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WRENCH SPLINES, SPLINE DRIVES AND SIMILAR COUPLERS

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ABSTRACT

The invention involves multisided and specially shaped jaws or splines in wrench sockets or other rotary drivers or couplers configurated around an internal periphery to present uniformly spaced flat driving sides, jaws, or flanks for flat surface-to-surface engagement to impart torque turning loads to complementary flat multifaced externally polygonal fastener faces or driven coupler elements rather than to the corners thereof, and to accommodate hexagon, double hexagon, triple square, and complementally fluted or fluted or multi-splined nuts and the like. The internal and radially extending peripheral splines are configurated to present specially angulated engaging jaw sides or flanks with interveniing and alternately spaced, complementally grooves for flat surface engagement with the sides of either hexagon, double hexagon, triple square, or complementally splined nuts or the like without any corner engagement therewith.

10 Claims, 5 Drawing Figures
WRENCH SPLINES, SPLINE DRIVES AND SIMILAR COUPLERS


This invention relates to wrench socket drives and more particularly to improvements in a multiplexed socket arrangement which will accommodate geometric fasteners that are multi-sided splines and multiplexes of hexagons such as but not limited to six, 12 and the like sides. The latter may consist of a double hexagon or a triple square nut fastener as well as standard single hexagon nut fasteners or complementally spline-shaped counterparts. With the teachings of the present invention which appear to be the most commonly used shape types.

It contemplates more especially a wrench socket or socket heads which are broached or otherwise shaped to provide a series of circumferentially spaced and longitudinally extending splines that is spaced by complementary longitudinal grooves of improved shape and cross-section extending inwardly from the contiguous splines which are also of improved shape and cross-section. The concept of providing driving splines of such number and shape for longitudinal or axial displacement in relation to hexagon, double-hexagon or triple-square nut fasteners and transmit torsional or rotational engagement or rotational engagement thereto for rotary displacement of the fastener as a multi-sided flank drive therefor, involves splined engagement with the fastener sides without impact with and free of all contact of their multi-sided corners to prevent mutilation thereof.

This is accomplished without any appreciable relative movement in a rotational direction which is limited to bare minimum and tolerable play which is necessary and yet understandably small to insure free registrable positioning between the wrench sockets and the nut fasteners preparatory to turning for the tightening or loosening application thereof relative to a threaded counterpart on a machine or other assembly. With the teachings of the present invention, the wrench socket is spared to provide, in this instance, twelve inwardly projecting splines with each presenting angularly related and inwardly inclined sides from 45° more or less and presenting substantially V-shaped roots or spline tips of between 146° to 150° degree or less. The driven complementary grooves alternate between the splines, and accommodate the corners of the nut fasteners so that the mutilation thereof in the region of the corners where fasteners are most vulnerable, will be completely eliminated.

It is worthy of note that this type of wrench socket configuration accommodates also spline nut fasteners that complement thereof, but the primary objective is to transmit torsional or rotary displacement to hexagon, double hexagon and 12-sided square nut fasteners which are in common use and to provide a flank drive therefor to more effectively sustain nut turning loads. This insures surface-to-surface flat engaging contact between the splines or radial jaws and the flanks of the nut fasteners irrespective of whether or not the spline-shaped complemental fasteners, the single hexagon fasteners, the double hexagon fasteners or the triple square-shaped fasteners or their counterparts in the form of coupler elements or shafts employed for any specific purpose requiring torque or turning loads. With this arrangement, the multi-sided driven elements are engaged away rather than at their corners where such are prone to mutilation. Straight surface-to-surface contact and turning engagement for the flank surface load transmitting contact is assured, and greater torque loads can be transmitted with the main wrench embodying the teachings of the present invention.

One object of the present invention is to provide an improved multi-sided drive for a variety of different fasteners such as spline nuts, hexagon nuts, double hexagon nuts and triple square nuts or fluted coupler parts complementally fitted for flank surface engagement therebetween.

Another object is to provide an improved and more versatile wrench socket of the fluted type to insure surface-to-surface face flank engagement between its splines and the flanks of a variety of multi-sided fasteners or coupler parts.

Still another object is to provide an improved multiplexed wrench socket or coupler element which is shaped to accommodate spline, single hexagon, double hexagon and triple square shaped standard nut fasteners for flank engagement with the multiplexes thereof and without any possible mutilation of the fastener corners so that torque turning capacities are increased without any change in the design or wall thicknesses of the drivers.

A further object is to provide an improved spline drive or wrench socket which is confined to flank engagement with multi-sided or cornered driven members of different shapes to insure maximum turning loads over an extended period of time without mutilation thereto.

A still further object is to provide a spline socket or fluted driver coupler element which has improved turning characteristics for maximum load capacities and minimum mutilation of both the driver and driven members.

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

In the drawings:

FIG. 1 is a perspective view of a driver element or wrench socket embodying features of the present invention.

FIG. 2 is an enlarged view of the socket illustrated in FIG. 1 in registry with either a single hexagon or double hexagon driven element such as fastener nuts, each being superimposed over the other to illustrate the possible different fasteners adapted thereto.

FIG. 3 is an enlarged sectional view taken through a spline or protuberance comprising a preferred shape of one of a plurality of circumferentially spaced teeth inside the socket.

FIG. 4 is an enlarged end view of the socket which is also adapted to register with a splined complemental fastener nut or coupler part to illustrate the fastener variations possible therewith.

FIG. 5 is an enlarged end view of the broached end of a socket like that shown in FIG. 1, but adapted to register with a triple square nut fastener or coupler driven member to illustrate yet another type of driven fastener formation usable therewith.

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, in this instance, by a cylindrical 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 or turning movement in tightening fasteners registered or telescoped therein as will appear more fully hereinafter.

The base 11 of the socket 10, merges in a somewhat enlarged cylindrical body 13 that is interiorly broached or otherwise polygonally shaped from the opposite end 14 thereof to present a definite and precise polygonal socket 15 which shall 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 (FIG. 2), a double hexagon nut superimposed on the single hexagon nut in FIG. 2, a splined complemental nut (FIG. 4), and a triple square nut (FIG. 5). The driver or socket 15 has its larger end specially configured internally to provide a side drive or flank surface-to-surface engagement relative to a complemental fastener nut used in engines and 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 substantially exact registry over the nut fastener sized therefore, and in the case of a twelve splined or double hexagon socket 15, the nut can be fitted therein every 30° turn rather than 60° and for a triple square-nut every 30° as well as with a 12-splined complemental nut to afford a double or triple bite thereon in one-half or one-third of the usual arc of rotation for greater accessibility in restricted spaces or locations. These advantages are somewhat offset by the reduction in wall thickness due to double or triple broacings with twice the outer corners that reduce wall body thicknesses in the region thereof. It is these corners in standard sockets that, for the most part, carry the turning or torque load imparted to the fastener nut of four or six or more corners and, therefore, the stress is the greatest in the weakest regions around the periphery of the wrench socket 10, although the same problems pertain to similarly shaped driven members or couplers with their counterpart drivers.

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 and circumferentially disposed side engaging lands or jaws better termed splines 16 of improved design, in this instance in number. The special shape splined surfaces 16 extend inwardly toward the axis of the socket 10, which alternate with equidistantly and circumferentially spaced slots or flutes 17 preferably of special shape and cross-section to provide flank surface-to-surface engagement with fastener sides and allow the corners thereof to be freely received within the flutes 17 as will be better understood from the following description. The angular surfaces 18-19 of the splines 16, intersect and converge to form inner spline corners 20 that align with radii, in this instance 30° apart. These splines 16 have their angularly converging surfaces 18-19 terminate in spline root sides 21-22 which are relatively angled at 45° to also constitute the sides of the flutes 17 contiguous therewith.

The flute sides 21-22 terminate in a circumferentially slightly arcuate bottom 17 that is relatively flat and extend outwardly while the opposite open portions thereof extend inwardly to receive the spline ends 16 (FIG. 4) or sharp corners 23 of the single hexagon nuts (FIG. 2) and the corresponding sharp corners 24 of the double hexagon nuts shown superimposed on the single hexagon fastener in the illustration (FIG. 2).

These spline sides 21-22 define the angular sides of the flutes 17 which afford complete clearance for the nut corners 23-24 to avoid any turning load thereon and preclude mutilation thereof in that the turning impact and load is concentrated away from the fastener corners 23-24 where there is sufficient surface body to more effectively sustain the torque turning load without any defacement, and there is surface-to-surface engagement between the spline sides 18-19 and the nut sides away from the outer corners 23-24.

While the hexagon and double hexagon fastener nuts are in registry with the splined socket 15, only straight and extensive side nut surfaces are under torque load and consequent stress and this takes place in the thinnest region of the socket wall 13 where it is the strongest so that increased capacity is attained without varying the thickness of the socket wall which are usually as thin as possible for greater accessibility in tight or restricted places. In either clockwise or counterclockwise turning rotation, this surface-to-surface contact and load bearing engagement is accomplished. In either event, the fastener nut corners 23-24 are stressed or load bearing, and correspondingly the alternate troughs or flutes 17 which are in the thinnest regions of the wrench socket wall 13, are never under direct stress so that torque transmission for tightening or loosening the fastener nuts are transmitted by the thinnest portions of the wrench sockets 10.

This is the converse of loading stress in the conventional wrench sockets of both the single hexagon and double hex-

agon 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 or reduces the stress and, therefore, is substantially weakened and less able to sustain repeated heavy loads over an extended period of time. The nut corners are especially vulnerable to mutilation with the standard hexagon and particularly double hexagon socket in that the load engagement is at the corners which region are susceptible to the greatest mutilation by reason of the limited body engagement at these points. With the teachings of the present invention and design, the greatest torque sustaining load is borne by the comparatively large side surface engagement of both the wrench socket 15 and the nut sides at points removed or away from the corners of the nuts so that the nut turning loads are borne in the strongest regions of both.

Thus the alternately spaced flutes 17 accommodate the nut corners to eliminate any possible stress thereon and consequent mutilation through the provision of side surface driving splines 16 which are supported and reinforced by the thickest regions comprising the inside socket corners which are the spline roots. The fastener nut corners 23-24 are stressed or load bearing, and therefore, the engaging abutments for the socket splines 16 so that the torque transmitting characteristics of the wrench socket 10 are substantially increased without increasing the thickness of the socket wall 13 which should be as thin as possible for utmost accessibility in tight places, this being in accordance with the dictates of commercial practice which tends to thinner and thinner socket designs. This renders the sockets more accessible in restricted nut locations on modern engines and other equipment.

It is worthy of note that the angularity of the flute sides 21-22 is not critical so long as the torque transmitting engagement with the fastener sides are substantially tangential in the region of contact and the depth of the flutes 17 is sufficient to provide minimum clearance for the nut corners 23-24 to insure that there is no load thereon during nut turning, and that the turning load is in the region of maximum socket wall thickness as explained supra, rather than in the critical regions which are the outer recess corners in standard socket constructions. Further, to provide for direct tangential flank engagement with the use of spline-shaped fasteners 25 (FIG. 4) as well as with other types of nuts described above, flute sides 26-27 are provided to constitute relatively angular extensions of the spline sides 18-19, and to attain the most direct tangential side engagement in transmitting the load their angle relative to each other is preferably though not critically essential substantially 45° (see FIGS. 2 and 3) for substantially normal engagement with complemental splines 17 comprising the periphery of a total spline fastener 25 (FIG. 4) which also could be a shaft or other coupler element. This flute angularity is also preferable for providing substantially the same directional surface-to-surface engagement with a single and double hexagon (FIGS. 2) and a triple square fastener (FIG. 5) comprising a standard nut 28 which are in use but not nearly as frequently as the single and double hexagon fasteners. The corners 29 of the triple square fastener 28 approach the outside ends 30 of the flutes 17 more closely as illustrated, but in practice this limited clearance is insufficient to avoid corner engagement with possible eventual mutilation, and thus the same advantages accrue therewith.

The greatest advantage not only is improved transmitting characteristics and torque load capacities, but also the transfer of the turning moment and its resultant stresses to the inside spline socket surfaces 18-19 and the interior corners 20 thereof where the wall thicknesses are the greatest rather than the least as in standard socket formations, and the torque load is applied for the most part to the side surfaces 18-19 of considerable expanse compared to the restricted corners as previously occurred so that the unit area load is minimum and both the socket 10 and fastener nuts of the illustrated sustain the loads in the regions of greatest strength. In the region of minimum strength and thickness which in stan-
standard wrench sockets and fasteners are at their outside corners, the improved construction is relieved of all corner contact stress and strain by providing the specially designed and contoured flutes 17-30 that are non-load bearing at all times.

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 angle of substantially 144° therebetween a very effective ratio exists between required looseness for fastener registry with its socket 15 and the desired region of engagement away from the fastener corners, although the range between 140° to 150° for said outside angle or angles is deemed tolerable and within the dictates of commercial as well as practical considerations. Important too is the fact that these advantages can be acquired without changing the shape, sizes, design or specifications of the geometric fasteners which have, for the most part, been standard for such long periods that it would be scarcely possible to expect changes therein without extended resistance. For these reasons, it is imperative or at least most desirable to improve the design and structure of the sockets or turning drivers utilized for nut turning and as couplers in other situations.

While 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 for fluted and standard nut fasteners or the like having a peripherally closed socket defined by a plurality of equidistantly spaced peripherally and radially disposed di-hedral end jaws presenting angularly related straight flat side jaw surfaces of substantially a range between 140° and 150° therebetween, said side flat jaw surfaces extending substantially for the depth of engagement for flat surface-to-surface contact with complementally fitting peripherally disposed straight flat-sided geometric fasteners or the like for aligned registry therebetween in longitudinal axial alignment with said socket, and oppositely disposed flutes with flat side surfaces defined by said flat side jaw surfaces extending radially to project oppositely to said first named straight surfaces and alternately therebetween in integral continuity therewith for defining a continuous geometric fastener engaging member to impart turning moments to fasteners in registry therewith, said oppositely disposed flutes having a depth sufficiently greater than the most outward corners of said geometric fasteners to avoid contact therewith and eliminate fastener corner engagement in imparting the turning load thereto.

2. A wrench structure or the like for fluted and standard nut fasteners defined in claim 1 wherein the angularly related straight flat side jaw surfaces tend to converge inwardly toward the axis of the wrench socket to present outward angles of substantially 144° and the flutes extend outwardly to accommodate the fastener corners so that their open troughs face the same axis and their closed ends are substantially concentric therewith to define a peripherally closed socket for substantially the depth of standard fasteners for effective registry with complementally fitting fasteners.

3. A wrench or the like for fluted and standard nut fasteners defined in claim 1 wherein the angularly related straight surfaces define pointed corners that extend inward with outward nut flank engaging surfaces of substantially 144° extending from said corners, said flank engaging surfaces having angularly disposed extensions defining outward angles of substantially 45° to constitute the flat sides of alternately disposed flutes opening inwardly to face the socket axis for registry with plural shapes of geometric fasteners to impart a flat surface-to-surface torque load for nut turning without any possible corner engagement therewith.

4. A wrench for fluted and standard nut fasteners defined in claim 3 wherein the flutes are sufficiently deep relative to the plural geometric fasteners to provide clearance with the nut fastener corners and fluted complementally fitting fasteners.

5. A wrench or the like for fluted and standard nut fasteners defined in claim 3 wherein the jaws are sharp cornered and the flutes are substantially flat bottomed for alternate uniform positioning around the interior periphery of said socket, said flutes having angularly related oppositely symmetrical flat sides extending radially toward the socket axis from their substantially flat bottoms to define peripherally spaced fluted openings for the reception of the fastener corners and complementally fluted fasteners.

6. A wrench or the like for fluted and standard nut fasteners defined in claim 5 wherein the inside faces thereof are angularly related to the jaw engaging sides, and said inside faces constitute extensions thereof to define splines around the periphery of the socket to provide flat surface-to-surface engagement in nut turning plural complementally fitting fastener shapes.

7. A wrench socket or the like for fluted and standard nut fasteners defined in claim 6 wherein the flutes and splines constitute the solid configuration of the wrench socket for the reception of nut corners and their sides, respectively, to provide flat surface-to-surface flank nut surface engagement with the corners thereof unengaged by said flutes.

8. A wrench or the like for fluted and standard nut fasteners defined in claim 6 wherein said contiguous oppositely disposed pairs of straight jaw surfaces have an outside angle of substantially 216° relative to each other.

9. A wrench or the like for fluted, splined, and standard nut fasteners defined in claim 8 wherein said angularly related and oppositely disposed pairs of straight jaw surfaces present sharp corners and these are interrupted by circumferentially intersected concavities to accommodate the corners of the geometric fasteners, and the bisectors of said corners and concavities are on 15° radii of the wrench socket axis.

10. A wrench or the like for fluted, splined, and standard nut fasteners defined in claim 9 wherein said oppositely disposed pairs of straight jaw surfaces inwardly intersect and said circumferentially spaced concavities extend outwardly to open toward the socket axis to provide limited rotary play and sufficient freedom of registry between the fasteners and the wrench for improved nut or other fastener turning.

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