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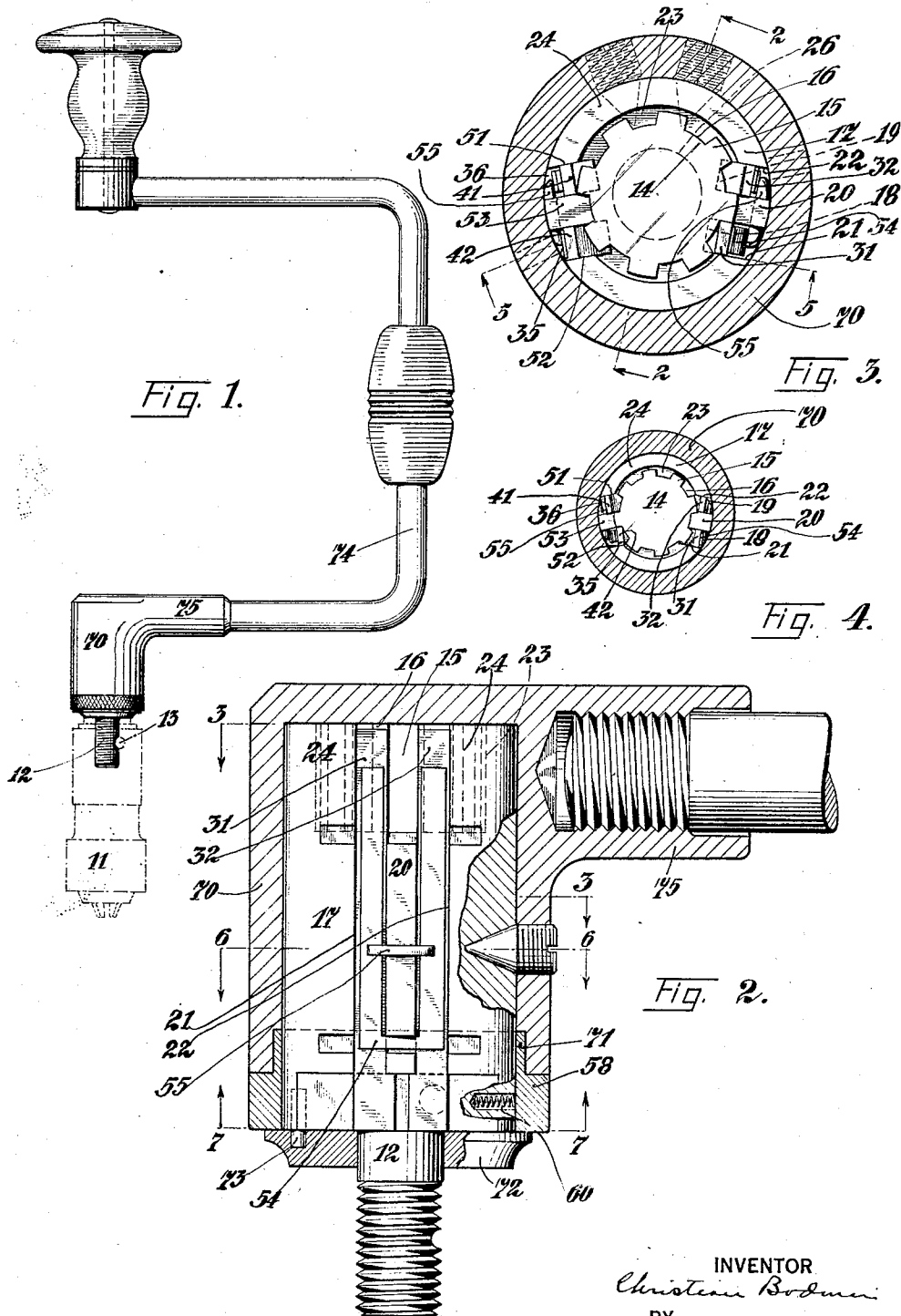
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RATCHET MECHANISM

Filed Sept. 4, 1926

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

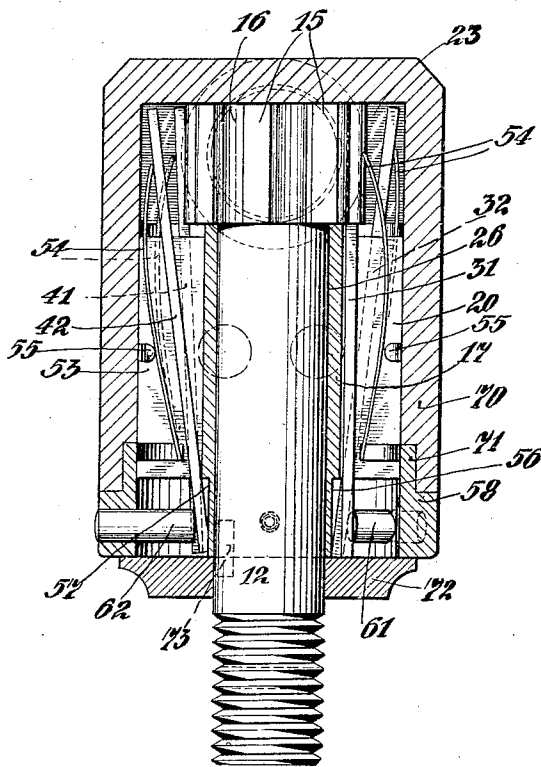


Fig. 5.

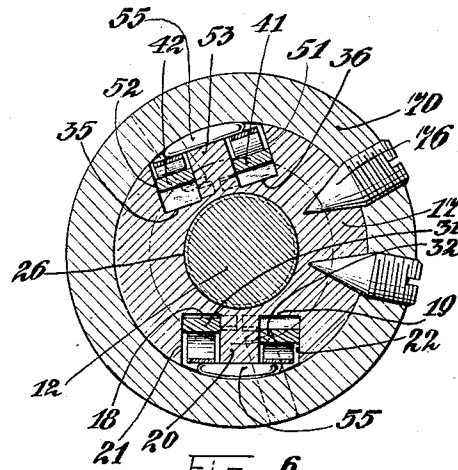


Fig. 6.

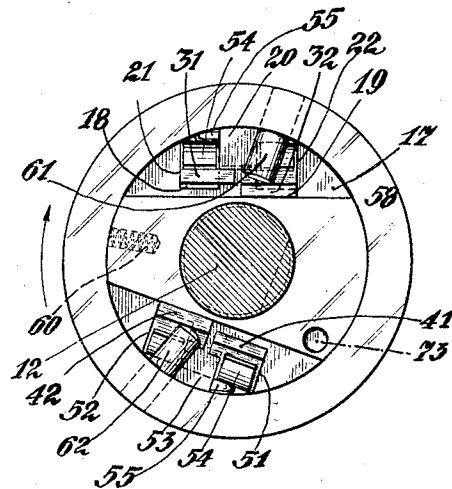


Fig. 7.

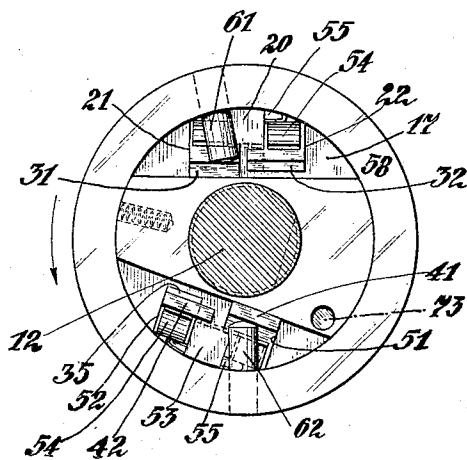


Fig. 8.

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RATCHET MECHANISM

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This invention relates to ratchet mechanisms.

It is an object of the invention to provide an effective and economical ratchet mechanism capable of imparting to tools fine ratcheting strokes. It is a further object of the invention to provide such a ratchet mechanism embodying the advantageous features of the tool disclosed in Patent No. 1,562,862 dated November 24, 1925.

With these general objects in view the invention consists in the features, combinations, details of construction and arrangements of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

In the drawings:

Figure 1 is a view in side elevation of a ratchet tool constructed in accordance with the invention;

Figure 2 is a sectional view taken on the broken line 2—2 of Fig. 3;

Figure 3 is a sectional view taken on the broken line 3—3 of Fig. 2;

Figure 4 is a similar view (reduced) showing a different position of the parts;

Figure 5 is a sectional view taken on the broken line 5—5 of Fig. 3;

Figures 6 and 7 are sectional views taken on the lines 6—6, 7—7 respectively of Fig. 2; and,

Figure 8 is a view like Fig. 7 showing a different position of the parts.

Referring to the drawings, there is provided a rotary spindle or blade, and ratchet means connected thereto to drive the same. The particular tool here illustrated as an example is a bit brace, as appears in Fig. 1. The chuck unit, indicated conventionally at 11, is rotated by a spindle or blade 12. The lower end of this spindle, for purposes of assembly, is threaded for connection with the chuck unit. The parts are held against relative angular movement by a pin 13 passing through the chuck unit and lying in a groove formed in the spindle 12. Secured to the opposite or upper end of the spindle, in the present embodiment, is a ratchet 14 having eight equally spaced alternating teeth

15 and grooves 16. As appears in the drawings, the ratchet teeth parallel the axis of the blade and the ratchet has a form somewhat like a spur gear.

The spindle unit is driven by means of pawls carried by a pawl carrier which is, in turn, driven by a handle. The invention in its entirety includes a plurality of sets of reverse-acting pawls, with selective means for tilting one pawl of each set into inactive position, the pawls being so arranged that while one pawl of a set is drivingly engaging a ratchet tooth, the corresponding pawl of another set is in a position to drivingly engage a ratchet tooth upon a reverse rotation of the pawl carrier less than the angular distance between two adjacent ratchet teeth. In structures embodying the invention to what is now considered the best advantage, the pawl carrier has two sets of grooves in which lie two sets or pairs of reverse-acting pawls. The planes of the two sets of flat seats formed by the groove bottoms lie at such an angle to each other that while one pawl of one set is engaging a ratchet tooth, the corresponding pawl of the other set is ready to engage a tooth upon an angular reverse rotation of the carrier of one-half the angular distance between teeth. Although capable of various constructions, in that here shown as an example, the pawl carrier is formed from a cylindrical block 17. This block is provided with two open parallel grooves 18, 19 located side by side and having flat bottoms lying in the same plane for receiving one set of pawls. These grooves, as here shown, are separated by a partition 20 and are bounded by side abutment walls 21, 22 which are substantially perpendicular to the groove bottoms. The carrier block is also provided with two open parallel grooves 35, 36, like grooves 18, 19 but in a different plane, as later referred to, for receiving a second set of pawls. These grooves are separated by a partition 53 and have side walls 51, 52 like walls 21, 22. At the upper end, the carrier block 17 is hollowed out to provide a recess 23 for receiving the ratchet. This recess is partly enclosed by a sleeve-like part 24 of the block which houses the ratchet with a guiding fit, the recess hav-

ing substantially the same length as the ratchet. This sleeve-like part of the block is cut away adjacent the grooves 18, 19 and 35, 36 to give the pawls access to the ratchet. As here shown, the walls defining the cutaway portions are continuations of the walls 21, 22 and 51, 52. The block 17 has an axial bore 26 for the spindle, the lower threaded end of which extends below the block, as appears in Fig. 5. The ratchet is confined endwise between the face of the block surrounding this bore and a housing to be described.

Cooperating with the ratchet and carrier are two sets of reverse acting pawls. In the present exemplification, these pawls are long flat bars freely positioned in the grooves to seat on the groove bottoms. They are of a width to fit within the grooves and of a length to project upwardly a substantial distance over the ratchet. Pawls 31, 32 of one set are located in grooves 18, 19 and pawls 41, 42 of the other set in grooves 35, 36. The pawls have half-T-shaped ends which hook around the end of the respective partitions.

When a pawl is seated on the flat of its groove its upper, i. e. outer, end lies in a plane that cuts the circumference of the ratchet, the pawl being confined between its adjacent side wall and a ratchet tooth. This driving position is illustrated, for example, in Fig. 3 which shows pawl 31 located between a ratchet tooth and side wall 21. When the carrier is rotated, as later described, the ratchet-spindle unit is rotated by pawl 31 being driven by side wall 21 against the ratchet tooth. It is noted that the pawls are wider than the ratchet grooves and so cannot drop into the latter, thereby jamming the ratchet mechanism, and, as appears in Fig. 3, the bite of the pawl is substantially at the root of the ratchet tooth. The other pawl 32 of this set is shown tilted into inactive position. If it were released, and pawl 31 tilted, as later described, for drive in the opposite direction, it would be located in reverse driving position between its side wall 22 and the opposite side of the same ratchet tooth.

Pawl 41 is the companion pawl to pawl 31 in driving in the first direction under discussion. This pawl takes the same sort of driving position with respect to a ratchet tooth, as pawl 31, but never simultaneously with the latter. That is, the parts are so arranged that when pawl 31 is in driving position the companion pawl 41 is out of driving position but is located to take driving position upon an idle reverse carrier stroke of one-half the distance between ratchet teeth, i. e. in the present case, a $\frac{1}{16}$ revolution. As appears in Fig. 3, pawl 41 is lying on the top of a ratchet tooth and so is idle. When, however, the carrier is given a $\frac{1}{16}$ back rotation, pawl 41 drops into driving position between such ratchet tooth and its side wall 51. At the same time, companion pawl 31 is tilted

by its next tooth and rests on the top of such tooth, the position being analogous to the position of pawl 41 in Fig. 3. Thus, the pawls 31, 41 alternately take driving and waiting positions for each $\frac{1}{16}$ back stroke of the carrier.

Pawl 42 of the second set, like its companion pawl 32, is, in Fig. 3, tilted into inactive position. When it is released, and pawl 41 tilted into inactive position, pawls 42, 41 are reversely interchanged in the same manner as pawl 32, 31, as above described (Fig. 4).

The desired spacing of the companion pawls about the ratchet to provide the relation described is obtained, in the present embodiment, by locating the planes of the two sets of groove bottoms at the proper angle, i. e. at such an angle that when one pawl is in driving position its companion pawl of the other set is in waiting position. As shown, these planes are at an angle of approximately $22\frac{1}{2}^\circ$. This offsets one pair of pawls from the analogous position of the other pair by $\frac{1}{16}$ circle.

There is provided spring means for normally holding the pawls in active position, i. e. seated on the groove bottoms. As here shown as an example, associated with each pair of pawls is a U-shaped bar spring element 54. The legs of this spring element lie in the grooves to engage the pawls and the cross piece of the U lies in a notch (Fig. 2) cut in the lower end of the corresponding partition to position the spring. The spring is anchored by a clip 55 wedged into a notch in the partition.

There is provided a housing for the pawl carrier and its associated parts and in structures embodying the invention to the best advantage the housing will serve as a connection between the carrier and the operating handle, and will cooperate with the carrier in confining the ratchet unit endwise. As here shown as an example, cylindrical housing 70 has a slip fit over the carrier block. Its open end fitting over a flange 71 on a selective ring 58 to be described. The lower end is closed by an annular cap 72 which surrounds the spindle and seats against the end of block 17 and the rim of ring 58. This cap is held against relative angular movement by a dowel 73 and is clamped in place by the chuck unit 11 (Fig. 1). As above stated, the particular tool here illustrated as an example is a bit brace. The operating element or handle shown, therefore, is a usual crank arm 74, one end of which is screw-threaded into a side socket 75 on the housing 70. The housing, as shown, is secured to the pawl carrier 17 by threaded dowels 76, thus making handle, housing and carrier block a unitary structure. The housing not only serves as an operating connection between handle and pawl carrier, but encloses the carrier and its asso-

ciated parts. It serves at least in part, as an abutment for the pawl springs. Its closed upper end serves as a bearing for the end face of the ratchet, thus confining the ratchet between housing and carrier block to prevent axial movement of the ratchet-spindle unit.

The pawl carrier is constructed to permit tilting of the pawls and there is provided selective means for tilting one pawl of each set into inactive position, such action being preferably simultaneous. Although capable of various constructions, as here shown as an example, the grooves 18, 19 and their walls terminate, at the lower end, in a flat surface 56, the plane of which is stepped down from the plane of the groove bottoms. The lower, i. e. inner, ends of the pawls project over this surface and pawls 31, 32 can be tilted over the resulting ledge or shoulder. The carrier block 17 is formed with a similar stepped-down surface 57 providing a shoulder or ledge for the other set of pawls 41, 42. While the selecting means may vary, as here shown as an example, located between the open end of housing 70 and cap 72 is a selective ring 58 rotatable with respect to the housing and pawl carrier. This ring has a flange 71 over which the rabbeted end of the housing telescopes, the outer knurled face of the ring being substantially flush with the outer face of the housing. This selective ring, as appears in Fig. 2, serves as a continuation of main housing 70 as regards the housing function of the latter.

The selective ring 58 is rotatable with respect to the carrier-housing unit but is normally held in a given position by a coiled spring 60 seated in a socket in block 17 and having its end bearing against the inner face of ring 58. The ring is movable between a neutral position for a non-ratchet drive and two extreme positions for ratchet drive in either direction. As shown, ring 58 carries two inwardly extending fingers or lugs 61, 62, one for each pair of pawls. When the selective ring is turned to one extreme position, its lug 61 tilts pawl 31 of one set of pawls into inactive position and at the same time lug 62 tilts the opposite and corresponding pawl 41 of the other set into inactive position (Fig. 8). This gives a ratchet drive in the direction of the arrow of Fig. 8 as later described. On reverse movement of the selective element, to the other extreme, lug 61 releases pawl 31 and tilts pawl 32 into inactive position and lug 62 releases pawl 41 and tilts pawl 42 into inactive position (Fig. 7). This gives a ratchet drive in the opposite direction. When the selective ring is in neutral position between the extreme position of Figs. 7 and 8 the lugs are so positioned that none of the pawls is tilted, giving a non-ratcheting drive.

In operation, assuming the position of Figs. 3, 6 and 7, pawls 32, 42 are tilted into

inactive position and pawls 31, 41 are the active pawls, for a counter-clockwise drive. Pawl 31 is in immediate driving position with pawl 41 in readiness to take such position. Upon rotation of the handle-carrier unit the ratchet-spindle-chuck unit is similarly rotated through the intermediation of pawl 31 between its side wall 21 and a ratchet tooth. Following this driving stroke the handle is given a return idle stroke. During the idle stroke the spindle-chuck unit remains stationary as the carrier moves around the ratchet with the then active pawls sliding over the ratchet teeth. At the end of this idle stroke pawl 31 or 41 drops into driving engagement with a tooth, depending on the extent of the return stroke. That is, if the idle stroke is $\frac{1}{8}$ circle or any multiple thereof, pawl 31 again takes driving position and the driving operation is repeated. If, however, the idle stroke is $\frac{1}{16}$ circle or any odd multiple thereof, pawl 41 takes driving position with respect to a ratchet tooth and pawl 31 takes the waiting position described. In the latter event the driving operation is as before except that the ratchet-spindle-chuck unit is rotated through the intermediation of pawl 41 between its side wall 51 and a ratchet tooth.

It will be seen, therefore, that with the construction described, while the idle ratchet stroke may have any desired length, very fine ratcheting may be obtained since, for a complete revolution, sixteen ratchetings are possible, i. e. twice the number of ratchet teeth. Or, in other words, there is possible rotative divisions double in number the ratchet teeth.

For a clockwise drive the selective ring is shifted to the opposite extreme position (Fig. 8). This tilts pawls 31, 41 into inactive position and releases pawls 32, 42 so that they can be returned to active position by their springs. In this active position one pawl is in immediate driving relation with a ratchet tooth, the other in the waiting position described. The rotary drive of the chuck unit is now effected as before except that it is in the opposite direction, pawl 32 or 42, as the case may be, serving to drive the ratchet on the forward stroke.

In case a non-ratchet drive is desired the selective ring is turned to neutral position, whereby no pawls are tilted to inactive position. As a result, both pawls of one pair or the other are in driving position, the particular pair depending on the relative position of carrier and ratchet. Whichever pair, however, is in this position, there are two reversely acting pawls in driving engagement with the opposite sides of a ratchet tooth. In whichever direction the handle-carrier unit is rotated, the ratchet-spindle unit is similarly rotated, the entire device being, in effect, a unitary structure just as if no ratchet mecha-

nism were provided. In this neutral position of the selecting device the pair of pawls not in driving position are inactive.

What is claimed is:

- 5 In a ratchet tool, including a cylindrical block having a recess for a ratchet and two sets of grooves for receiving pawls, the portion of the block defining the recess being cut away to form abutment walls in continuation
10 of the outer walls of said grooves, and a spindle, a ratchet thereon with its teeth and grooves paralleling the axis of the spindle, the ratchet being located in said recess, two reverse-acting pawls positioned in the grooves
15 of each set and having their ends extending over the ratchet, spring means for normally holding the pawls seated on the groove bottoms, the block being cut away at the rear of said grooves to provide a ledge over which
20 the pawls may tilt, selective means for simultaneously tilting one pawl of each pair into inactive position, the groove bottoms of one set being at such an angle to the groove bottoms of the other set that when one active
25 pawl is in driving engagement with a ratchet tooth the active pawl of the other pair is offset from driving position with a ratchet tooth by substantially one half the angular distance between ratchet teeth, whereby said
30 second active pawl takes driving position with its adjacent tooth upon a back idle stroke of the carrier substantially half the angular distance necessary to place the first active pawl into driving engagement with its next
35 tooth.

In testimony whereof, I have hereunto set my hand.

CHRISTIAN BODMER.

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