

FASTENER-DRIVING TOOL

This invention pertains to an improved fastener-driving tool useful to drive a fastener having an axis, a shank and a threaded portion, an externally non-circular head when viewed axially and having a concave recess extending into the head.

So-called stand-up screw guns, which are powered by trigger-actuated, electric motors, are exemplified in Murray U.S. Patent No. 3,960,191, Dewey U.S. Patent No. 4,236,555, and Dewey U.S. Patent No. 4,397,412 and are available commercially from ITW-Buildex (a unit of Illinois Tool Works Inc.) of Itasca, Illinois, under its AUTOTRAXX trademark.

Typically, stand-up screw guns employ driving members with driving tips, such as driving tips adapted to drive Phillips-head screws. Fastener-driving tools of other types, which may be powered by electric motors or by pneumatic motors, employ driving members with driving sockets, which fit axially over conforming heads of fasteners, such as screws or bolts. Typically, the sockets and fastener heads are non-circular or polygonal when viewed axially. Commonly, the sockets and fastener heads are hexagonal when viewed axially.

Often, it is difficult for a user to center the non-circular socket of such a tool and the non-circular head of such a fastener, particularly if a stand-up screw gun is used. Although a bolt or machine screw can be manually started for a few turns into a pre-threaded hole in a workpiece, it is difficult for a user to stabilize a screw having a non-circular head and having a drilling or tapping tip before the screw has been driven for a few turns into a workpiece. Centering of the non-circular socket of a fastener-driving tool and the non-circular head of such a screw, therefore, can be especially difficult for a user.

If the non-circular socket of such a fastener-driving tool and the non-circular head of such a fastener are not

centered relative to each other, it is possible for the fastener, the workpiece, or both to be damaged if an attempt is made to drive the fastener into the workpiece via the fastener-driving tool. The non-circular socket may be damaged also.

Therefore, there has been a need, to which this invention is addressed, for an improved way to center the non-circular socket of such a fastener-driving tool and the non-circular head of such a fastener relative to each other.

According to this invention, a fastener driving tool useful to drive a fastener having an axis, a shank and a threaded portion, the head being externally non-circular when viewed axially and having a concave recess extending into the head, wherein said tool comprises:

a tubular housing;

a driving member substantially co-axial with the tubular housing, and having a tubular extension with a socket extending axially into the tubular extension, the socket being non-circular when viewed axially, conforming generally to the non-circular head of the fastener, and adapted to be axially fitted over the head of the fastener so as to define a driving relationship, in which the driving member is arranged to drive the fastener;

a port defined within a sidewall of the tubular housing, arranged to allow delivery of the fastener into a position downstream of, and co-axial with, the driving member;

a support, pivotally connected to the tubular housing and arranged to support the fastener substantially co-axial with the driving member prior to engagement with the socket; and,

a centering pin co-axial with the driving member, the centering pin being assembled to the driving member for axial movement of the centering pin relative to the socket between an extended position and a retracted position, the centering pin being biased toward the extended position,

the centering pin having a convex end and extending axially through the socket in such manner that the convex end extends axially beyond the socket in the extended position but is retracted axially within the socket in the retracted position, the centering pin being adapted to fit at the convex end into the concave recess in the head of the fastener, and to be axially moved from the extended position to the retracted position when the socket is fitted axially over the head of the fastener,

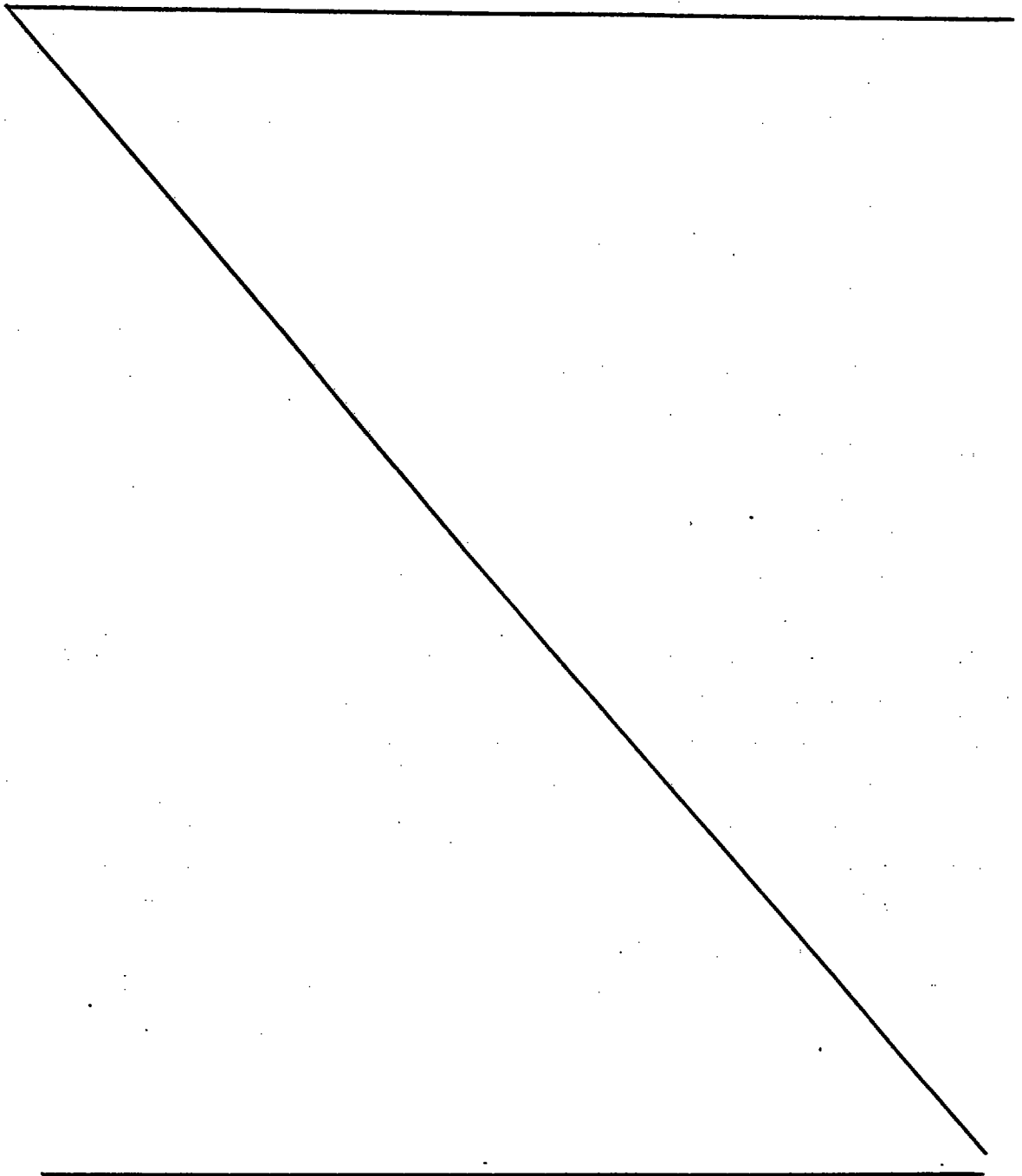
wherein the driving member is movable between an inoperative position, in which the centering pin is spaced from the head of the fastener, and an operative position, in which the socket is fitted axially over the head of the fastener, and in which the centering pin is fitted at the convex end into the concave recess in the head of the fastener and is moved axially from the extended position to the retracted position so as to center the socket and the head of the fastener relative to each other.

This invention facilitates centering of the non-circular socket of the improved tool and the non-circular head of a fastener relative to each other via a centering pin of the driver co-acting with a concave recess in the non-circular head of the fastener.

Preferably, in such an embodiment, the convex end of the centering pin has six facets conforming substantially to a pyramid having a hexagonal base.

In a preferred construction, the tubular extension is connected mechanically to the driving member, and an annular retainer is disposed within the tubular extension. The retainer, which may be press fitted into the tubular extension, has a central aperture, through which the centering pin extends for axial movement of the centering pin relative to the retainer. In the preferred

construction, the centering pin has an annular rib, which is disposed within the tubular extension. The rib is adapted to engage the retainer upon axial movement of the centering pin to the extended position. Moreover, in the preferred construction, the centering pin is biased by a coiled spring disposed within the tubular extension so as to bear against the rib.



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Particular embodiments of driving tools in accordance with this invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is an elevational view of a stand-up screw gun constituting a preferred embodiment of the improved tool;

Figure 2, on a larger scale, is a fragmentary, exploded view of some components of the stand-up screw gun shown in Figure 1, along with a screw;

Figure 3 is an axial view of some components shown in Figure 2, namely a driving member with a non-circular socket and a centering pin, as taken along line 3--3 of Figure 2, in a direction indicated by arrows;

Figure 4, on a similar scale, and Figures 5 through 8, on a larger scale, are sequential, fragmentary views through some components of the stand-up screw gun shown in Figures 1, 2, and 3, as used to drive the screw shown in Figure 2 through two decking members at an overlapped seam, into one flange of an I-beam, which is shown only in Figure 8. Some elements shown in Figure 4 are omitted in Figures 5 through 8;

Figure 9 is an enlarged, fragmentary, elevational detail of a modified socket co-acting with the screw shown in Figure 2;

Figure 10 is an enlarged, fragmentary, perspective detail of a centering pin having a modified, convex end according to an alternate embodiment of the improved tool;

Figure 11, on a smaller scale compared to Figure 10, is an axial view looking upwardly at the centering pin and related components of the improved tool according to the alternate embodiment.

As shown in Figure 1 and other views, a stand-up screw-gun 10 constitutes a preferred embodiment of the improved tool provided by this invention. As shown in Figures 2 and 4 through 8, the screw gun 10 is useful to drive a screw through two decking members 14, 16, at an overlapped seam, into one flange 18 of an I-beam, as in a

floor or roof construction. The screw gun 10 shown is used to drive a screw 20, such as that disclosed fully in GB-A-2268241, a patent application divided from the present case.

5 The screw 20, has an axis, a head 22, a shank 24, and a washer-like portion 26 between the head 22 and the shank 24. The head 22 is hexagonal when viewed axially, so as to adapt the head 22 to co-act with a suitably shaped socket of a fastener-driving tool, such as the socket of the screw
10 gun 10 to be later described. The shank 24 has a threaded portion 28 adjoining the washer-like portion 26 and a drilling tip 30 adjoining the threaded portion 28. The screw 20 has a concave recess 40 extending axially into the head 22, from a top surface 42 of the head 22.

15 The concave recess 40 provides a datum that is useful in centering a socket of the fastener-driving tool, and the screw head 22 relative to each other before the fastener-driving tool is used to drive the screw 20.

20 Except as illustrated in the drawings and described herein, the screw gun 10 is similar generally to stand-up screw guns disclosed in the Murray and Dewey patents noted above and specifically to stand-up screw guns available commercially from ITW-Buildex, supra, under its ACCUTRAXX trademark.

25 Broadly, the screw gun 10 comprises a nosepiece 50 having various components to be later described, two tubes in a telescoping relationship, namely an outer, upper tube 52 and an inner, lower tube 54 mounting the nosepiece 50, a driving member 56 mounted rotatably within the tubes 52,
30 54, and arranged to drive other components to be later described, and a driver 58 mounted to the upper tube 52. The driver 58 is powered by an electric motor (not shown) and is arranged to be manually actuatable via a trigger 60 and to drive the driving member 56 rotationally when
35 actuated. The tubes 52, 54 are biased by internal springs (not shown) to an elongated condition. The tubes 52, 54, are adapted to be axially telescoped to a shortened

condition, when a user presses downwardly on the driver 58 with the nosepiece 50 pressed against a workpiece.

Further, the screw gun 10 comprises a screw-feeding tube 62, which is mounted to the nosepiece 50 via a mounting block 64 having a passageway 66 for guiding screws from the screw-feeding tube 62 into the nosepiece 50. Each screw must be individually dropped into the screw-feeding tube 62 in such manner that the shank of such screw leads the head of such screw.

The nosepiece 50 has an upper, tubular portion 72 arranged to receive each screw from the passageway 66, a lower, tubular portion 74, and a pair of lower flanges 76, 78, on opposite sides of the tubular portion 74. The flanges 76, 78, extend below the tubular portion 74 and are designed to be downwardly pressed against a workpiece when the screw gun 10 is used to drive a screw into or through the workpiece.

The nosepiece 50 has a pair of gripping jaws 80, 82, which are mounted between the flanges 76, 78, for pivotal movement of each of the jaws 80, 82, between a closed position and opened positions. Each of the jaws 80, 82, is shown in its closed position in Figures 4 through 7 and in one of its opened positions in Figure 8. The gripping jaw 80 is mounted for pivotal movement on a pivot pin 84, which is mounted to the flanges 76, 78, and is biased to its closed position by a coiled spring 86. The spring 86 is disposed operatively between an upper end 88 of the jaw 80 and the tubular portion 74 of the nosepiece 50. The end 88 has a pocket 90 receiving one end of the coiled spring 86. The gripping jaw 82 is mounted for pivotal movement on a pivot pin 92, which is mounted to the flanges 76, 78, and is biased to its closed position by a coiled spring 94. The spring 94 is disposed operatively between an upper end 96 of the jaw 82 and the tubular portion 74 of the nosepiece 50. The end 96 has a pocket 98 receiving one end of the coiled spring 94.

When each of the gripping jaws 80, 82, is in its closed position, the jaws 80, 82, are disposed loosely to grip the shank of a screw, as the shank 24 of the screw 20 is shown as gripped loosely in Figures 4 through 7, and further to prevent the head of the screw from dropping through the jaws 80, 82, if the nosepiece is not against a workpiece. Pivotal movement of the jaw 80, as biased by the spring 86, is limited by engagement between a shoulder 100 on the jaw 80 and the tubular portion 74 of the nosepiece 50. Pivotal movement of the jaw 82, as biased by the spring 94, is limited by engagement between a shoulder 102 on the jaw 82 and such portion 74.

The driving member 56, which has an axis, has a tubular extension 108. The tubular extension 108 defines a socket 110 extending axially into the tubular extension 108. The socket 110 is hexagonal when viewed axially, conforms generally to the head 22 of the screw 20, and is adapted to be axially fitted over the screw head 22. The tubular extension 108 is connected mechanically to the driving member 56, by having a partly threaded portion 112 threaded onto a partly threaded, tubular portion 114 of the driving member 56.

A centering pin 120, which has an axis that coincides generally with the axis of the driving member 56, is disposed within the tubular portion 114 of the driving member 56 for axial movement of the centering pin 120 relative to the driving member 56 between an extended position and retracted positions. In the extended position, the centering pin 120 extends axially through the socket 110, as shown in Figures 4, 5, and 6. The centering pin 120 is shown in a retracted position in Figures 7 and 8.

The centering pin 120 has a convex end 122 having a frusto-conical surface 124 converging toward the axis of the centering pin 120. The frusto-conical surface 124 defines a conical angle that, preferably, is about equal to but not greater than the conical angle defined by the

frusto-conical surface 46 of the concave recess 40 in the head 22 of the screw 20.

5 The centering pin 120 has an annular rib 126, which is disposed within the tubular portion 114 of the driving member 56. An annular retainer 128 is pressed into the tubular portion 114, below the annular rib 126, in such manner that the retainer 128 is held frictionally by the tubular portion 114. The rib 126 is adapted to engage the retainer 128 upon axial movement of the centering pin 120 to the extended position. Thus, the retainer 128 retains the rib 126, so as to prevent the centering pin 120 from dropping from the tubular portion 114. A coiled spring 130 is disposed within the tubular portion 114, around the centering pin 120, so as to bear downwardly against the rib 15 126 and thus to bias the centering pin 120 toward the extended position.

The centering pin 120 is adapted to be axially fitted at the convex end 122 into the concave recess 40 in the head 22 of the screw 20. Also, the centering pin 120 is adapted to be axially moved from the extended position to a retracted position when pressed upwardly into the tubular extension 108. The centering pin 120 is used to center the socket 110 and the screw head 22 relative to each other. 20

The driving member 56 is movable between inoperative positions, in which the centering pin 120 is spaced from the head 22 of the screw 20, and an operative position. In the operative position, the centering pin 120 is fitted at the convex end 122 axially into the concave recess 40 in the screw head 22 and is moved axially from the extended position to a retracted position, whereby the centering pin 120 centers the socket 110 and the screw head 22 relative to each other. 25 30

When the driving member 56 has been moved to the operative position by a user pressing downwardly on the driver 58 and telescoping the tubes 52, 54, to the shortened condition with the nosepiece 50 pressed against a workpiece, such as the decking member 14 shown in Figure 35

8 and other views, the screw gun 10 maybe then actuated to drive the screw 20 via the driving member 56 with the socket 110 fitted axially over the head 22 of the screw 20, as illustrated in sequential stages in Figures 4 through 8.

5 As shown in Figures 6, 7, and 8, the convex end 122 is fitted loosely into the concave recess 40, so as not to impart frictional drag as the screw 20 is driven. Moreover, as shown in Figure 8, the tubular extension 108 engages the washer-like portion 26 of the screw 20 after the socket 110
10 has been fitted axially over the head 22 of the screw 20, so as to limit axial movement of the socket 110 over the head 20 of the screw 20.

If the screw 20 should be slightly tipped, as suggested in Figure 5, and if the centering pin 120 were
15 omitted, a user could face some difficulty in fitting the socket 110 axially over the head 22 of the screw 20. Advantageously, the centering pin 120 facilitates centering the socket 110 and the screw head 22 relative to each other, so as to obviate such difficulty.

20 As shown in Figure 9, one possible enhancement of this invention is to chamfer lower edges 140 defined by the socket 110. Upper corners 142 defined by the head 22 of the screw 20 are rounded in a known manner. The chamfered edges 140 and the rounded corners 142 facilitate centering the
25 socket 110 and the screw head 22 relative to each other.

In Figures 10 and 11, primed reference numbers are used to designate elements that are similar or analogous to elements designated by similar, unprimed reference numbers in the other views.

30 The fastener to be driven by the fastener driving machine may be constituted by a screw 20' similar to the screw 20, except that the concave recess 40' in the head 22' of the screw 20' has six substantially triangular surfaces 160, which are arranged in a regular array about
35 the axis of the screw 20'. Such surfaces 160 define a continuous, upper edge 162, which conforms to a regular hexagon having each of six respective sides

parallel to an adjacent one of six flat surfaces 164 of the screw head 22'. This is shown in Figure 10.

5 In this case, the improved tool provided by this invention is constituted by a stand-up screw gun 10' similar to the screw gun 10, except for the centering pin 120' and the annular retainer 128', which is fitted into the tubular extension 114' in such manner that the retainer is held frictionally by the tubular extension 114'.

10 The centering pin 120' is hexagonal in cross section, except for an annular rib (not shown) similar to the annular rib 126 used in the screw gun 10. The annular retainer 128' is shaped complementarily, as shown in Figure 11, so that the centering pin 120' rotates conjointly with the socket 110', which is hexagonal when viewed axially.
15 The centering pin 120' and the socket 110' are oriented similarly in a rotational sense, whereby each of six axially extending, flat surfaces 166 defined by the centering pin 120' is parallel to an adjacent one of six flat surfaces 168 defined by the socket 110' in the tubular extension 108'.
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The convex end 122' of the centering pin 120' conforms generally to the concave recess 40' in the head 22' of the screw 20' and has six substantially triangular facets 170 arranged in a regular array about the axis of the centering pin 120'. The facets 170 converge toward the axis of the
25 centering pin 120' and conform substantially to a pyramid having a regular, hexagonal base. The convex end 122' has a small, blunt tip 172.

Because the centering pin 120' rotates conjointly with
30 the socket 110', the centering pin 120' orients the screw 20' in such manner that the socket 110' and the head 22' of the screw 20' are oriented similarly in a rotational sense, when the convex end 122' of the centering pin 120' is fitted axially into the concave recess 40' in the head 22
35 of the screw 20. Thus, when the socket 110' and the screw head 122' are oriented similarly in a rotational sense as well as centered relative to each other, the socket 110'

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can be axially fitted over the screw head 22' without interference.

C L A I M S

1. A fastener-driving tool useful to drive a fastener having an axis, a shank and a threaded portion, the head being externally non-circular when viewed axially and having a concave recess extending into the head, wherein said tool comprises:

a tubular housing;

a driving member substantially co-axial with the tubular housing, and having a tubular extension with a socket extending axially into the tubular extension, the socket being non-circular when viewed axially, conforming generally to the non-circular head of the fastener, and adapted to be axially fitted over the head of the fastener so as to define a driving relationship, in which the driving member is arranged to drive the fastener;

a port defined within a sidewall of the tubular housing, arranged to allow delivery of the fastener into a position downstream of, and co-axial with, the driving member;

a support, pivotally connected to the tubular housing and arranged to support the fastener substantially co-axial with the driving member prior to engagement with the socket; and,

a centering pin co-axial with the driving member, the centering pin being assembled to the driving member for axial movement of the centering pin relative to the socket between an extended position and a retracted position, the centering pin being biased toward the extended position, the centering pin having a convex end and extending axially through the socket in such manner that the convex end extends axially beyond the socket in the extended position but is retracted axially within the socket in the retracted position, the centering pin being adapted to fit at the convex end into the concave recess in the head of the fastener, and to be axially moved from the extended



position to the retracted position when the socket is fitted axially over the head of the fastener,

wherein the driving member is movable between an inoperative position, in which the centering pin is spaced
5 from the head of the fastener, and an operative position, in which the socket is fitted axially over the head of the fastener, and in which the centering pin is fitted at the convex end into the concave recess in the head of the
10 fastener and is moved axially from the extended position to the retracted position so as to center the socket and the head of the fastener relative to each other.

2. A fastener-driving tool according to claim 1, wherein the convex end of the centering pin has a frusto-conical surface converging toward the axis of the centering pin.

15 3. A fastener-driving tool according to claim 1 or 2, wherein the convex end of the centering pin has six substantially triangular facets conforming substantially to a pyramid having a regular, hexagonal base.

4. A fastener-driving tool according to any one of claims
20 1 to 3, wherein the tubular extension is connected mechanically to the driving member, wherein an annular retainer is disposed at a fixed position within the tubular extension, the retainer having a central aperture, through which the centering pin extends for axial movement of the
25 centering pin relative to the retainer, wherein the centering pin has an annular rib disposed slidably within the tubular extension and adapted to engage the retainer upon axial movement of the centering pin to the extended position, and wherein the centering pin is biased by a
30 coiled spring disposed within the tubular extension, around the centering pin, so as to bear against the rib.

5. A fastener driving tool substantially as described with reference to the accompanying drawings.