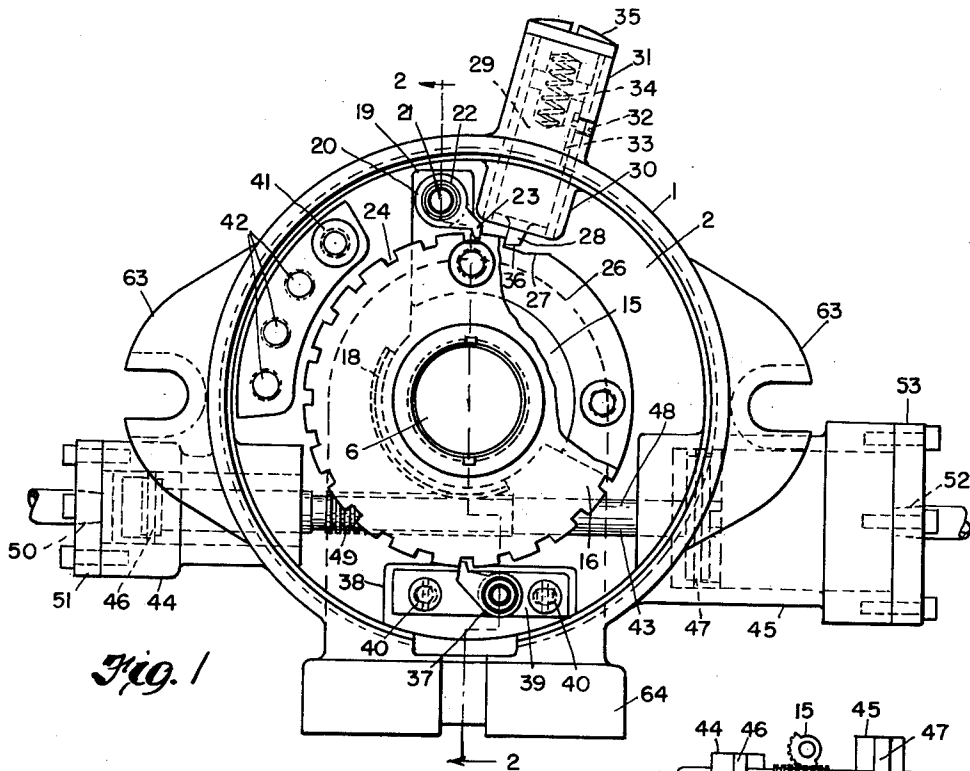


Fig. 1

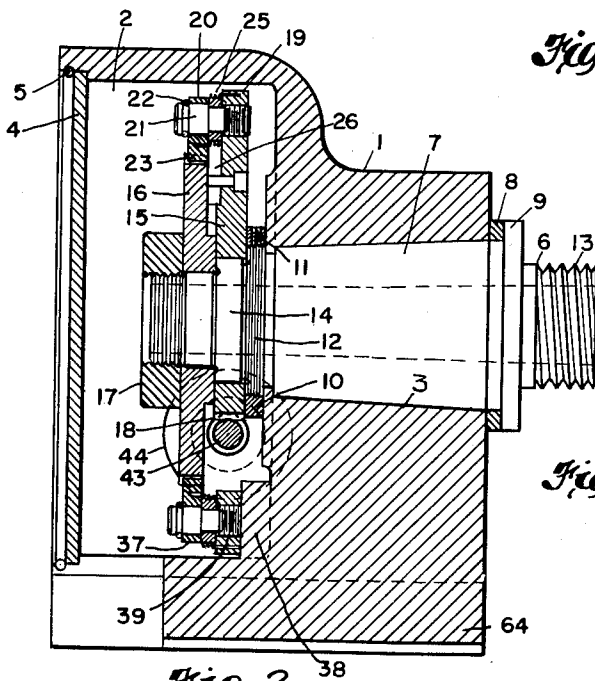


Fig. 2

Fig. 3

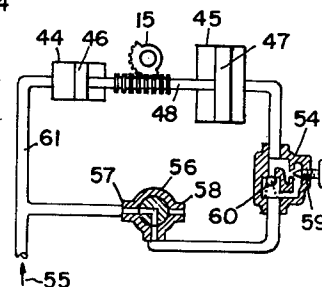
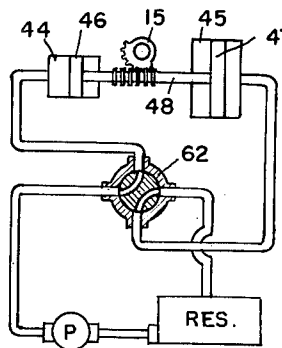


Fig. 4



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INDEX FIXTURE

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The present improvements relating generally as indicated to an index fixture are more particularly concerned with an index fixture for machine tools and the like wherein, for example, it is necessary to predeterminedly relatively rotate a workpiece and a tool to position the former for operation upon by the latter. One illustrative example is the milling of uniformly spaced longitudinal slots in contractible collets and the like wherein, after the formation of one slot, it is necessary to index the collet or milling cutter for forming the next slot.

It is a primary object of this invention to provide an index fixture which is accurately indexed through reciprocation of the movable element of a fluid power device therein.

Another object is to provide an index fixture in which the rotary member thereof operatively connected with a ratchet wheel and pawl mechanism is immovably locked in indexed positions by means independent of the ratchet pawls.

Another object is to provide a fluid pressure actuated index fixture in which the movable element of the fluid power device when actuated in one direction releases the aforesaid locking means and positions one pawl for engagement with the ratchet wheel while another pawl holds the wheel and which element when actuated in an opposite direction moves the wheel to a new position through said one pawl and at a predetermined rotative position of the ratchet wheel permits the locking means to engage the wheel whereby to firmly lock the latter in such newly indexed position.

Another object is to provide an index fixture of a simple economical form permitting adjustment of the indexing movement.

Another object is to provide a novel form of locking plunger adapted to wedge in the interdental spaces in the ratchet wheel and thus eliminate looseness of the parts when in an indexed position.

Another object is to provide an index fixture in which the aforesaid movable element of the fluid power device comprises a reciprocating rack in engagement with a gear segment on the ratchet mechanism, said rack being in the form of an annularly grooved rod whereby rotary disposition thereof about its own axis and lateral disposition is immaterial.

Other objects and advantages will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particu-

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larly pointed out in the claims, the following description and the annexed drawing setting forth in detail one illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a rear elevation view of one embodiment of this invention with the cover plate thereof removed and with a portion of the ratchet wheel broken away to more clearly show the locking plunger cam;

Fig. 2 is a cross section view taken substantially along the line 2—2, Fig. 1; and

Figs. 3 and 4 are schematic piping diagrams for operating the fluid power device with a gaseous and a liquid pressure medium respectively.

Referring now to the drawings and first more especially to Figs. 1 and 2 thereof there is shown therein a housing 1 formed with a recess 2 and a bore 3, preferably tapered as shown, leading into such recess, such recess being closed as by a cover plate 4 fitted in the open end of recess 2 and held in place as by a snap ring 5.

Rotatable in bore 3 of said housing 1 is a spindle 6 including an intermediate tapered section 7 of the same taper as bore 3 and provided with a spacer 8 adjacent the flange 9 formed adjacent one end thereof and with a lock nut 10 threaded onto the other end thereof, said lock nut being held against rotation from adjusted position as by means of a set screw 11 radially through lock nut 10 frictionally engaged with the threads 12 on said spindle. Obviously, as well known, the forming of said housing 1 and spindle 6 with complementary tapered sections as shown makes it possible to take up any wear of the interengaged surfaces and thereby eliminate all looseness in such rotary connection. The front end of said spindle is threaded as shown at 13 for mounting a workpiece or tool supporting assembly thereon (not shown) including a collet, mandrel, arbor, or the like. The rear end of said spindle 6 extends into recess 2 in said housing 1 and is formed with a bearing surface 14 on which a pawl support member 15 is rotatable, and adjacent said pawl support member 15 and keyed to said spindle is a ratchet wheel 16, said pawl support member and ratchet wheel being axially retained on said spindle as by means of lock nut 10 and spindle nut 17 between which nuts said pawl support member 15 and ratchet wheel 16 are disposed. As will hereinafter more fully appear, ratchet wheel 16 and spindle 6 con-

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stitute a driven member whereas said pawl support member operates as a driving member.

Said pawl support member 15 comprises a gear segment 18 concentric with the axis of rotation of said member and a radially projecting lug 19 to which a driving pawl 20 is pivotally mounted through the intermediary of a pawl bolt 21 threaded into said lug and provided with a snap ring 22 retaining said pawl on said bolt. The end 23 of said pawl is adapted to be engaged in one of the interdenal spaces or notches 24 in the periphery of said ratchet wheel 16 and is so formed as to permit relative rotation of said ratchet wheel and pawl support member in one direction only. A torsion spring 25 around the bolt 21 having its axially directed ends fitting in holes in said pawl and lug is operative to rotate the pawl to a position with the end thereof disposed in an interdenal space 24.

Bolted or otherwise attached to said pawl support member 15 is an arcuate cam plate 26 provided with a cam surface 27 engageable with the inner end 28 of a locking plunger or lock member 29 which is radially reciprocably mounted on said housing. Said locking plunger 29 is reciprocable in a bore formed in the radial bosses 30 and 31 on said housing and is held against rotation about its own axis as by means of a set screw 32 having the point thereof slidably fitting in a longitudinally extending slot or groove 33 formed in said plunger. Said plunger is urged radially inward by means of the compression spring 34 interposed between said plunger and a cap 35 closing the outer end of the boss 31. As shown, the inner end of said plunger 29 is slightly tapered on its opposite sides, viz. of wedge shape of included angle of 6°, for example, and the end surface 36 thereof is also at an angle relative to the axis of the plunger to facilitate entry of said plunger end in the interdenal spaces or notches 24 between the teeth of ratchet wheel 16. The teeth of said ratchet wheel are shaped similar to the end of the plunger so as to be complementary therewith and to wedgedly receive the wedge shaped end of said plunger. As shown, the cam surface 27 of said cam plate 26 is such that the plunger end surface 36 is free therefrom when the plunger is in locking engagement with said ratchet wheel.

As shown, rotation of the pawl support member 15 in a counterclockwise direction as viewed in Fig. 1 will effect engagement of the cam surface 27 of cam plate 26 with the inner end 28 of said plunger 29 to thereby force said plunger radially outward relative to the ratchet wheel and thus disengage the plunger from the respective interdenal space 24 in said wheel.

In order to hold ratchet wheel 16 against rotation during such counterclockwise rotation of pawl support member 15 there is provided a spring actuated holding pawl 37 pivotally supported on a boss 38 raised from the bottom of recess 2 in said housing 1. Said last-named pawl 37 is identical to pawl 21 and arranged as shown to permit clockwise rotation of said ratchet wheel 16 through said first pawl 21 and support member 15. In the case of pawl 37 the bolt 21 on which the pawl is pivoted is threaded into a plate 39, said plate being secured to boss 38 as by screws 40 passing through elongated holes in said plate and threaded into boss 38. By so adjustably carrying pawl 37 it can be accurately positioned with reference to pawl 21 and to the interdenal spaces 24 in ratchet wheel 16.

The lug 19 of said pawl support member 15

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is engageable with a stop pin 41 in said housing 1 to limit the extent of counterclockwise movement of said pawl support member 15, said stop pin being insertable in any one of a plurality of openings 42 whereby the indexing movement may constitute, in the form of the invention illustrated, the angle between 2, 3, 4, and 5 teeth of the ratchet wheel.

Oscillation of said pawl support member 15 in opposite directions is effected by reciprocation of the movable element 43 of a fluid power device, said fluid power device as herein illustrated comprising coaxial cylinders 44 and 45 formed in housing 1 of different diameters and a movable element 43 in the nature of pistons 46 and 47 respectively reciprocable in said cylinders and having a common piston rod 48 therebetween formed with annular grooves 49 of shape for engagement with the teeth of gear segment 18 of said pawl support member 15. Obviously with an arrangement as shown the rotary or lateral disposition of said piston rod 48 and pistons 46 and 47 does not effect any misalignment between the grooves 49 and the teeth of the gear segment 18 as would be the case if a common gear rack were substituted for the annularly grooved rod 48. It will be evident that in lieu of a piston rod provided with annular grooves 49 the same may be provided with a worm of shape for engagement with helical teeth of a gear segment, such latter arrangement being desirable in some instances as where it may be necessary to change the relationship of the rod 48 relative to the support member 15.

From Fig. 1 it can be seen that admission of fluid under pressure through the port 50 of the head 51 of cylinder 44 will cause piston rod 48 to shift toward the right and thereby rotate pawl support member 15 in a counterclockwise direction until lug 19 engages stop pin 41. Such counterclockwise rotation of the pawl support member 15 causes similar rotation of cam 26 and consequent withdrawal of the locking plunger 29 from between the teeth of ratchet wheel 16. During such counterclockwise movement of the pawl support member 15, pawl 21 thereon passes over the teeth of the ratchet wheel and the other pawl 37 holds said ratchet wheel against counterclockwise rotation with said support member.

Now, when fluid under pressure is admitted into cylinder 45 through the port 52 in cylinder head 53 the resulting lefthand movement of piston rod 48 effects clockwise rotation of pawl support member 15 and corresponding clockwise rotation of ratchet wheel 16 through the driving engagement of pawl 21 with said wheel and the passing over of pawl 37 over the teeth of the ratchet wheel. During such rotation of pawl support member 15 the cam surface 27 of cam plate 26 permits compression spring 34 to urge locking plunger 29 into wedging and locking engagement in the particular interdenal space 24 of the ratchet wheel then opposite the inner end 28 of said plunger. Thus, such clockwise rotation of ratchet wheel 16 correspondingly rotates spindle 6 and the tool or workpiece supporting member adapted to be connected thereto. The parts of the fixture are locked firmly in such indexed position until fluid under pressure is again admitted to actuate the piston rod 48 toward the right as previously explained.

With respect to Fig. 3, when air or like compressible fluid is employed for actuating said fluid power device it is preferred that an air flow control valve 54 be included in the piping system to

cause the piston rod 48 to move with a desired slowness in a lefthand direction to minimize shock on the end 28 of locking plunger 29 and to permit relatively rapid movement of the piston rod in a righthand direction. In Fig. 3 the arrow 55 denotes the direction of flow of pressure fluid from a compressor, and the numeral 56 denotes a three way selector valve for selectively connecting cylinder 45 to the pressure port 57 or to the exhaust port 58.

The flow control valve 54 as herein illustrated comprises a needle valve 59 and a check valve 60 connected in parallel whereby when the valve 56 is in the position shown, pressure fluid can only flow through the restricted passageway of needle valve 59 to cylinder 45, thus effecting shifting of rod 48 toward the left with the desired slowness, such lefthand movement being possible by reason of the larger diameter of cylinder 45 as compared with cylinder 44 to which latter cylinder the pressure line 61 is constantly connected. On the other hand, when valve 56 is actuated to connected cylinder 45 to exhaust, the fluid acting on piston 46 urges rod 48 toward the right, such righthand movement of said rod being at desired rapidity in view of the relatively free exhaust of fluid from cylinder 45 through both the check valve 60 and needle valve 59.

However, when hydraulic oil or like liquid is employed as the motivating fluid for the fluid power device the piping diagram should be modified as illustrated in Fig. 4. With a liquid pressure medium, it has been found that the flow control valve 54 can be dispensed with and a four-way valve 62 can be substituted for the valve 56 for directing fluid under pressure from pump "P" to one cylinder and discharging the fluid from the other cylinder into reservoir "RES".

For convenience in rigidly mounting the index fixture, the housing 1 thereof is formed with ears or lugs 63 and with a base portion 64.

From the foregoing description of the construction and operation of an illustrative embodiment of this invention it will be apparent to those skilled in the art to devise various schemes for operating the valves 56 and 62 by means of cams or the like in timed relation to the movements of the slide or the equivalent of a machine tool. In essence, the successive operations involved in the slotting of collets for example are:

- (1) Index collet a part revolution about its central axis;
- (2) Engage cutter and collet and shift relatively in axial direction to form a slot in said collet from one end toward the other end;
- (3) Disengage collet and cutter;
- (4) Index collet to next position;
- (5) Engage collet and cutter and shift relatively in opposite axial direction to form another slot; and
- (6) Disengage collet and cutter.

Such operations are repeated until the desired number of slots are formed in the collet. Inasmuch as the present invention is only concerned with an indexing mechanism no specific controls have been disclosed for effecting other relative movements between a workpiece and tool.

Furthermore, insofar as the primary features of this invention are concerned the ratchet mechanism may be variously modified including for example the provision of an internally

toothed ratchet wheel with cooperating pawls and locking member and a cam track for actuating the locking member in both directions in lieu of the cam plate 26 and spring 34.

In any event there is herein disclosed a unique form of index fixture of a most elemental construction but yet efficiently operating to accurately index and to immovably hold any indexed position. Also, the fluid pressure operating means is such that the locking of the driven member in an indexed position does not entail the application of undue forces on the locking member.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In an index fixture, the combination with a ratchet mechanism comprising a driven member, and a driving member movable in opposite directions having a one-way driving connection with said driven member, of a housing, said driven member comprising a spindle rotatable in said housing and a ratchet wheel non-rotatably fixed on said spindle, said driving member comprising a pawl support member rotatably mounted on said spindle adjacent said wheel, and a driving pawl on said pawl support member engageable in the interdental spaces in said wheel when said pawl support member is rotated in the direction of such one-way driving connection, a positively holding pawl in said housing operative to hold said wheel against rotation in a direction opposite to such one-way driving connection, a locking plunger in said housing movable into and out of locking engagement with said wheel, and a cam on said pawl support member operative to disengage said locking plunger from said wheel upon rotation of said pawl support member and driving pawl thereon in a direction opposite to its one-way driving connection with said wheel and spindle.

2. In an index fixture, the combination with a ratchet mechanism comprising a driven member, and a driving member movable in opposite directions having a one-way driving connection with said driven member, of a housing, said driven member comprising a spindle rotatable in said housing and a ratchet wheel non-rotatably fixed on said spindle, said driving member comprising a pawl support member rotatably mounted on said spindle adjacent said wheel, and a driving pawl on said pawl support member engageable in the interdental spaces in said wheel when said pawl support member is rotated in the direction of such one-way driving connection, a positively holding pawl in said housing operative to hold said wheel against rotation in a direction opposite to such one-way driving connection, a locking plunger in said housing movable into and out of locking engagement with said wheel, and a cam on said pawl support member operative to effect engagement of said locking plunger with said wheel upon predetermined rotation of said wheel and spindle by said pawl support member and driving pawl.

3. In an index fixture, the combination with a ratchet mechanism comprising a driven member, and a driving member movable in opposite directions having a one-way driving connection with said driven member, of a housing, said driven member comprising a spindle rotatable

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in said housing and a ratchet wheel non-rotatably fixed on said spindle, said driving member comprising a pawl support member rotatably mounted on said spindle adjacent said wheel, and a driving pawl on said pawl support member engageable in the interdental spaces in said wheel when said pawl support member is rotated in the direction of such one-way driving connection, a positively holding pawl in said housing operative to hold said wheel against rotation in a direction opposite to such one-way driving connection, a locking plunger in said housing movable into and out of locking engagement with said wheel, and a cam on said pawl support member operative to disengage said locking plunger from said wheel upon rotation of said pawl support member and driving pawl thereon in a direction opposite to its one-way driving connection with said wheel and spindle, said locking plunger being provided with a locking wedge shaped end portion, and said wheel being provided with a complementary notch for receiving such end portion of said lock member.

4. In an index fixture, the combination with a ratchet mechanism comprising a driven member, and a driving member movable in opposite directions having a one-way driving connection with said driven member, of a housing, said driven member comprising a spindle rotatable in said housing and a ratchet wheel non-rotatably fixed on said spindle, said driving member comprising a pawl support member rotatably mounted on said spindle adjacent said wheel, and a driving pawl on said pawl support member engageable in the interdental spaces in said wheel when said pawl support member is rotated in the direction of such one-way driving connection, a positively holding pawl in said housing operative to hold said wheel against rotation in a direction opposite to such one-way driving connection, a locking plunger in said housing movable into and out of locking engagement with said wheel, a cam on said pawl support member operative to disengage said locking plunger from said wheel upon rotation of said pawl support member and driving pawl thereon in a direction opposite to its one-way driving connection with said wheel and spindle, and means for rotating said pawl support member in opposite directions comprising a gear segment on said pawl support member, and a cylindrical rod reciprocally supported in said housing and provided with a series of annular grooves in mesh with the teeth of said gear segment.

5. In an index fixture, the combination of a housing, a ratchet mechanism in said housing comprising a driven member rotatably supported

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by said housing, and a driving member rotatable in opposite directions having a one-way driving connection with said driven member, and a lock member mounted in said housing for reciprocation radially into and out of engagement with said driven member, a spring in said housing constantly urging said lock member toward said driven member, and a cam on said driving member operative to engage said lock member and move the same radially out of engagement with said driven member upon rotation of said driving member in a direction opposite to its one-way driving connection with said driven member, said lock member being provided with a locking wedge shaped end portion, and said driven member being provided with a complementary notch for receiving such end portion of said lock member.

6. In an index fixture, the combination of a housing, a ratchet mechanism in said housing comprising a driven member rotatably supported by said housing, and a driving member rotatable in opposite directions having a one-way driving connection with said driven member, and a lock member mounted in said housing for reciprocation radially into and out of engagement with said driven member, a spring in said housing constantly urging said lock member toward said driven member, and a cam on said driving member operative to engage said lock member and move the same radially out of engagement with said driven member upon rotation of said driving member in a direction opposite to its one-way driving connection with said driven member, said lock member being provided with a locking wedge shaped end portion, and said driven member being provided with a complementary notch for receiving such end portion of said lock member, said lock member being further formed with an end portion of which one edge is radially inward of another edge, the innermost edge of such end portion first entering such notch in said driven member to facilitate positioning of said lock member in engagement with said driven member.

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