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SOCKET WRENCH

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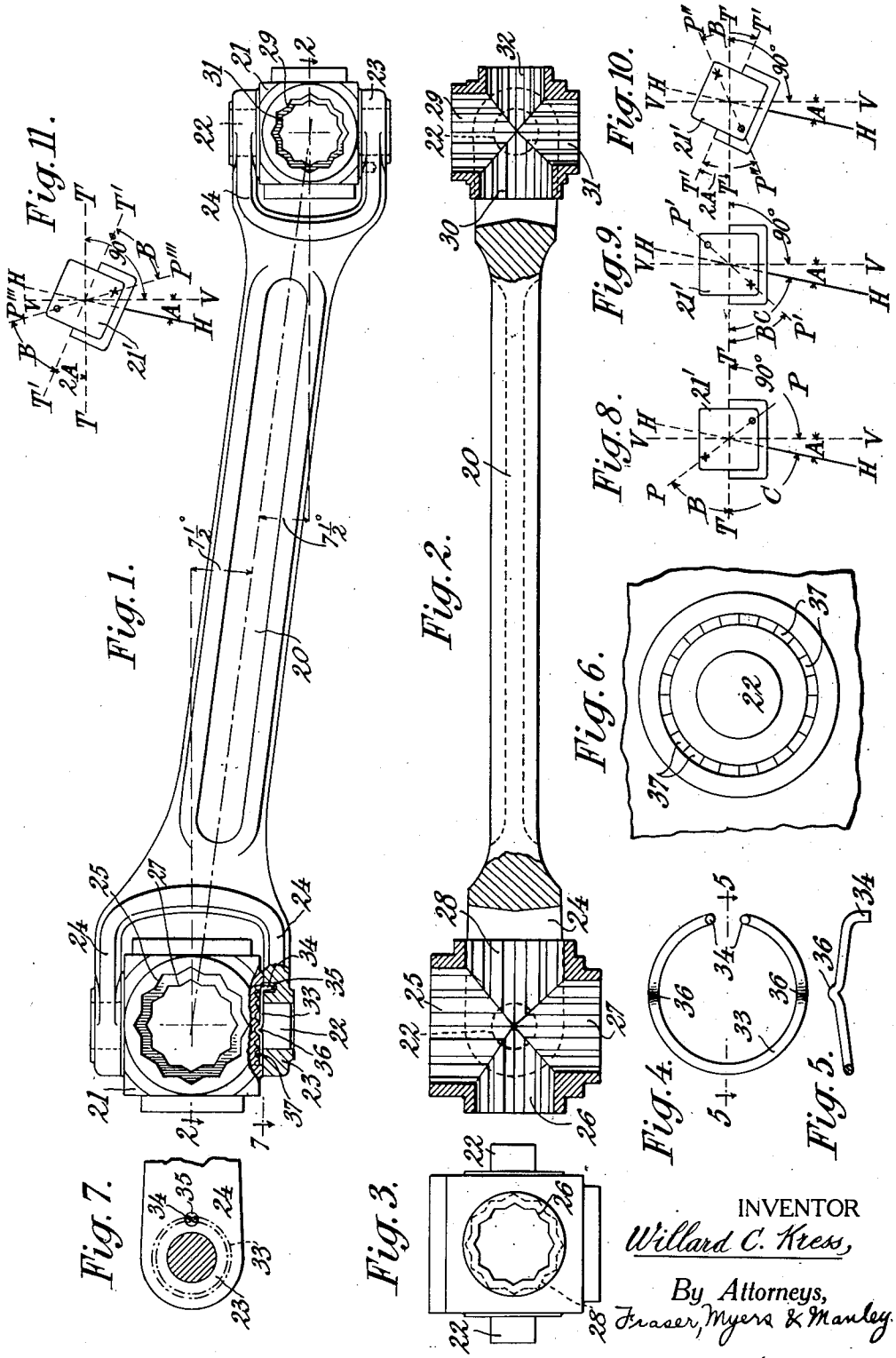

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SOCKET WRENCH

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This invention relates to improvements in socket wrenches of the type in which a block pivotally mounted in the end of a handle is provided with a number of sockets of different dimensions in a plurality of faces, each of which may be rotated to an effective working position. One object of the invention is to provide improved means whereby the socket block may be yieldingly held in any one of the working positions to which it may be moved. Another object of the invention is to reduce the minimum throw of the handle of a wrench of the above-described character which is required to turn a nut, bolt, or other work-piece, when the space in which the wrench must be used is limited.

In the accompanying drawings illustrating the preferred form of the invention:

Figure 1 is a side view of a wrench embodying the above-designated features of invention, the capacity of the wrench being increased by mounting a socket block in each end of the handle.

Fig. 2 is a view of another side of the wrench which makes an angle of 90° with the side illustrated in Fig. 1.

Figure 3 is a view of the wrench as it would appear to an observer looking directly towards the left end of Fig. 2, the trunnion bearings in the end of the handle being omitted.

Fig. 4 is an enlarged detached view of a spring holding ring mounted between the end of the socket block and the adjacent fork of the handle, as indicated in Fig. 1.

Fig. 5 is a view in cross-section through the ring illustrated in Fig. 4, the plane through which the section is cut being represented by the line 5—5, and the direction of observation being indicated by the arrows.

Fig. 6 is an enlarged end view of a part of one of the socket blocks of the wrench shown in Fig. 1, illustrating a circular series of depressions adapted to receive the humps or protuberances on one of the faces of the ring shown in Figs. 4 and 5.

Fig. 7 is an inside view of one of the forked ends of the handle of the wrench as shown in Fig. 1, illustrating a recess adapted to receive the bent end portions of the ring shown in Figs. 4 and 5,

Figs. 8, 9, 10 and 11 are diagrams used to illustrate the change of position of any point of a socket in use which results from inverting the socket block in the wrench handle and then inverting the wrench as a whole to restore the socket to working position.

As herein disclosed in its preferred form the invention is embodied in a double-ended socket wrench comprising a handle 20 and a pair of socket blocks 21 pivotally mounted in the opposite ends of the handle in any appropriate manner, as by means of trunnions 22 swiveled in bearings 23 in the ends of forks 24 extending from the ends of the handle. Each of the blocks 21 may be provided with a plurality of faces, the respective faces being appropriately recessed to provide sockets 25 to 32, inclusive, each of which may be of dimensions differing from those of any of the others. In the form of the invention herein illustrated and described, the socket blocks are six-sided, two sides of each block being provided with trunnions and the remaining four sides of each block being recessed to serve as sockets, thus resulting in a wrench having eight sockets each of which may differ from all the others.

To facilitate the construction of the socket blocks they may, if desired, be made open from one face to the other so that the four sockets will be intercommunicating, as clearly indicated in Fig. 2. The socket blocks may be assembled in the ends of the handle in any appropriate manner. If, as in the form herein selected for purposes of illustration, the trunnions are integral portions of the blocks, the blocks may be positioned between the forks of the handle while spread or opened outwardly and the forks may then be bent to their finished positions, as illustrated in Fig. 1, by the application of a hydraulic press or other suitable implement.

The improved means whereby the socket block may be yieldingly held in any of its various working positions in the handle is best illustrated in Figs. 1, 4, 5, 6 and 7. It comprises a resilient ring mounted between

an end wall of the socket block and the inner wall of the adjacent fork of the handle, the parts of the mechanism being so related as to cause the ring to be held in a fixed position with respect to one of its confining wall portions and to cause a yielding engagement with parts of the other wall portion for each of the working positions of the socket block. In the specific form of block-holding means herein selected for purposes of illustration, the split ring 33 has its end portions 34 bent at right angles and inserted in a recess 35 in the inner wall of one of the forks 24, and the ring 33 is provided with a pair of humps 36 adapted to enter any one of a circular series of recesses 37 in the end of the socket block. By providing a relatively large number of recesses 37 to receive the humps 36 of the ring, the socket block may be held in various angular positions whereby the working relation between any socket and the handle may be adjusted to suit the conditions under which the wrench has to be used. Whenever it is desired to slightly change the position of the socket block when using any socket, or to change the position of the block in order to bring a different socket into its working position, this may be accomplished by the application of sufficient force to cause the humps of the ring 33 to be snapped over the portions of the end wall of the block separating the pair of recesses in which they are positioned from adjacent recesses and permit them to enter other recesses corresponding with the position to which the block is rotated.

Yielding block-holding devices of the above-described character are herein illustrated as being provided at one end of each of the two socket blocks of the tool.

The means whereby the minimum throw of the handle of a wrench of the above-described character, to rotate a nut or a bolt, may be reduced to facilitate the use of the wrench when working in a limited space, will now be described.

It is well known that the minimum throw of the handle of an ordinary hexagonal wrench of which the working head is open from side to side and of the same dimension at both faces, may be reduced by so relating the positions, of the handle and the hexagonal opening in the head that the longitudinal axis of the handle will not coincide with an axis of symmetry of the hexagon. By making the axis of the handle bisect the angle between two axes of symmetry of the hexagon which are nearest parallel, the throw of the handle may be cut in half if the wrench be inverted between each successive stroke.

The heads of nuts, bolts and other fastening elements to be rotated by wrenches are usually square or hexagonal, or of some other geometrical form which may be defined as being symmetrical with respect to a point. that is, they are in the form of a polygon, an outline of which may be rotated about a central point through an angle of less than 360° to a position in which the outline will coincide in form with the original figure. A hexagon has six such positions of symmetry with respect to a point. The angular distance between one position and the other may, as a matter of convenience, be referred to as the pitch of the hexagon. This pitch is the angular distance through which an ordinary hexagonal wrench would have to be rotated in order to get a new hold on a nut or bolt head. The hexagon has twelve lines of symmetry, of which any two which are nearest parallel have an angle of divergence of 30°. If the handle of the wrench is so positioned that its axis bisects the angle between two such lines of symmetry, in order to make an angle of 15° with one of them, the minimum throw of the wrench may be reduced to 30° if the tool is inverted between strokes.

It is also well known that the minimum angle of throw of the handle of a wrench for use on hexagonal bolt and nut heads, if of the type in which the opening in the head of the wrench extends through from one surface to the other so as to be reversible, may be cut in half by superposing one hexagon upon another and making the opening in the head of a form known as a double-hex head, the intersecting parts of the two hexagons within the outline thus produced being cut away. The form of such a double-hex head is represented by the sockets of the wrench illustrated in Fig. 1 of the accompanying drawing. It will be apparent that the pitch of a double-hex head is 30°, which would, therefore, define the minimum angular movement of a double-hex head required to turn a nut or bolt. By so positioning the handle of an ordinary double-hex wrench as to cause its longitudinal axis to bisect two axes of symmetry which are nearest parallel, and then inverting the wrench between successive strokes, the minimum stroke may be reduced to one of 15°. The double-hex head has twelve different positions of symmetry with respect to a point and has twenty-four axes of symmetry. The angle between two axes of symmetry which are nearest parallel is 15°. If, therefore, the axis of the handle is so positioned as to make an angle of 7½° with an axis of symmetry, the position of the head will be changed to an extent of 15° by inverting the wrench, and the stroke necessary to obtain a new hold is, therefore, but 15°.

On first impressions it would seem obvious that this principle of placing the handle at some particular angle of inclination with respect to the head of the wrench and reversing the wrench between strokes would have no application to a socket wrench of the character of the one herein disclosed, since the in-

version of the wrench would move the socket in use to an inoperative position with respect to the bolt or nut being operated upon and would bring another socket of different dimensions to a position adjacent the workpiece.

As a result of applicant's study, however, it has been discovered that the minimum throw of a wrench of the character of the one herein disclosed, having a socket of hexagonal form or of double-hex form, or of the form of any polygon having multiple symmetry with respect to a point and a number of axes of symmetry which is divisible by two, may be reduced by an appropriate positioning of the handle with respect to the head of the wrench. This positioning differs from that resorted to in an ordinary wrench having duplicate faces, in that the axis of the handle must be caused to have a definite angular relationship with respect to the pivotal axis of the block. The angular relationship between the axis of the handle and the axes of symmetry of the sockets in the block is of no consequence, as will be shown on reference to the diagrams Figs. 8 to 11, inclusive. Each of the sockets may be disposed with one of its axes of symmetry coincident with the pivotal axis of the block and one axis at right angles thereto as indicated in Fig. 1, or any one or more of the sockets may be so positioned that the pivotal axis of the block will not coincide with an axis of symmetry of the socket.

Fig. 8 is a diagram illustrating one end of a socket wrench like that shown in Fig. 1. In this diagram the rectangular figure 21′ represents the socket block, the line T T represents the pivotal axis of the block, the line H H represents the longitudinal axis of the handle, the line V V is a perpendicular to the pivotal axis of the block drawn through the center of the block, and the line P P represents any axis of symmetry of a polygon of the form of the socket. In the diagram the handle is arbitrarily indicated as being disposed at an angle C with respect to the pivotal axis of the block and at an angle A with the line V V perpendicular to the axis. It will be apparent that the sum of the angles A and C is 90°. The axis of symmetry P P is arbitrarily assumed to make an angle B with the pivotal axis of the block, and this axis need not be so positioned as to cause any other axis of symmetry to coincide with the pivotal axis T T. The cross at the upper left-hand corner of the block 21′ is intended to represent one of the angles of a polygon of the form of the socket. It will be obvious that a similar angle will always be located directly opposite to the cross at the position indicated by the small circle.

If the socket block 21′ of Fig. 8 be inverted by rotating it through an angle of 180° about its pivotal axis, the axis of symmetry P P will be shifted in a counter-clockwise direction through an angle 2B to the position indicated by the line P′ P′ in Fig. 9.

If the wrench as a whole be inverted by rotating it through an angle of 180° about the axis H H of the handle as indicated in Fig. 8, to the position indicated in Fig. 10, the pivotal axis of the block T T will be shifted in a clockwise direction through an angle 2A to the position indicated by the line T′ T′ of Fig. 10, and the axis of symmetry P P will be shifted in a counter-clockwise direction with respect to the pivotal axis of the block T′ T′ through an angle 2B to the position indicated by the line P″ P″ in Fig. 10.

If the socket block 21′ be inverted and the tool as a whole including the inverted block, be also inverted, the pivotal axis T T of the block will be shifted in a clockwise direction through an angle 2A to the position T′ T′ as indicated in Fig. 11, and the axis of symmetry P P will also be shifted in a clockwise direction through an angle 2A to the position P‴ P‴, so that the angular relation between the angle of symmetry and the pivotal axis of the block remains unchanged as a result of the double inversion of the tool and block. It follows from this that if the handle is inclined at any angle A with respect to the pivotal axis T T of the block, the double inversion will cause any angle of the polygonal socket to be shifted through an angle 2A irrespective of its position with respect to the pivotal axis of the block. This will always be true if the polygon is one which is symmetrical with respect to a point and one which has a number of axes of symmetry which is divisible by two, so that the angle represented by the small circle in Figs. 8 to 11, inclusive, is complementary to the angle represented by the cross on said figures. The importance of this condition will be apparent on comparing Fig. 11 with Fig. 8, as a result of which it will be observed that the complementary angle represented by the circle in Fig. 11 takes the place of the angle represented by the cross in Fig. 8 after the socket block has been inverted in the handle and the handle and block inverted as a unit.

Since polygons of the type of those now being considered always have two of their axes of symmetry disposed at an angle of 90° with each other, and since the sum of the angles A and C of Fig. 8 always equals 90°, the foregoing demonstration would lead to the same conclusion if based upon the angle C between the axis of the handle and the pivotal axis T T of the socket block, instead of the angle A between the axis of the handle and the line V V perpendicular to the pivotal axis of the block. This will be true because angle C equals 90° minus angle A, wherefore 2C equals 180° minus 2A, and since each point in the polygon has a complementary point at an angle of 180° therefrom, the angle 180°

may be disregarded. It results that the shifting of a point of the polygon through an angle 2A in one direction will cause the complementary point to be shifted through an angle 2C in the opposite direction, and vice versa.

It follows from the foregoing demonstration that, if the axis of the handle of the wrench illustrated in Fig. 1 be inclined at an angle of 7½° with respect to a line perpendicular to the axis of the block as indicated, the inversion of the socket block in the handle and the inversion of the wrench as a whole will have the effect of shifting the double-hex socket through an angle of 15°, and a new hold may be obtained upon a bolt or nut head by a rotational movement of the wrench about the center of the socket through an angle of 15 more degrees to correspond with the pitch of the double-hex socket, which is 30°.

Although the placing of the handle in an angle of 7½° inclination with respect to a perpendicular through the pivotal axis of the socket block, as illustrated in Fig. 1, results in what is believed to be the preferred form of wrench, it need not be so positioned in order to obtain the minimum angle of handle movement. The same result would be obtained by so placing the handle that its longitudinal axis would bisect the angle between any two axes of symmetry of a polygon of the form of the socket if the polygon were so placed as to cause its center to lie on the axis of the handle and one of its axes of symmetry to coincide with the pivotal axis of the block, as indicated in Fig. 1. In other words, the axis of the handle might be disposed at an angle 7½° with the pivotal axis of the block, or at an angle of 7½° plus 15° or plus any multiple of 15°.

It will also be obvious that the required throw of the handle might be reduced to an angular movement of something less than that corresponding with the pitch of the socket, although not reducing it to the minimum of one-half of the angular pitch of the socket, by so positioning the handle as to divide the angle between two axes of symmetry of least divergence without bisecting the angle. For example, if the handle in Fig. 1 were disposed at an angle of 5° with a perpendicular to the pivotal axis of the block, instead of at an angle of 7½°, an inversion of the block and the handle, followed by an inversion of the tool as a whole, would shift the socket with respect to a nut or bolt head through an angle equal to twice 5°, or 10°, and a new hold might be obtained upon the nut or bolt head by shifting the handle through an angle of 20°. A second inversion of the block and tool as a whole would shift the socket with respect to the nut or bolt head through an angle of twice 10°, or 20°, and a new hold might then be obtained by a handle throw of 10°. This would enable the bolt or nut to be rotated in restricted space by alternate handle movements of 20° and 10° as compared with a throw of 30° without inversion and a minimum throw of 15° if the handle is disposed at the most effective angle.

The invention is not intended to be limited to the specific form herein selected for purposes of illustration but should be regarded as covering modifications and variations thereof within the scope of the appended claims.

What is claimed is:

1. A wrench comprising a handle and a socket block having double hexagonal sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that any socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the pivotal axis of the socket block and the longitudinal axis of the handle being relatively inclined at an angle of 82½°.

2. A wrench comprising a handle and a socket block having double hexagonal sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that any socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the pivotal axis of the socket block and the longitudinal axis of the handle being relatively inclined at an angle greater than 75° but less than 90°.

3. A wrench comprising a handle and a socket block having double hexagonal sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that any socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the longitudinal axis of the handle being inclined with respect to the pivotal axis of the socket block at an angle such as would cause it to bisect the angle between two of the least divergent axes of symmetry of a double hexagon if so positioned as to cause its center to lie on the axis of the handle and one of its axes of symmetry to coincide with the pivotal axis of the socket block.

4. A wrench comprising a handle and a socket block having double hexagonal sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that any socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the longitudinal axis of the handle being inclined with respect to the pivotal axis of the socket block at an angle such as would cause it to divide the angle between two of the least divergent axes of symmetry of a double hexagon if so positioned as to cause its center to lie on the axis of the handle and one of its axes of symmetry to coincide with the pivotal axis of the socket block.

5. A wrench comprising a handle and a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that a socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the socket being of the form of a polygon having multiple symmetry with respect to a point and a number of axes of symmetry divisible by two, the pivotal axis of the socket block and the longitudinal axis of the handle being relatively inclined at an angle greater than zero which is not exactly divisible by the angle at the center of the socket between two of its axes of symmetry which are nearest parallel.

6. A wrench comprising a handle and a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that a socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the socket being of the form of a polygon having multiple symmetry with respect to a point and a number of axes of symmetry divisible by two, the longitudinal axis of the handle being inclined with respect to the pivotal axis of the socket block at an angle such as would cause it to bisect the angle between two of the least divergent axes of symmetry of a polygon of the form of the socket if so positioned as to cause its center to lie on the axis of the handle and one of its axes of symmetry to coincide with the pivotal axis of the socket block.

7. A wrench comprising a handle and a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that a socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the socket being of the form of a polygon having multiple symmetry with respect to a point and a number of axes of symmetry divisible by two, the pivotal axis of the socket block and the longitudinal axis of the handle being relatively inclined at an angle equal to ninety degrees plus one half the angle between two of the most nearly parallel axes of symmetry of the socket.

8. A wrench comprising a handle and a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that a socket in use may be rotated with respect thereto to either of two oppositely-disposed working positions, the socket being of the form of a polygon having multiple symmetry with respect to a point and a number of axes of symmetry divisible by two, the pivotal axis of the socket block and the longitudinal axis of the handle being relatively inclined at an angle equal to ninety degrees plus a fraction of the angle between two of the most nearly parallel axes of symmetry of the socket.

9. A wrench comprising a handle, a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that the respective sockets may be selectively moved into and out of a working position, and a humped spring-retaining ring confined between adjacent walls of the socket block and the handle, said ring being concentric with the pivotal axis of the block and secured to one of the two parts of the wrench between which it is confined, the other of said parts having a circular series of depressions therein, the depressions being so spaced that a hump on the ring will enter a depression and resist rotation of the socket block whenever one of the sockets is in a working position.

10. A wrench comprising a handle, a socket block having sockets of different dimensions in different faces, the block being pivotally mounted in the handle so that the respective sockets may be selectively moved into and out of a working position, and a split spring ring having right angled bends at its ends and a pair of humps intermediate its ends, said ring being confined between adjacent walls of the socket block and its handle in a concentric relation with respect to the pivotal axis of the block, the wall of the handle being provided with a recess to receive the bent ends of the ring and hold it fast, and the wall of the socket block being provided with a series of recesses so spaced as to receive the humps of the ring and resist rotation of the block when one of the sockets is in a working position.

In witness whereof, I have hereunto signed my name.

WILLARD C. KRESS.