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WRENCH SOCKETS, SOCKET DRIVES AND SIMILAR COUPLERS

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Fig. 1

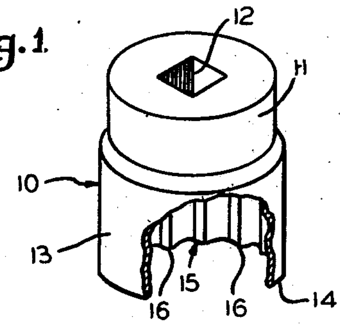


Fig. 2

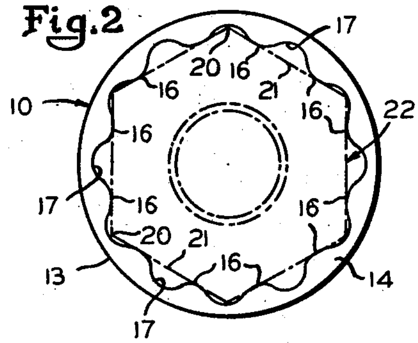
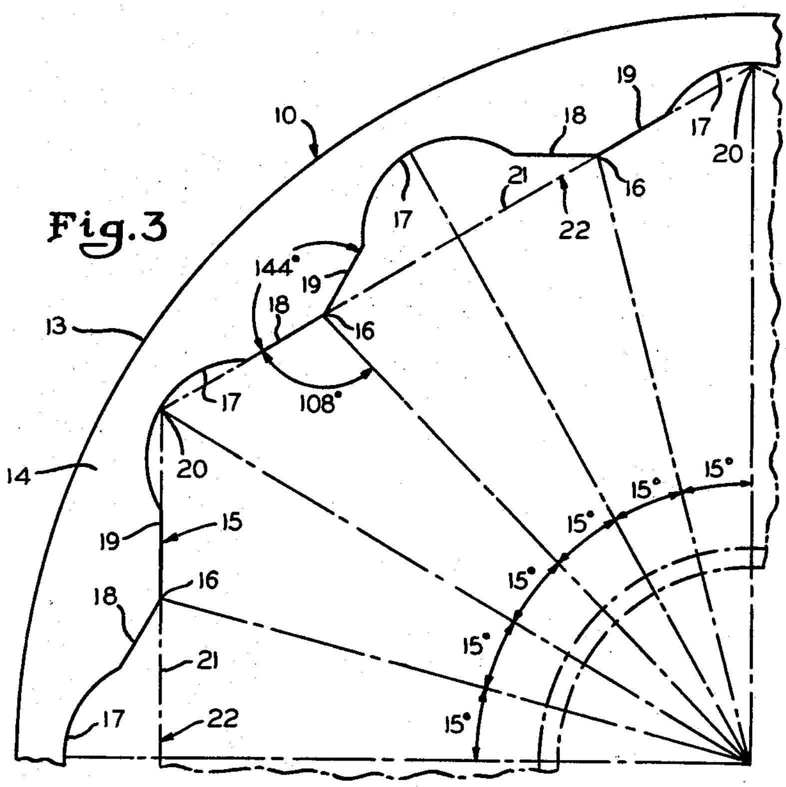


Fig. 3



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WRENCH SOCKETS, SOCKET DRIVES AND SIMILAR COUPLERS

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U.S. Cl. 81—121 6 Claims

ABSTRACT OF THE DISCLOSURE

The invention involves hexagon and double hexagon or the like flank sockets or drives for corresponding standard fasteners which impart the torque turning load thereto to the sides or flanks rather than to the corners thereof, and to accomplish this with limited looseness for oscillatory play and maximum accessible registry between the driving and driven elements, the angularity of the socket faces are within a limited plus or minus range of 144 degrees outside and 216 degrees inside as a preferred angularity for minimum permissible looseness with sufficient clearance to facilitate registry between the driver and driven elements. The geometric peripheral configuration of the flank engaging driver jaws alternate between concavities to provide complete nut corner driving disengagement, and the centers of the concavities alternating with the oppositely inclined flank jaws are symmetrically indexed on substantially 15 degree radii emanating from the wrench or driver socket axis.

This invention relates to socket drives and more particularly to wrench sockets of the flank drive type effective to engage the sides rather than the corners of standard fasteners such as hexagon nuts with substantially improved torque transmission characteristics over standard hexagon and particularly double hexagon corner drives heretofore in general use. This application is related to our copending application Ser. No. 321,955 filed Nov. 6, 1963, which eventuated into Letters Patent No. 3,272,430 dated Sept. 20, 1966.

It contemplates more especially the improved hexagon and double hexagon flank socket or wrench jaw drives for standard fasteners such as hexagon nuts and the like which impart the torque transmission load to the sides or flanks rather than to the corners thereof and accomplishing this with limited looseness or oscillatory-type play necessary to a degree so that registry is possible between the socket or wrench drive and the nut fasteners.

With the teachings of the present invention, the angularity of the oppositely related nut flank engaging surfaces is within a range which will afford minimum practical looseness for registry with the fastener nuts and contact therewith near but not at the corners to insure proper nut turning leverage and to avoid under all circumstances corner engagement. The elimination of nut corner engagement is absolute irrespective of wrench surface engaging flanks by reason of interposing concavities between each pair of opposing angular flank surfaces around the circumference of the wrench socket or open end jaw configuration. This improves torque transmission characteristics, greater stress withstanding configurations result, and both the hexagon fastener nut drivers and particularly the double hexagon type wrench drives therefore are rendered more egective to turn greater torque tightening loads without increasing the present wall socket thicknesses nor limiting registration accessibility between the drive sockets and the nut fasteners.

The trend has for many years been in the direction

of reducing wrench socket wall thicknesses of driving sockets and particularly in double hexagon or so-called twelve-point sockets which agord a double bite or nut registration in half the arc of movement in restricted or unaccessible locations in tightening and loosening nut fasteners. This is particularly important in the automobile industry by reason of the design of engines which are provided with many nut fasteners in relatively inaccessible places so that twelve-point wrench socket drives and increasingly thinner wrench socket walls are requirements that pose problems which are effectively overcome with the specific teachings of the present invention.

It is generally known that because of these requirements and the use of tighter applied fasteners with the higher compression engines, the thin wall double hexagon or twelve-point wrench socket is vulnerable in the sharp corners. This is true even though wrench socket materials have been strengthened greatly in the last decade or more so that improvement must now come in providing a more effective torque transmitting wrench socket design. This has been accomplished with the teachings of the present invention by utilizing a socket design having specific ranges of angularly related nut flank engaging surfaces that constitute a complete side drive socket with curved recess receiving rather than sharp corner engaging expedients to relieve the stress therein and increase the resistance to stress with improved torque transmitting characteristics and longer life to both the wrench sockets or open end wrenches including box socket wrenches and the nut fasteners turned therewith.

One object of the present invention is to provide an improved side drive wrench or wrench socket design for hexagon nut fasteners and the like wherein a limited angular relation is provided between opposed contiguous driving surfaces for nut fastener flank surface engagement.

Another object is to provide a more effective side drive wrench socket design which will vastly improve the torque transmitting characteristics of thin wall wrench sockets and particularly thin wall wrench sockets of the twelve-point or double hexagon type without sacrificing freedom of registration between the sockets and the fastener nuts.

Still another object is to provide a wrench socket or its complemental male drive with a hexagon or double hexagon configuration that more fully sustains the nut sides rather than the nut corners to accomplish nut turning with increased torque loads and less stress without sacrificing freedom of registration between the sockets and the fastener nuts.

A further object is to provide an improved wrench socket drive design which imparts increased side torque transmission to the fasteners and totally relieves the corner contact stresses in the socket so that improved torque transmitting characteristics result with less deformation to the reacting surfaces of both the fasteners and the wrench socket jaws or drives, and accomplishing this without too much looseness or play of the ratcheting type and with sufficient freedom of registration therebetween.

A still further object is to provide an improved hexagon or double hexagon wrench socket drive that provides maximum side torque transmitting surface engagement with complemental nuts or their counterparts, and totally eliminates corner loads thereon, and accomplishing this with oppositely angular contiguous jaw surfaces of limited angularity having alternately interposed recesses for nut corner stress relief, thereby avoiding fastener corner mutilation with increased load capacity in nut turning.

Still a further object is to provide a wrench socket or a male drive counterpart thereof having improved nut turning torque transmitting characteristics of maximum side drive and zero corner engagements with minimum ratchet-type looseness and sufficient freedom of registration with complemental nut fasteners so that longer service is possible for both with improved load bearing limits.

Other objects and advantages will appear from the following description of an illustrated embodiment of the present invention.

In the drawing:

FIGURE 1 is a perspective view of a wrench socket embodiment of the present invention, parts thereof being broken away and shown in section to clarify the showing.

FIGURE 2 is a plan view of a wrench socket embodying features of the present invention, the nut fastener being shown in dotted outline to illustrate the torque transmitting side drive characteristics thereof.

FIGURE 3 is an enlarged fragmentary plan view similar to FIGURE 2 and illustrating the side drive characteristics of the socket design without any corner engagement with the nut fastener.

The structure selected for illustration is not intended to serve as a limitation upon the scope or teachings of the invention, but is merely illustrative thereof. There may be considerable variations and adaptations of all or part of the teachings depending upon the dictates of commercial practice. The present invention is exemplified by a wrench socket **10** preferably though not essentially provided with a reduced cylindrical base **11** having a polygonal axially positioned bore therethrough, in this instance a square-shaped bore **12** for receiving a correspondingly shaped but slightly smaller drive shaft in registry therewith for detachable association in the customary manner for imparting rotation thereto and the fastener in registry therewith.

The base **11** of the socket **10** merges in a somewhat enlarged cylindrical body **13** that is broached to otherwise polygonally shaped from the opposite side or end **14** thereof to present a definite and precise polygonal socket **15** to be presently described. The socket **15** usually communicates with the drive bore **12** so that the chips resulting from the broaching of the socket **15** will find their way through the bore **12**. In the present embodiment, a socket **15** is provided for a hexagon nut and it affords a double bite on the complemental fastener which is usually a single hexagon in shape. This is made possible by the double hexagon or twelve point broaching which is specially configurated to provide a side drive engagement relative to a hexagon nut that are most always used in engines and most other devices held assembled therewith.

The standard hexagon or double hexagon socket usually comprises a series of equidistantly and alternately disposed relatively inward and outward corners to correspond with and afford registry over fastener nut sized therefor, and in the case of a double hexagon socket the nut can be fitted therein every thirty degrees or every thirty degree turn rather than the usual sixty degree arc of rotation to afford a double bite thereon in half the arc of swing for greater accessibility in restricted spaces or locations. These advantages are somewhat offset by the reduction in wall thickness due to double hexagon broachings with twice the outer corners that reduce wall body thicknesses in the region thereof. It is these corners that, for the most part, carry the turning or torque load imparted to the fastener nut of six corners and, therefore, the stress is the greatest at the weakest regions around the periphery of the wrench socket.

To overcome this decided disadvantage and weakness, the wrench socket **15** and for that matter its counterpart in a male drive should such be desired for recessed heads of screw fasteners and the like, is provided with a series of equidistantly spaced inner corners **16**, in this instance twelve in number, which alternate with equidistantly spaced outer curved flutes **17** that are substituted for the usual outer corners in standard twelve-point sockets. The radial lines to the inner corners **16** and the alternate bisectors of the curved flutes **17** which intersect and converge at the axial center of the socket **15**, form fifteen degree angles (FIGURE 3) between alternate adjacent peripheral formations **16–17**.

In the preferred embodiment, the outside angles formed by the straight intersecting surfaces **18–19** which are oppositely angulated, in this instance outwardly for substantially 144 degrees and inwardly angulated relative to the axial direction of the socket for substantially 216 degrees (FIGURE 3) to define the inner corners **16**. The corners **16** measure, in this instance, one hundred and forty-four (144) degrees and these load bearing surfaces **18–19** constitute the side drive engagements for the fastener nuts sized to fit therebetween with the nut corners **20** disposed within and free of the curved outside flutes **17** with a minimum of clearance therewith. Thus the fastener nut corners **20** and their load bearing sides **21** (FIGURE 3) constitute the outline for the fastener nut **22**, and the turning moment is imparted to the straight side walls **21** thereof by the wrench socket surfaces **18–19** in one direction of rotation and the wrench socket surfaces **19–18** in the opposite direction of rotation.

While the nut **22** and its wrench socket **15** are stationary and under no turning torque load, the nut corners **20** and the nut sides **21** are free from load stress. During the application of a turning moment by the wrench socket **15** to the fastener nut **22** in either direction, however, only the straight side surfaces **21** thereof are under a torque load as are the alternate converging socket sides **18–19** which are in the thickest region of the socket wall **13**. In neither event, the corners **20** of the fastener nuts **22** are stressed or load bearing and correspondingly the curved flutes or concavities **17** which are in the thinnest regions of the wrench socket wall **13**, are never under direct stress so that the torque transmission for tightening or loosening the fastener nuts **22** are always carried by the strongest load bearing portions of the wrench sockets **10**. This is highly advantageous in increasing the load capacities of given wrench sockets so shaped as well as to insure flank engagement with the sides rather than the corners of the fastener nut **22**. Corner mutilation of nuts **22** is entirely eliminated with this type of socket or open-end jaw construction, and all these advantages accrue without undue looseness nor restricted range of registry between the wrench socket **15** and fastener **22** when the angularity of the socket faces **18–19** are within the limited plus or minus range of 144 degrees outside and 216 degrees inside as a preferred angularity to accomplish these attributes with minimum looseness and a sufficient degree of registry within practical requirements, these being the guiding and controlling prescriptions for a satisfactory construction embodying the teachings of the present invention.

This is the converse of loading stress in conventional wrenches and wrench sockets of both the single hexagon and the double hexagon standard design. In the latter especially there is the greatest load in the corners where the wall thickness is minimum and comparatively thin owing to the twelve-cornered configuration which eliminates considerable body and, therefore, is substantially weakened and less able to sustain repeated heavy loads over extended periods of time. With the teachings of the present invention and design, the greatest torque sustaining load is borne by the comparatively large side surfaces of both the wrench socket **15** and the fastener nut **22** in the thickest and strongest regions of the socket **10** whose corners have curved flutes **17** to minimize stress and increase strength and provide a side drive through the straight surfaces **18–19** that are in the thickest regions reinforced by the inner corners **16**. The fastener nut corners **20** are not, therefore, the engaging abutments for the socket **10–15** so that the torque transmitting characteristics of the wrench socket **10** are substantially increased without increasing the thickness of the socket wall **13** that in accordance with the dictates of commercial practice are made as thin as possible in order to render them more accessible in restricted nut locations. This advantage accrues even though the flank engaging reaction between the socket **10** and the fastener nut **22** occurs near rather than at the corners of the latter, since at any point away from the nut corners there is sufficient fastener body to withstand mutilation and particularly corner mutilation.

The curvature of the flutes **17** is not critical but should provide minimum clearance for the nut corners **20** so that maximum body is attained for the wrench socket **10** in the critical regions of the socket recess **15** thereof. The greatest advantage with the improved torque transmitting characteristics are attained by transferring the turning moment stresses to the inside surfaces **18–19** and interior corners **16** where the wall thicknesses are the greatest rather than the least as in standard sockets, and the torque load is applied to the side surfaces **18–19** of considerable expanse so that the unit area load is minimum and both the wrench socket **10** and fastener nuts **22** are the strongest. In the region of minimum strength and thickness which in standard wrench sockets is at the outside corners, the improved wrench socket **10** is relieved of all corner contact stress and strain by providing curved flutes **17** that are non-load bearing at all times. The maximum advantages have been attained with the teachings of the present invention without any increase in cost of material or production costs.

While the outside angularity (relative to the socket axis) between the oppositely inclined fastener flank engaging surfaces **18–19** need not be precisely limited within a matter of several degrees (more or less), it has been found that with a specific outside angle of 144 degrees therebetween a very effective ratio exists between required looseness and registry of fastener nut **22** and socket **15**, although a range of 140 to 150 degrees for said outside angle or angles is deemed tolerable and within substantial commercial considerations. Important too is the fact that these advantages can be experienced without changing the shape, sizes, or design of hexagon nutfasteners which have been standard for so long that it would be scarcely possible to expect any change therein, except for special situations and purposes which would not command any general acceptance among nut manufacturers and distributors. For that reason, it is imperative to improve the design and structure of the wrench sockets and tools utilized for nut turning to tighten as well as loosen such threaded fasteners.

Although we have illustrated and described a preferred embodiment of the invention, it must be understood that our invention is capable of considerable variation and modification without departing from the spirit of the invention. We, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail ourselves of such variations and modifications as come within the scope of the appended claims.

We claim:

1. A wrench or the like having a fastener nut engaging socket defined by a plurality of uniformly spaced peripherally and radially disposed protuberances presenting angularly related straight engaging surfaces extending for the depth of said socket to constitute a drive element, said straight angularly related surfaces being complementally and peripherally disposed at substantially 144 degrees outside obtuse angles to each other for free registry with a straight sided and sharp cornered geometric fastener when in axial alignment with the longitudinal axis of the wrench socket to constitute a driven element, there being flank surface engagement between said angularly related straight socket surfaces and the straight peripheral fastener surfaces for the transmission of a torque load to said fastener by said wrench socket with engagement away from the corners of the driven element.

2. A wrench defined in claim **1** wherein said nut engaging socket is peripherally closed and said angularly related straight surfaces are provided in uniformly spaced relation in pairs relative to each other and spaced with intermediate concavities for complete fastener corner disengaging reception during turning engagement between the driver and driven elements.

3. A wrench defined in claim **2** wherein said contiguous oppositely disposed-pairs of straight surfaces have an outside angle of substantially 144 degrees and an inside angle of substantially 216 degrees relative to each other.

4. A wrench defined in claim **3** wherein said angularly related and oppositely disposed pairs of straight surfaces present sharp corners and these are interrupted by circumferentially interposed concavities to accommodate the corners of the geometric fasteners, and the bisectors of said corners and concavities are on 15 degree radii spaced of the wrench pocket axis.

5. A wrench defined in claim **4** wherein said oppositely disposed pairs of straight surfaces inwardly intersect and said circumferentially spaced concavities extend outwardly to open toward the socket axis.

6. A wrench defined in claim **4** wherein the points of convergence of said oppositely angulated straight surfaces and the radii of said concavities are disposed on uniformly and alternately spaced radii of said wrench socket.

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