May 29, 1951 L. E. KILNESS 2,554,990

RATCHET MECHANISM

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Fig. 1.

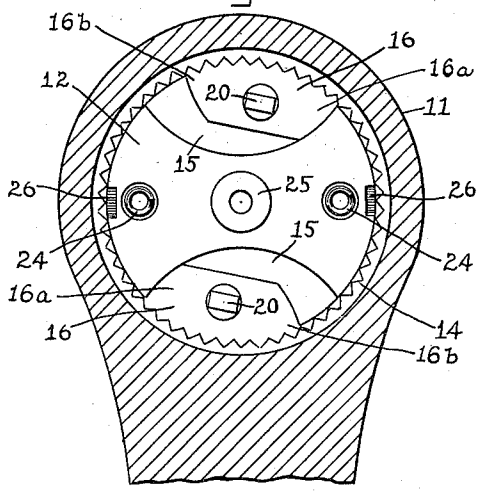
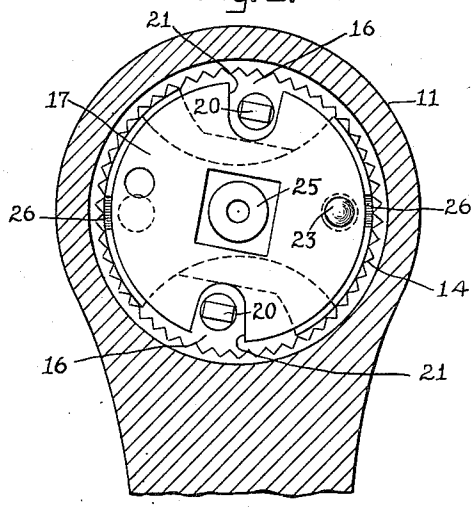


Fig. 2.



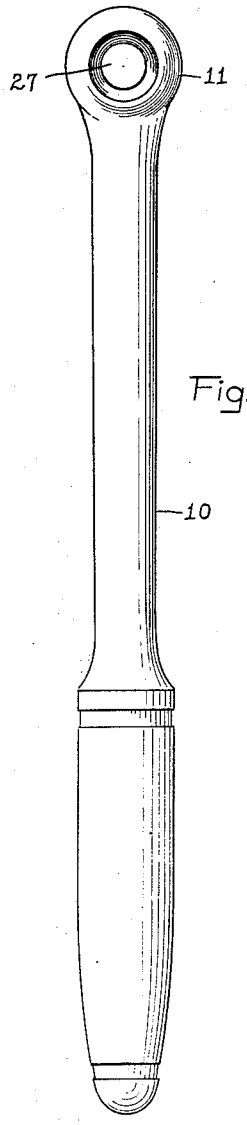


Fig. 3.

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Fig. 4.

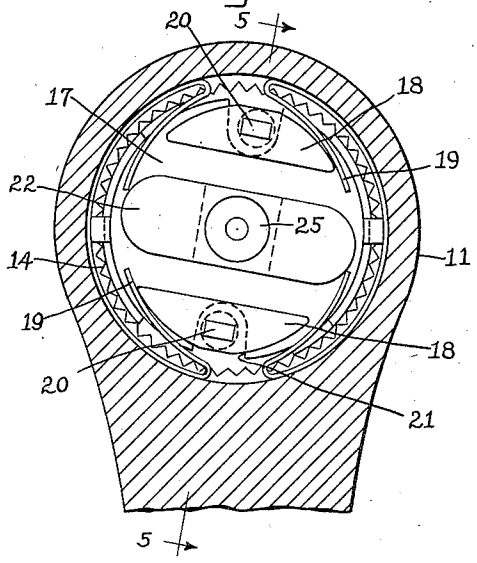
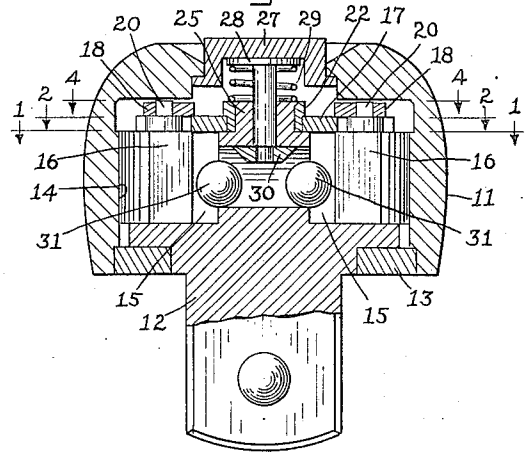


Fig. 5.



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RATCHET MECHANISM

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Application November 18, 1949, Serial No. 128,103

4 Claims. (Cl. 192—45.1)

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This invention relates to ratchet mechanisms and has particular reference to ratchet wrenches.

The primary object of this invention is to provide a ratchet mechanism of such high strength that the ratchet head may be of a greatly reduced and compact size as compared to conventional ratchet devices of the same torque capacity.

Other objects and advantages will be apparent from the description and from the drawings, which show an application of the invention to a ratchet wrench.

In the drawings,

Figure 1 is a sectional view taken substantially on the line 1—1 of Figure 5.

Figure 2 is a similar view on the line 2—2 of Figure 5.

Figure 3 is a top view of the wrench.

Figure 4 is a sectional view taken on the line 4—4 of Figure 5.

Figure 5 is a vertical section taken on the line 5—5 of Figure 4.

The wrench has a driving member comprising a handle 10 integrally formed with a wrench head 11. The wrench head 11 has a cylindrical opening to receive the head portion of a work-turning member 12. A retaining ring 13 is pressed into a shouldered recess on the lower side of the head 11 and secures the turning member 12 in the wrench head 11. The turning member is aligned in the head 11 by the ring 13 and by the peripheral portion of the turning member bearing against ratchet teeth 14 in the head 11.

The turning member 12 has two opposite concave recesses 15 having thrust-bearing ends that are curved towards radial lines on the turning member 12. Pawls 16 are carried in the recesses 15. The pawls are shaped with a long curved side having ratchet teeth that conform to the toothed portion of the head 11 and with two shorter opposing sides that conform to the ends of the recesses 15 when the pawls are in full engagement with the teeth in the head 11. The pawls 16 are smaller than the recesses 15 and have a shorter length to permit withdrawal of the pawls from the ratchet teeth 14. Every tooth on each pawl is used to drive the turning member 12 for both ratcheting directions. Each pawl engages a section of teeth in the head 11 having about 20% of the total number of teeth 14.

The force transmitted to each pawl by the turning member 12 is directed perpendicularly to the radially curved ends of each recess. The moment arm of the force extends well into the outside half of the turning member 12 and may be designed to approach the periphery of the

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turning member 12. The components of the force diverge outwards on both sides to pass to the individual pawl teeth. The curvature of the teeth over the large section of teeth used enables the diverging components to approach the teeth at approximately right angles to the sides of the teeth. The teeth are therefore under compression on the side the force components are directed to and are capable of withstanding heavy stresses efficiently.

The combination of the large number of ratchet teeth effectively used and the large moment arms give the mechanism an exceptionally high torque capacity. The high torque capacity permits a considerable reduction in the size of the head members and enables the ratchet to be conveniently used in places where conventional ratchets would be too large.

The ratcheting motion of the pawls 16 is controlled by a reversing disc 17, control plates 18, and springs 19. Pins 20 are pressed into small holes in the tops of the pawls and extend past slots 21 in the reversing disc 17, where they are terminated by rectangular projections that fit into rectangular holes in the control plates 18.

During the ratcheting action, one end of each spring 19 is held out of contact with the control plates 18 by a spring guide 22 while the other end of each spring 19 is free to press against a control plate 18, as shown in Figure 4. The spring guide 22 maintains the position shown in Figure 4 relative to the spring ends until the ratchet motion is reversed by the manual control.

The ratcheting action is as follows. For illustrative purposes, the action is described for the direction which drives the work clockwise.

The handle is turned counter-clockwise to obtain a new hold. This permits the springs 19, which act on the pawls 16 through the control plates 18, to move pawl ends 16*a* away from the ratchet teeth 14. At the same time, the pawls 16 are pivoted by the pins 20 as the pins contact the inner portion of the slots 21 in the reversing disc 17. The spring pressure acting on the pawls tends to rotate the pawls about the pivots provided by the inner sides of the slots and urges pawl ends 16*b* against the ratchet teeth 14.

As the handle movement is continued in a counterclockwise direction for a new hold, the ratchet teeth 14 exert a frictional drag on the pawl ends 16*b*. The frictional force between the pawl ends 16*b* and the ratchet teeth 14 causes the pawls to follow the ratchet teeth 14 until the pawl pins are brought against the sides of the

slots 21. The pawls are thereby prevented from following the ratchet teeth further, and continued back movement of the handle causes the pawl ends 16b to engage successive series of teeth of the ratchet teeth 14.

As the handle is turned in a clockwise direction to drive the work, the pawl ends 16b are still releasably held against the ratchet teeth 14. The pawl ends 16a are now forced against the ratchet teeth by the concave surfaces of recesses 15 to bring all of the pawl teeth into locking engagement with the ratchet teeth 14.

The ratcheting direction is dependent on the angular position of the reversing disc 17 and spring guide 22 relative to the turning member 12. Spherical detents 23 hold the reversing disc in either of two positions, depending on the ratcheting direction. The two positions of the reversing disc align the slots 21 so that the pins 20 may have pivotal supports in both ratcheting directions. Figure 2 shows the position of the reversing disc for driving the work in a clockwise direction. For turning the work in a counterclockwise direction, the slots 21 on the reversing disc must be positioned toward the other side of each recess 15.

The spring guide 22 has a square extension fitted to the reversing disc 17 to change the angular position of the spring guide for the two ratcheting directions. The ends of the spring guide intercept the ends of the springs 19, which are fixed to the turning member 12 by extensions from the center of each spring 19 that enter grooves 26 on the periphery of the turning member. Relative motion between the spring guide 22 and the springs 19 causes one end of each spring 19 to be withdrawn from the control plate while the other end is free to actuate the control plate. Figure 4 shows the position of the spring guide for driving the work in a clockwise direction. For the counterclockwise driving direction, the spring guide intercepts the spring ends which are shown in contact with the control plates 18 in Figure 4.

The spherical detents 23 are contained in two diametrically spaced holes in the turning member 12. Helical springs 24 force the detents 23 against the reversing disc 17. A projection 25 extending from the turning head 12 holds the reversing disc and spring guide to the turning member 12 against the pressure of the detents 23. The spherical detents 23 are urged against two smaller diameter holes in the reversing disc which are diametrically offset so that only one detent is operable at a time. The reversing disc is held in position by either detent to give two angular positions corresponding to the two ratcheting directions.

A push button 27 gives manual control of the ratcheting direction. Pressure on the push button forces down a push rod 28 against a spring 29. The end of the push rod is secured to a wedge 30. The downward movement of the push button 27 brings the wedge 30 against two balls 31, which are in a hole joining the recesses 15. The wedge 30 forces the balls apart and against the pawls and locks the pawls with the ratchet teeth 14. With the push button in the normally up position, as shown in Figure 5, the wedge 30 is withdrawn from the balls 31 and permits them to have freedom of movement in the hole joining the recesses 15. The pawl action is then unaffected by any contact that the loosely confined balls 31 may have with the pawls.

In operation, the ratcheting direction is selected by depressing the push button 27 and rotating the handle through a small arc in the direction that the work is to be driven. Depressing the push button locks the pawls with the wrench head 11, and the subsequent rotation of the handle causes the pawls to be moved to the other end of the recesses 15. The reversing disc is shifted by the pawl pins 20 to the second operative position. The spring-pressed balls or detents 23 are partly entered in holes in the reversing disc 17 and have a holding effect on the reversing disc that is sufficient to maintain the position of the reversing disc once reversal is effected. During reversal of the ratchet mechanism, the normal holding force acting on the reversing disc is overcome by the movement of the pawls to the opposite ends of the recesses 15. The movement of the pawls brings the pawl pins 20 against the slots 21 in the reversing disc and causes the reversing disc to be rotated against the holding force of one detent 23 to a new angular position where the second detent 23 may enter one of the offset holes in the reversing disc. With the pawls now moved to the other ends of the recesses 15 and the reversing disc held in position by the second detent 23, the push button may be released. The driving action of the ratchet mechanism is now in the same direction as the rotation of the handle while the push button was depressed.

While one form of the invention has been described, the invention is not limited to the particular structure shown except as specified in the following claims, in which I claim:

1. In a ratchet mechanism, the combination of a driving member and a work-turning member, one of said members having a cylindrical opening with inwardly extending ratchet teeth and the other having a head portion rotatably mounted in said opening, a reversible pawl carried in a concave recess on the side of the head portion, the ends of the recess being curved towards radial lines on the head portion, said pawl having two short sides conforming to the thrust-bearing ends of the recess and a long curved side joining the short sides made with a series of ratchet teeth, the size of the pawl being smaller than the recess to permit withdrawal of the pawl from engagement with the teeth in the cylindrical opening, means for bringing every tooth on the pawl into reversible and coacting engagement so that the combination of the simultaneous engagement of a large section of teeth in the cylindrical opening and the radially curved ends of the recess may have a compressional force action on the sides of the pawl teeth, the compression components of each tooth adding to a large resultant force having a large moment arm in the outside half of the head portion for a maximum torque effect, and means for reversing the ratcheting direction.

2. In a ratchet mechanism, the combination of a driving member having a cylindrical opening with inwardly extending teeth, a work-turning member rotatably mounted in the cylindrical opening, said turning member having a recess on one side, a reversible pawl carried in the recess, said pawl having two short opposing sides conforming to the ends of the recess and a long curved side joining the opposing sides made with a series of ratchet teeth conforming to the teeth in the cylindrical opening, the length of the pawl being shorter than the distance across the ends of the recess to permit withdrawal of the pawl from engagement with the teeth in the cylindrical opening, means for disengaging one pawl

end while the other pawl end is releasably pressed against the teeth in the cylindrical opening as the driving member is turned back for a new hold and for bringing all of the pawl teeth into concurrent engagement with the ratchet teeth in the cylindrical opening during the positive stroke of the driving member, and means for reversing the ratcheting direction.

3. In a ratchet mechanism, the combination of a driving member having a cylindrical opening with inwardly extending teeth, a work-turning member rotatably mounted in the cylindrical opening, said turning member having a recess containing a toothed pawl of smaller size than the recess to permit withdrawal of the pawl from the teeth in the cylindrical opening, and means for turning the pawl as the driving member is brought back for a new hold so that the teeth on one end of the pawl may be withdrawn from the teeth in the cylindrical opening while the teeth on the other end of the pawl are releasably pressed against the teeth in the cylindrical opening, said means cooperating with the recess for bringing the teeth on both pawl ends into concurrent engagement with the ratchet teeth in the cylindrical opening during the positive stroke of the driving member.

4. In a ratchet mechanism, the combination of a driving member having a cylindrical opening with inwardly extending teeth, a work-turning member rotatably mounted in the cylindrical opening, said turning member having a recess on one side, a reversible pawl carried in the

recess, said pawl having two similar opposing sides conforming to the ends of the recess and a long curved side with ratchet teeth conforming to the teeth in the cylindrical opening, means for pivoting the pawl at either of two positions in the recess for the two ratcheting directions, means for turning the pawl as the driving member is brought back for a new hold so that one pawl end may be withdrawn from the teeth in the cylindrical opening while the other end of the pawl is releasably pressed against the teeth in the cylindrical opening, said turning means cooperating with the recess for bringing all of the pawl teeth into concurrent engagement with the ratchet teeth in the cylindrical opening during the positive stroke of the driving member, and means for reversing the ratcheting direction.

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