SPLIT RATCHET SOCKET WRENCH

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1. This invention relates to socket wrenches and more particularly to a split form of socket wrench particularly adapted for use in difficult applications such as to encircle tubing, conduit, cable, shafting and the like in close quarters where wrenches of ordinary construction can not be used.

This invention is an improvement on and modification of the wrench disclosed in my co-pending application Serial No. 590,577, filed April 27, 1945, entitled "Split Ratchet Socket Wrench" and differs primarily therefrom in the structure of the work turning member and its driving element.

Wrenches previously intended for a similar purpose have been of too bulky or rugged construction for closest types of work and their vulnerability to spreading under heavy loads has made them of limited adaptability, and generally cumbersome in use as well as uneconomical in production. A split or tubing type wrench with a universally manipulatable handle, whose operating parts are of small compass, and which can sell within the competitive price range of more conventional types of wrenches, has not hitherto been successfully made. Herefore, wrenches of the general type intended by this invention, if made at all, have required massive jaws and a bulky, non-adaptable and rigid construction to provide adequate strength for sustaining the extraordinary stresses to which this type of equipment is often subjected.

This invention therefore has for an object the provision of a wrench of the ratchet type utilizing replaceable, split sockets combining maximum strength and adaptability with minimum over-all dimensions for accomplishment of the desired purposes herein referred to, and to this end has among its more specific objects the following:

1. To provide a combined wrench head and handle constructed of the fewest possible operative parts, all of which are quickly and easily assembled or replaced.

2. To provide a wrench of the desired character described, the individual parts of which are strong, readily manufactured and easily and economically replaced or repaired.

3. The provision of a wrench adapted for use on tubing fittings and the like having a relatively small over-all measurement of the working parts to provide a maximum clearance for working around obstructions and adapted to be operated in hard, inaccessible locations, such as around stuffing tubes and packing glands, in manifolds having many fittings closely grouped, and particularly in marine installations where bulkhead fittings render access almost impossible with conventional equipment.

4. To provide a universally adjustable wrench head of small compass and of new and improved construction which is light in weight, yet adapted to withstand unusual stresses, and to this end providing a new and improved socket retainer in combination with a new and improved socket shank in a manner to combine great strength with unusual compactness.

5. Provision of a new and improved constructional relationship between a wrench handle, head and optional ratcheting hub.


7. Provision of a new and improved manufacturing method peculiarly suited to production of the wrench described.

Another object of this invention is the improvement of prior devices and methods intended for the purposes contemplated.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

Referring to the drawings:

Figure 1 is an elevational view of a preferred embodiment of this invention showing in dotted outline alternate relative positions of the wrench, head, socket and handle respectively.

Figure 2 is a view on the line 2—2 of Figure 1.

Figure 3 is a view on the line 3—3 of Figure 1.

Figure 4 is an enlarged view of the wrench body or head similar to Figure 2, the cover being removed to show the working parts.

Figure 5 is a fragmentary, enlarged view of a portion of the socket-driving construction.

Figure 6 is a sectional elevational view on the line 6—6 of Figure 4.

Figure 7 is a reduced view similar to Figure 4, but showing the operative parts in a different functional relationship.

Figure 7a is an enlarged sectional view on the line 7a—7a of Figure 7.

Figure 8 is a view similar to Figure 7, but showing the parts in a subsequent operative position.

Figure 9 is an elevational view of the wrench as used.

Figure 10 is a plan view of a modified form of wrench.
Figure 11 is a further modified form of said wrench.

Referring more particularly to the drawings, a wrench head generally designated by the numeral 20 may be provided with a handle 21 optionally pivotal through an angle of 180° by means of a knuckle 22 and provided, if desired, with a cross bar 23 extendible to any desired extent through a suitably formed hole 24 in the handle through which the cross bar 23 is slidable or completely withdrawable. The end of the handle adjacent the head 20 is preferably provided with a square end 25 equipped with a spring urged ball 26 and is adapted for engagement in a correspondingly shaped opening 27 in the wrench head. The wrench head may, but need not, be provided with a suitable concavity 27' for the reception of the ball 26, as is conventional in similar forms of construction. Other customary features of the handle may include knurling 28 of the hand grip or reducing shank portions 29.

The head 20 comprises a preferably oval shaped body portion 32 formed at one end with a slot 33 adapted for the accommodation of conduit 34 (Figure 9) or the like. The slot 33 is in communication with a bore 35 extending, like the slot 33, throughout the thickness of the body 32.

Rotatably mounted within the bore 33, in a manner to be described, is a hub or ratchet wheel 37 formed with a slot 38, corresponding to the slot 33, communicating with a hollow central portion 39. The hub 37 is provided with full-width, notch-like grooves 41 and teeth 42 circumferentially about its entire unslotted periphery. The hub is further formed with an arcuate socket-receiver face 43 preferably terminating in substantially hook-shaped driving faces 44 and 45, thereby providing a recess for the slidable reception of a shank 46 of any selected socket 47.

Surrounding the bore 35 preferably upon one side 50, herein arbitrarily designated as the "bottom" of the wrench body, an annular flange 52 is preferably formed bounded by a concentric annular groove 53. Said groove is continuous upon one of its walls with a wall 55 of the body 32.

The hub 37 is normally rotatable within the bore 35 and may be guided for such purpose as well as strongly reinforced by a concentric annular shoulder or flange 56 complementary to the annular groove 53 and an annular groove 57 complementary to the annular flange 52.

Leaf shaped paws 60 and 61 having bearing ends 62 are disposed within suitable bores or recesses 63 and 64, respectively, in one end of the body in a manner to turn the hub from a side remote from the slot 35. These are normally urged into engagement with the teeth 42 at their operative edges 65 as by means of pyramid shaped coil springs or the like 66. It will be seen that the orientation of the paws is such that rotation of the hub is permitted in only one direction. In order to reverse the direction of effective rotation of the hub and therefore of the wrench, it is necessary to reverse the relative position of the socket as illustrated in Figure 1 in dotted outline and as further elaborated below, such as socket 47, may be of all standard sizes and of any conventional construction upon their mating edge 70 and may, for example, be formed with an outer wall 71 and any conventional number of facets 72. The sockets may be of any desired depth and are most desirably provided, as heretofore stated, with an axially disposed shank 46 of arcuate shape, an inner face 76 of which confronts the space 39, and an outer face 71 of which is normally contiguous with the inner face 43 of the hub 31.

It is to be noted that the shank 46 terminates at each side in acute angles 78 and 79 formed by driven faces 80 and 81, respectively. Angles 78 and 79 on the driven shank are more acute than those formed by the corresponding driving faces 45 and 44, respectively, on the hub 37 (as disclosed most clearly in Figure 5). By this means potentially destroying contact between the shank 46 and the points 82 and 83 on the driving hooks 84 and 85, respectively, is prevented. Thus, the hooks 84 and 85, although subject to a great deal of direct strain, will not be deformed over at said points, nor the hooks bent out of line. Instead the torquing forces are transmitted by the innermost angles of the hooks, avoiding the usual and undesired spreading of the hub and socket.

The end 56 of the body 32 opposite from the slot 33 is, as stated, adapted for the handle 21 and is furthermore preferably formed as at 87 for the reception of any suitable securing means such as screws 88 extending through an appropriately shaped cover 89 which is preferably nested in a similarly shaped recess 90 formed in the top side 91 of the body 32. In this manner the cover 89 is made flush with the top of the wrench body.

The cover 89 serves not merely to form one side of the wrench head but also serves to retain the paws 60 and 61 in place. It, moreover, serves to retain the hub 37 in proper position and within the groove 53 and upon the annular flange 52. Removal of the cover renders all of these parts accessible and readily removable for replacement or repair.

The sockets, through their shanks 46, may be retained within the hub either through friction alone or by means of a spring urged ball 92 in a similar manner to the retention of the handle within the wrench head by the spring urged ball 95.

The wrench as thus formed comprises a compact unit into which a socket 47 may be fitted from either the top side or the bottom side of the head and made to rotate in a corresponding clockwise or counterclockwise motion, respectively, as desired.

Operation

In the use of this new and improved wrench as disclosed in Figures 1 through 9, as for example, where a coupling or packing nut 55 upon a conduit 34 (Figure 9) must be removed although disposed closely between like structures 56 and 97 in a manifold or the like, a socket 47 of proper size corresponding to the nut 95 is selected and inserted into the hub 37 from the top side 91 of the hub. The handle 21 may then be inserted into the opening 27 from either side of the wrench head and may then extended either radially in the manner of a torque wrench, or vertically, utilizing the cross bar 23 or, if desired, the handle may be positioned at any convenient intermediate angle.

In order to slip the wrench over the conduit 34 it will be necessary to align the slots 33 and 38 in the body and hub of the wrench respectively. Such alignment will automatically place the slot 56 of the socket and shank in correct alignment with said other slots 33 and 38 in a manner to permit the wrench head to be placed in a working position. In such position the head
itself is normally placed between the conduit or, as shown, slightly above the nut 85, thereby providing greater clearance for the head than is required between the nuts 85 themselves (except of course upon very large nuts which may exceed the width of the head 20). However, in the more confined position between the fittings, the sockets are easily overmodulated. The wrench may now be turned by continuous oscillation of the handle and, depending upon the angular size of the teeth which have been found suitably formed at approximately 7½ degrees to 9½ degrees around the circumference of the hub.

When the nut has been completely removed and it is desired to replace the same, the position of the parts must be operatively reversed and for this purpose the socket 47 may be removed from the hub and inserted from the opposite or bottom side 50 of the wrench head and the whole again inverted into position upon the nut, whereupon like oscillatory movement of the handle will act to drive the nut in a clockwise direction, tightening the same. In removing the socket for the effective reversing movement thereof it will be necessary to align the slot in the socket with the body and the hub in a similar manner to that previously required for fitting them to the nut in the first instance.

**Modified form**

The form of wrench body 101, shown in Figure 10, comprises a pair of arms 102 and 103 formed with suitable hooks 104 and 105. The inner faces 106 and 107 of the hooks form preferably acute angles with the inner face 108 comprising the socket retaining recess of this form of the device. No ratchet and therefore no hub is necessary in this simplified form, but it has been found practical to provide a suitably shaped, preferably square opening 109 at the back side of the wrench for the insertion of a handle either of any conventional, rigid construction or of a substantially similar construction to that illustrated for the preferred embodiment first above described and illustrated.

**Further modified form**

The still further modification illustrated in Figure 11 is similar in all operative respects to the modified form illustrated in Figure 10 wherefore the same reference numerals are applied to both modifications, but in lieu of the square opening 109 or, if desired, in addition thereto the wrench may be provided with an integral handle 110.

The manner of use of both modified forms is identical to that of the first embodiment except that they are not subject to use in such confined quarters nor with as much facility. It is not necessary in either of the modified forms to reverse the socket in order to reverse their operative motion but replaceable sockets are provided in either case. These modified forms have the advantage of simplicity and therefore are more economical of production and within their relatively limited use a considerably even less attention and may be given more abuse than the preferred embodiment first described.

It is worthy of note that in the preferred embodiment of Figures 1 through 9 the body of the wrench is susceptible of manufacture, so far as the method of cutting is concerned, by two end milling or drilling operations without the necessity of moving the mill into or through intermediate positions. Thus, the bore for the reception of the hub can be drilled through and the shoulder and guide elements for such hub, being concentric with such bore, can be formed therein either by the same continuous operation of drilling or by the utilization of other appropriate tools without the necessity of moving this part from its centered position. Closer tolerances may thus be provided resulting in more accurate and trouble free operations.

The pawl recesses and bearing recesses associated therewith may be end-drilled with slight movement of the part from its centered position or may be drilled in place by tools previously positioned for that purpose so that the drilled and tapped holes for screwing the cover and the cutout 27 of the handle.

A similar end milling operation from the center of the bore 28 and on a slightly larger radius provides a suitable recess on the end 36 of the body for the reception of the cover. In the manufacturing process, the pawls may be slipped into place without removing the body or head from its drilled position. The hub may likewise be dropped into place, although a slight twisting movement has been found desirable in securing the proper orientation of the pawls during such assembly.

The cover in fitting snugly into its recess and in view also of its substantially figure 8 form is rigidly held against sidewise movement in any direction and furnishes a satisfactory guard, conduit guide and retaining member for the pawls and hub.

All of the illustrated forms of this wrench, including the first preferred embodiment, are possessed of unusual strength in view of the hook shape of the driving element which thereby tends to urge the socket member circumferentially in a manner to avoid the usual radial stresses upon the hub and socket. Such radial stresses are further minimized and overcome by the guided groove-and-flange relationship of the body and hub. This relationship can, if desired, be duplicated in the top side of the wrench. Other forms of flanges, grooves, or parts thereof and equivalent guide means would readily occur to one skilled in the art and are contemplated within this inventive conception which is to be taken as illustrative only, and not as limiting.

Any form of spring other than the pyramidal form of coil spring shown may obviously be employed with similar effect, although it has been found desirable to employ a spring of the character set forth (which is independently secured to the pawl) prior to the sidewise insertion of the pawl into the body, as by means of the groove and bores established for such purpose.

As may be seen from Figures 7 and 8 one of the pawls is always engaged with the hub, even though the other is passing the slot 38, and the wrench is therefore capable of being used so that the hub continuously rotates through an angle of 360°. Moreover, the pawl presses upon the hub from the rear of the wrench so as to distribute the stresses upon the hub and force the same in a manner which resists radial and other pull-a-part forces normally tending to permanently strain the wrench and/or socket.

The wrench may obviously be made of any suitable ferrous material, and chrome molybdenum steel has been found to be entirely satisfactory.

The wrench is particularly adapted for tightening nuts on tubing, cables, shaft fittings or protruding studs wherein ordinary socket or ratchet wrenches cannot be used. The socket
is capable of encircling such tube, shaft or cable and will ratchet continuously without interruption with only slight movement of the handle. If desired, the pawls may be spaced to operate on the teeth alternately, thereby permitting an even lesser movement of the handle in order to assure effective ratcheting movement.

This invention features a slotted ratchet type wrench with replaceable sockets, the head being of maximum strength and minimum width utilizing interlocking flanges and grooves or other guide means in a rotatable hub. A hooked type drive is provided between the body and the hub. A square handle socket is employed where removable handles are desired, and such handle may be universally movable. A telescopic connection of the wrench body with the socket element assures a narrow overall measurement.

The pawl action is simple, sturdy and effective. Of particular importance is the short overall distance across the head from arm to arm which is made possible primarily by the reinforcing of the arms through their hub-guiding elements. Said guides, in addition, insure the proper alignment of the hub within the body especially during and after the movement of the hooks 84 and 85 across the slot 33 in the body. In view of the fact that the whole construction is calculated to oppose radial distortional stresses of the work engaging parts and the associated structures.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A wrench comprising a rotatable driving element having an opening therethrough, said opening having an arcuate wall, a shoulder extending inwardly from each end of said arcuate wall at an acute angle thereto, a wall extending from each of said shoulders to the exterior of said element and forming an open slot communicating with said opening, a replaceable nut turning member having a portion adapted to be inserted in said opening, said portion having an arcuate exterior surface corresponding to said arcuate wall and adapted to lie contiguous thereto in the inserted position of said portion, said portion being formed with a face extending inwardly from each end of said arcuate wall at an acute angle thereto and forming a pair of abutments to engage said shoulder and provide driving connection between the driving element and work turning member, and means for rotating said driving element.

2. A wrench according to claim 1 in which the angle of each of said faces to the arcuate surface of said portion of the work turning element is less than the angle of each shoulder to said arcuate wall of the driving element.

3. A wrench according to claim 2 in which said arcuate wall is not less than 180°.

4. A wrench comprising a rotatable driving element having an opening therethrough and walls forming a slot extending from the exterior of said element into the opening, said opening having an arcuate wall extending substantially between the inner ends of the slot forming walls, a replaceable nut turning member having a body formed with a nut gripping socket, and a coaxial shank, said shank having an exterior arcuate surface and adapted to be inserted in said opening with said arcuate surface lying contiguous to said arcuate wall, said member having a side opening extending the full length of said body and shank and having an inner wall concentric with the common axis of the socket and shank, and longitudinally extending complimentary keying means formed respectively on said shank and wall of said opening and interengaged in the inserted position of said shank to provide a rotary driving connection between the driving element and nut turning member and to align said side opening in registration with said slot.

5. A wrench comprising a rotatable driving element having an opening therethrough having an arcuate wall, a shoulder extending inwardly from each end of said arcuate wall at an acute angle thereto, a wall extending from each of said shoulders to the exterior of said element and forming an open slot communicating with said opening, a replaceable nut turning member having a portion adapted to be inserted in said opening with the said arcuate surface lying contiguous to said arcuate wall, said member having a side opening extending the full length of said body and shank and having an inner wall concentric with the common axis of the socket and shank, said shank engaging said shank adjacent the outer end of said side opening in the inserted position of the shank to provide a driving connection between the driving element and the nut turning member and to align said side opening in registration with said slot.

6. A wrench comprising a head having an arcuate bore therein and an open slot extending from the exterior of the head into said bore, a hub journaling for rotation in said bore, said hub having an opening formed with an arcuate wall concentric with the axis of rotation of the hub, said hub also having an open slot extending from the exterior thereof into said bore, said hub being adapted to register with the slot in the head in one rotative position of the hub, abutment means on the hub forming at least one shoulder extending from said wall into said opening, a replaceable work turning member having a portion adapted to be inserted axially into said opening, said portion having an external arcuate surface corresponding to said arcuate wall and adapted to lie contiguous thereto in the inserted position of said portion, an abutment formed on at least one end of said portion and engaging said shoulder in the inserted position of said portion to provide driving connection between the hub and work turning member, and ratchet means operatively connecting the head and hub whereby the hub may be rotated upon rotation of the head.

7. A wrench comprising a head having an arcuate bore therein and an open slot extending from the exterior of the head into said bore, a hub journaling for rotation in said bore, said hub having an opening formed with an arcuate wall concentric with the axis of the rotation of the hub, said hub also having an open slot extending from the exterior thereof into said opening and adapted to register with the slot in the head in one rotative position of the hub, abutment means on the hub forming a pair of circumferentially spaced and facing shoulders extending
from said wall into said opening parallel to said axis of rotation, a replaceable work turning member having a hub engaging portion adapted to be inserted axially into said opening, said portion having an external arcuate surface corresponding to said arcuate wall and adapted to lie contiguous thereto in the inserted position of said portion to provide driving connection between the hub and work turning member, and ratchet means operatively connecting the head and hub whereby the hub may be rotated upon rotation of the head.

8. A wrench according to claim 7 in which one of said shoulders lies at each end of said arcuate wall adjacent the inner end of said slot.

9. A wrench comprising a head having an annular bore therein and an open slot extending from the exterior of the head into said bored, a hub journalned for rotation in said bored, said hub having an opening therein formed with an arcuate wall of not less than 180° concentric with the axis of rotation of the hub and spaced walls extending from the ends of said arcuate wall to the exterior of the hub, said spaced walls defining an open slot adapted to register with the slot in the head in one rotative position of the hub, each of said spaced walls having a portion adjacent the juncture thereof with said arcuate wall extending inwardly from said arcuate wall at an acute angle thereto and forming a pair of hooks, a replaceable work turning member having a hub engaging portion adapted to be inserted axially into said opening, said portion having an external arcuate surface corresponding to said arcuate wall and adapted to lie contiguous thereto in the inserted position of said portion, a pair of abutments formed on the ends of said portion and engaging respectively in said arcuate walls to provide driving connection between the hub and work turning member, and ratchet means operatively connecting the head and hub whereby the hub may be rotated upon rotation of the head.

10. A wrench comprising a head having an annular bore therein and an open slot extending from the exterior of the head into said bored, a hub journalned for rotation in said bored, said hub having an opening therein formed with an arcuate wall of not less than 180° concentric with the axis of rotation of the hub and spaced walls extending from the ends of said arcuate wall to the exterior of the hub, said spaced walls defining an open slot adapted to register with the slot in the head in one rotative position of the hub, each of said spaced walls having a portion adjacent the juncture thereof with said arcuate wall extending inwardly from said arcuate wall at an acute angle thereto and forming a pair of hooks, a replaceable work turning member having a hub engaging portion adapted to be inserted axially into said opening, said portion having an external arcuate surface corresponding to said arcuate wall and adapted to lie contiguous thereto in the inserted position of said portion, a pair of abutments adapted to nest respectively in the first named angles in the inserted position of said portion to provide driving connection between the hub and work turning member, and ratchet means operatively connecting the head and hub whereby the hub may be rotated upon rotation of the head.

11. A wrench comprising a head having an annular bore therein and an open slot extending from the exterior of the head into said bored, a hub journalned for rotation in said bored, said hub having an opening therein formed with an arcuate wall concentric with the axis of rotation of the hub and spaced walls extending from the ends of said arcuate wall to the exterior of the hub, said spaced walls defining an open slot adapted to register with the slot in the head in one rotative position of the hub, each of said spaced walls having a portion adjacent the juncture thereof with said arcuate wall extending inwardly from said arcuate wall at an acute angle thereto and forming a pair of hooks, a replaceable nut turning member having a body formed with a nut gripping socket and a shank extending axially to said socket, said shank having an external arcuate surface and adapted to be inserted into said opening with the said arcuate surface lying contiguous to said arcuate wall, said member having a side opening extending the full length of said body and shank and having an inner wall concentric with the common axis of the socket and shank, the said shoulders engaging said shank adjacent the outer end of said side opening in the inserted position of the shank to provide a driving connection between the driving element and the nut turning member and to align said side opening in registration with said slot, and ratchet means operatively connecting the head and hub whereby the hub may be rotated upon rotation of the head.

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