

March 6, 1962

C. S. FELDMAN

3,023,652

RATCHET WRENCH WITH PIVOTED HEAD

Filed Sept. 8, 1959

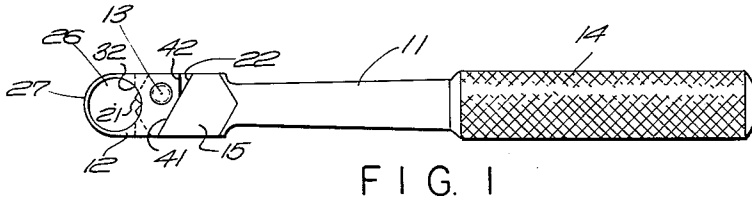


FIG. 1

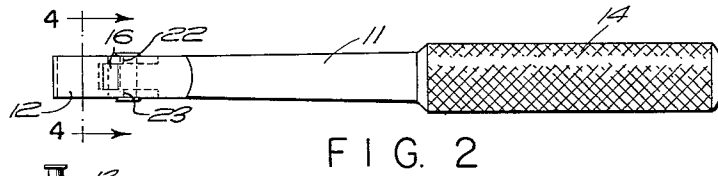


FIG. 2

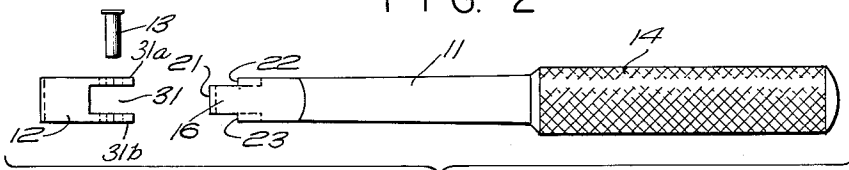


FIG. 3

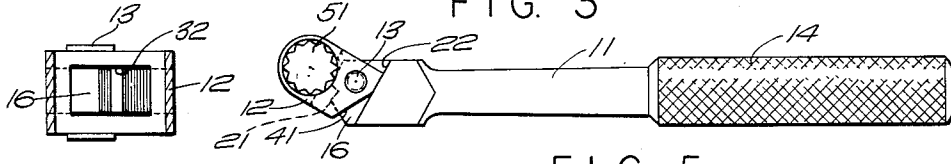


FIG. 4

FIG. 5

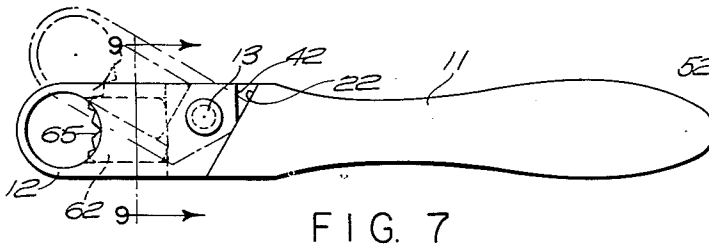


FIG. 7

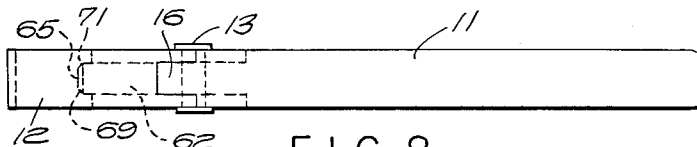


FIG. 8

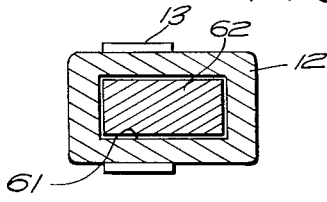


FIG. 9

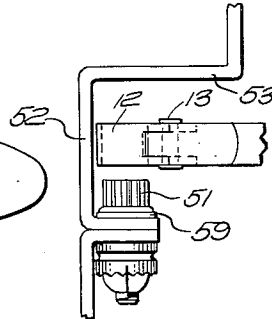


FIG. 6

INVENTOR.
CHARLES S. FELDMAN
BY
Joseph Weingarten
ATTORNEY

1

3,023,652

RATCHET WRENCH WITH PIVOTED HEAD

Charles S. Feldman, Swampscott, Mass., assignor to Eastern Research Corp., Lynn, Mass.

Filed Sept. 8, 1959, Ser. No. 838,631

6 Claims. (Cl. 81-60)

The present invention relates in general to hand tools, and more particularly concerns a novel ratchet wrench especially adapted for use in confined areas, and which is of unusually simplified, economical mechanical design.

The concept of the ratchet wrench is exceedingly well known as evidenced by its widespread usage in the mechanical arts. Although these wrenches are available in many designs, each for some specialized application, all fundamentally utilize the pawl and ratchet principle for the transmission of driving force to a bolt head or the like when rotated in one direction, while permitting substantially frictionless slippage upon rotation in the opposite direction. The utility of such wrenches may be extended considerably by utilizing a handle member which contains the required pawl and ratchet mechanism, together with a relatively large number of individually sized adapters for bolt heads of different configuration. The versatility of these devices may even be further extended by special handle shapes and flexible drives for bolts located in otherwise inaccessible locations.

As a general rule, designers of complex mechanical assemblies utilizing large numbers of nuts and bolts provide reasonable means of access to minimize initial fabrication and service problems. There are, however, many instances where the very nature of the mechanical apparatus requires an absolute maximum of components in a minimum of space, typical examples being miniaturized assemblies for use in aircraft and missiles. In fact, in some fields, the component packing density may become so high that the wrenching area which is ultimately available is no more than a few thousandths of an inch more than the space occupied by the nut or bolt head.

It is immediately apparent that the time and consequent cost of assembly under such circumstances is materially higher than that which would be encountered with an equally complex assembly spread over a volume which would provide ready access to each of the component parts.

In evaluating the basis for increased cost of closely packed mechanical assemblies, it is found that a significant factor is the sharp rise in time consumed in wrenching in crowded quarters. In many instances, a box wrench may be used effectively, but in the absence of a ratchet mechanism the wrench must be lifted completely from the head of the nut or bolt and relocated after some small fraction of a turn. It is not surprising therefore that in many jet aircraft engines or missile assemblies, as long as twenty minutes may be expended to tighten or loosen a single bolt. While this may be extreme, it points up the problem which must be faced by equipment designers, cost analysts, and those responsible for efficiently programming production schedules.

The present invention contemplates and has as a primary object the provision of a novel ratchet wrench particularly adapted, but not limited to, use in mechanical assemblies substantially inaccessible with wrenches of conventional commercial design. As the present description progresses, it will be seen that the novel wrench provided by this invention is of general utility, and thus may replace the more common, commercially available wrenches in a mechanic's toolbox, while in addition providing the means for performing wrenching operations in areas of mechanical assemblies which are ordinarily inaccessible to box wrenches or prior art ratchet devices.

2

It is another object of the present invention to provide a ratchet wrench which is of exceedingly simplified mechanical design. This in turn permits fabrication of the wrench from the finest quality materials at relatively low cost.

It is still a further object of the present invention to provide a novel ratchet wrench which completely avoids the need for gear mechanisms and the like which would otherwise have the effect of requiring a considerably enlarged wrench head, thus increasing the size, cost, and maintenance problems.

Another object of the present invention is to provide a ratchet wrench wherein the pawl is formed as an integral portion of the wrench handle member, thus assuring the strength and long-term durability, while avoiding entirely the need for delicate pivot pins and other movable parts.

Still another object of the present invention is to provide a ratchet wrench wherein the wrench head which encompasses the nut or bolt being worked is entirely free of pawl and ratchet mechanisms, thus enabling the external dimensions thereof to be maintained at an absolute minimum to enhance the utility of the device in respect to nuts and bolts situated in very close quarters.

It is a further object of the present invention to provide a ratchet wrench whose design inherently permits reversal of the direction of operation at the complete control of the user without resorting to push-buttons, pins, gears, or the like. Reversal of the driving direction is achieved by the simple expedient of inverting the wrench.

Yet a further object of the present invention is the provision of a reversible ratchet wrench which may be used directly on screws, bolts or nuts of hexagonal, square, or twelve point type, and whose utility may be vastly expanded by means of adapters for nuts and bolts of all commercial or special sizes and configurations.

Broadly speaking, the novel wrench of this invention comprises two basic elements; one of which is a handle member and the other a wrench head pivotally secured by a straightforward pin or a rivet. In the normal operating position, a pawl which comprises an integral extension of the handle member extends into a smooth generally cylindrical opening in a thin-walled wrench head. When the handle member is turned in the driving direction, the pawl grippingly engages the nut or bolt head for rotation with the wrench. Upon reversal of the direction of rotation, the pivotal connection between handle and wrench head operates to withdraw the pawl from the opening in the wrench head so that substantially frictionless, non-engaging reverse rotation is achieved. To reverse the operation from tightening to loosening, or vice versa, it is merely necessary to turn the wrench over with respect to the nut or bolt head. The cooperation between the wrench head and the handle member is essentially the same whether a nut is being tightened or loosened.

The foregoing design of features, objects, and advantages of the present wrench will become more apparent from the following detailed specification, when read in connection with the accompanying drawing in which:

FIG. 1 is a top view of a preferred embodiment of the ratchet wrench;

FIG. 2 is a side view of the wrench illustrated in FIG. 1;

FIG. 3 is an exploded side view of the novel wrench shown in FIGS. 1 and 2 and illustrates the exceedingly simplified mechanical design of the three basic components of the device;

FIG. 4 is a cross-sectional view of the wrench head taken along the line 4-4 of FIG. 2;

FIG. 5 is a top view of wrench shown in FIGS. 1-4 inclusive, and illustrates the operation of the pawl and wrench head combination for a particular direction of wrench rotation;

3

FIG. 6 illustrates a close quarters mechanical assembly and the special utility of the wrench of this invention in such situations;

FIG. 7 is a top view of a wrench embodying the principles of operation disclosed in connection with the wrench of FIGS. 1-5 inclusive, but including an additional element for further extending the utility of the device;

FIG. 8 is a side view of the wrench disclosed in FIG. 7; and

FIG. 9 is a cross-sectional view taken along the line 9-9 of FIG. 7.

With reference now to the drawing and more particularly to FIGS. 1-5 thereof, there is illustrated a preferred embodiment of a ratchet wrench embodying the principles of this invention. Generally speaking, this wrench is comprised of two simple mechanical members; namely, a handle member 11 and a wrench head 12 connected by a pin or rivet 13 for providing a pivotal connection between the wrench head 12 and the handle member 11.

The shape of the handle member 11 is a matter of design choice for a particular application, but is preferably in the form of an elongated generally cylindrical stem having a knurled-gripping end 14. At its left-hand end, the handle member 11 is formed with a section 15 of generally rectangular cross section which is symmetrically reduced in thickness to provide the outwardly extending, integral flat portion 16. The outermost end of the flat portion 16 is tapered as best illustrated in FIG. 1; and the pointed end thereof is notched to provide the pawl 21.

The junction between sections 15 and 16 of the handle member is defined by a pair of upstanding flat surfaces 22 and 23, which it will be observed from the drawing, are formed at an angle to the longitudinal axis of the handle member 11.

Turning now to the wrench head 12, this element is seen to be formed with essentially the same cross-sectional dimension as the section 15 of the handle member. The wrench head 12 is provided with a generally cylindrical opening 26 enclosed by a semi-cylindrical thin wall 27 at the outer end thereof. With specific reference to FIGS. 2 and 3, the wrench head is, at its inner end, formed with a slot 31 forming opposed ears 31a and 31b adapted to fit smoothly over and embrace the protrusion 16 at the left-hand end of the handle member 11. This slot, which may be milled or broached in the wrench head, extends to a depth sufficient to provide an opening 32 of rectangular cross-section, which communicates with the opening 26 in the wrench head. The purpose of this opening, as is best evident from FIG. 1, is to permit the free extension of the pawl 21 into the cylindrical opening 26 provided in the wrench head.

As illustrated in FIGS. 1, 2, and 3, the rivet 13 provides for a pivotal connection between the wrench head 12 and the handle member 11. The extent of angular rotation in either direction of the wrench head 12 on the handle member 11 is expressly limited by means of a pair of angular surfaces 41 and 42 on each of the ears 31a and 31b at the innermost end of wrench head 12. These surfaces 41 and 42 are of unequal length for reasons which will presently appear.

For convenience of explanation, consider the handle member 11 to be fixed. FIG. 1 thus illustrates the position of the wrench head 12 when rotated angularly counter-clockwise to the extent limited by the engagement of surfaces 41 and 22. In this condition, the pawl 21 extends into the wrench head opening. Turning now to FIG. 5, the wrench head 12 is shown rotated clockwise to the extent limited by the engagement of surfaces of 42 and 22. Under this condition it is clear that pawl 21 is withdrawn from the cylindrical opening 26, to provide an unobstructed passage through the wrench head opening.

In other words, the relative angular position of the wrench head 12 on handle member 11 determines whether

4

or not the pawl 21 extends into the opening 26 of the wrench head. Thus, the position of the integral pawl 21 is determined not by springs, gears, or other associated mechanism, but rather by the simple expedient of relative angular movement between the two principal members of the wrench itself.

Having thus described the mechanical structure of a preferred embodiment of the wrench of this invention, its utility and mode of operation will now be considered. FIG. 6 illustrates a typical close quarters requirement; namely, a bolt having a 12 point head 51 closely confined between side wall 52 and an overhang 53. The wrench of this invention is shown in position before being lowered upon the bolt head 51. Observe the absolute minimum of clearance around the bolt head 51 and the manner in which this bolt head is accessible to the illustrated wrench. Simply by lowering the wrench over the head of the bolt, the desired wrenching operation in either direction may be achieved. The 12 point head illustrated is shown with a lower washer flange 59. Note that the semi-cylindrical end of the wrench head need be no greater in wall thickness than this washer flange. In other words, if there is sufficient space for a 12 point bolt or nut, there is sufficient space for use of the novel wrench and its ratchet mechanism.

To further illustrate this mode of operation, reference is now made to FIG. 5 which shows a top view of the novel wrench, with the wrench head 12 in engagement with a 12 point bolt head 51, of the type illustrated in FIG. 6. As viewed in FIG. 5, the wrench handle member 11 is being rotated counter clockwise, and under these conditions the wrench head 12 and handle member 11 will angularly reside in the position shown, with the pawl 21 withdrawn from the wrench head opening. Accordingly, as the wrench is rotated counter clockwise as viewed in FIG. 5, the wrench head 12 will simply slip over the bolt head, since the pawl is withdrawn from engagement with the bolt head. By rotating the wrench clockwise as viewed in FIG. 5, the relative angular position of handle member 11 and wrench head 12 will change to that shown in FIG. 1, whereby the pawl 21 will enter the wrench head opening and engage the 12 point bolt head for tightening. In short, by repeated clockwise and counter clockwise strokes, as viewed in FIG. 5, the bolt head 51 will be tightened, the length of the stroke being determined by the available space for handle rotation in the particular mechanical assembly.

It is appropriate at this point to note that if it is desired to loosen rather than tighten the bolt head 51 shown in FIG. 5, it is merely necessary to invert the entire wrench; no other operation in respect to the pawl being required. The inversion of the wrench will have the effect of reversing the direction of bolt rotation.

Returning to FIG. 1, the disparity in the relative lengths of the surfaces 41 and 42 of the wrench head 12 was previously noted. As viewed in FIG. 1, clockwise rotation will apply the driving force to a bolt head within the wrench opening to achieve maximum driving force, the engagement between surfaces 41 and 22 is maintained at a maximum. When the wrench shown in FIG. 1 is rotated counter clockwise, the pawl 21 is withdrawn and no driving force is transmitted, thus the surface 42 in engagement with surface 22 as viewed in FIG. 5, merely provides a stop without the transmission of any forces. Accordingly, this surface engagement may be relatively small. In the foregoing manner, maximum utility is made of the available material.

With reference now to FIGS. 7, 8, and 9, an alternative embodiment of the wrench disclosed in the preceding figures is illustrated. In view of the close similarity between these devices, like reference numerals have been applied wherever applicable. The principal point of distinction is that the wrench head 12 is somewhat longer in the region between the pivot pin 13 and the opening 26. A rectangular slot 61 as shown in FIG. 9 is broached

5

or otherwise formed in this wrench head 12, and a small, smoothly fitting rectangular block 62 is inserted therein prior to final assembly with rivet 13. The axial length of block 62 is such that it is unable to slip out of the assembled wrench through opening 26.

The end of block 62 which extends toward or into opening 26 is formed with a plurality of notches thereby defining the pawl 65. The number of notches is dependent upon the type of work-piece to be used, and in FIG. 7, this is designed to engage either a 12 point bolt head or a 6 point bolt head.

The left-hand end of handle member 11 is formed with a cam-like outer surface which as illustrated operatively engages the inner end of block 62. When the wrench shown in FIG. 7 is rotating clockwise, the cam surface drives block 62 into the opening 26 and into engagement with the nut or bolt being driven. When the handle member 11 is rotated counter clockwise as viewed in FIG. 7, the cam surface recedes and permits block 62 to slide to the right thereby clearing opening 26 to permit substantially frictionless return movement of the ratchet wrench, as illustrated. In FIG. 8, the pawl 65 is chamfered or rounded at edges 69 and 71 thereby enabling the wrench to slip over the bolt to be tightened or loosened. In other words, the chamfered edges ease the sliding motion of block 62.

In all other respects, operation of the wrench of FIGS. 7, 8 and 9 is the same as that disclosed in the preceding figures. Heavier loads, however, may be applied due to the increased number of teeth in the pawl, or for a given use, longer life may be expected.

Summarizing the foregoing, the present invention provides a ratchet wrench of exceedingly simplified, durable design with a minimum of components. The location of the pawl permits a wrench head design which need be only slightly larger than the diameter of the bolt head being turned. In particular, 12 point heads are formed with relatively shallow serrations having fairly wide tolerances. Prior available tooling, such as box wrenches, also are made with wide tolerances, resulting in the not too infrequent occurrence that wrench and head would grip poorly, if at all. Proper wrenching torque cannot thus be applied. With the present novel wrench, the pawl will automatically seat and lock irrespective of bolt head diameter variations.

Although the above description has been related to 12 point heads, and the like, it should be observed that by means of suitable adapters these wrenches may be used to grip other fastening devices, including socket heads or even fillister heads. Of course, the adapters will have a 12 point head sized to fit the particular wrench head opening.

The wrench may be made of a suitable steel and may be appropriately tempered to achieve the desired degree of toughness despite the relatively close dimensions of the wrench head itself.

In view of the foregoing, various modifications and alternative designs may become apparent to one skilled in this art. Accordingly, the present invention is to be construed as limited only by the spirit and scope of the appended claims.

What is claimed is:

1. A ratchet wrench comprising an elongate handle member and a wrench head having a first opening for encompassing a bolt head or the like, said handle member having at one end thereof a flat integral extension termi-

6

nating in a pawl, said wrench head being formed with opposed means for embracing said flat extension, said wrench head having a second opening communicating with said first opening, means pivotally connecting said opposed embracing means and said flat extension, and a surface on said handle member cooperating with means on said wrench head for limiting the relative pivotal movement of said wrench head between a first limit wherein said pawl projects through said second opening into said first opening and a second limit wherein said pawl is withdrawn from said first opening.

2. A ratchet wrench in accordance with claim 1, wherein said cooperating means on said wrench head for limiting said pivotal movement comprises a pair of angularly related surfaces which abut along different areas of the cooperating surface on said handle member at said first and second limits of said pivotal movement.

3. A ratchet wrench in accordance with claim 1, wherein said pawl is formed as a substantially pointed and notched coplanar end of said flat integral extension of said handle member.

4. A ratchet wrench comprising an elongate handle member and a wrench head having a first opening for encompassing a bolt head or the like, said handle member being formed at one end thereof with a flat integral extension defining a cam, said wrench head being formed with means for embracing said flat extension of said handle member, means for pivotally connecting said embracing means of said wrench head to said flat extension of said handle member, said wrench head being formed with a second opening communicating with said first opening, and a pawl slidably fitted in said second opening and engageable with said cam, relative angular movement of said wrench head and handle member being adapted to drive said pawl into said second opening.

5. A ratchet wrench in accordance with claim 4, wherein said pawl is a substantially rectangular block having notches formed in the end thereof adapted to extend into said second opening, said handle member and said wrench head having cooperating means for limiting the relative angular motion therebetween, said pawl being driven into said second opening by said cam upon angular movement to the limit in one direction and being adapted to slide into said wrench head away from said second opening upon angular movement to the limit in the opposite direction.

6. A ratchet wrench as defined by claim 1 wherein said surface extends transversely of said handle member and said pivot is located between said surface and said first opening in eccentric relation to said pawl.

References Cited in the file of this patent

UNITED STATES PATENTS

149,641	Collis	Apr. 14, 1874
282,768	Pollard	Aug. 7, 1883
453,537	Bates et al.	June 2, 1891
909,101	Longdin	Jan. 5, 1909
1,022,591	Perry	Apr. 9, 1912
1,370,510	Bockover	Mar. 8, 1921
1,380,822	Mason	June 7, 1921
1,436,698	Croft et al.	Nov. 28, 1922
2,751,802	Revillard	June 26, 1956
2,764,049	Hartung	Sept. 25, 1956

FOREIGN PATENTS

26,212	Great Britain	of 1914
--------	---------------	---------