June 18, 1963 J. J. VARGA 3,094,344

IMPACT WRENCH AND SOCKET COUPLER DEVICES

Filed April 6, 1961

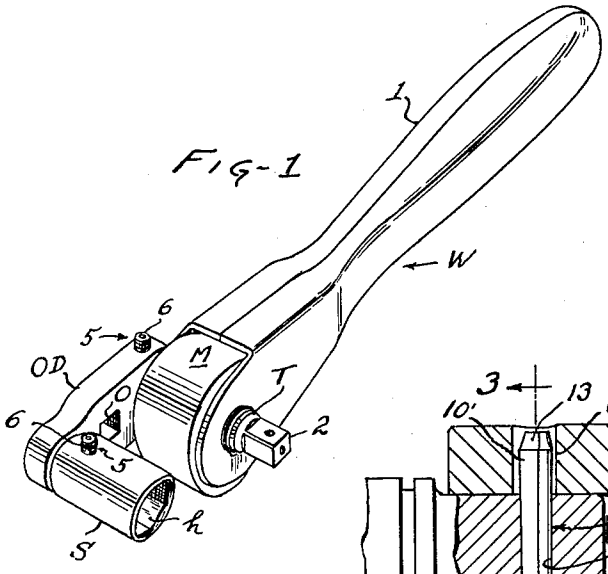


FIG-1

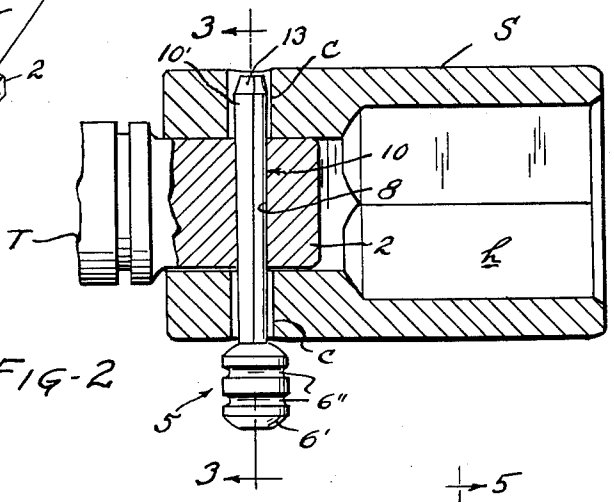


FIG-2

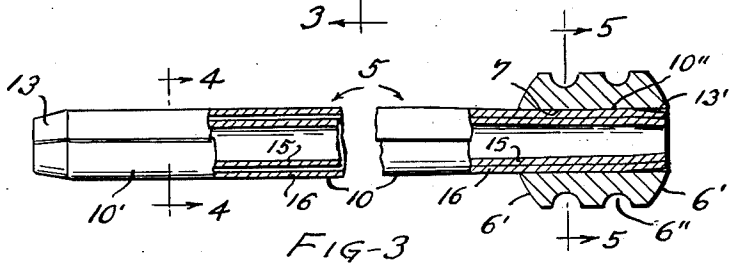


FIG-3

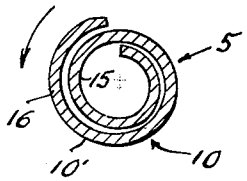


FIG-4

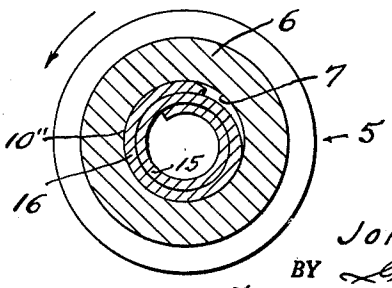


FIG-5

INVENTOR.
JOHN J. VARGA
BY Gregory Louis
ATTORNEY

United States Patent Office 3,094,344
Patented June 18, 1963

3,094,344

IMPACT WRENCH AND SOCKET COUPLER DEVICES

John J. Varga, Lyndhurst, Ohio, assignor to Curtiss-Wright Corporation, a corporation of Delaware

Filed Apr. 6, 1961, Ser. No. 101,260
2 Claims. (Cl. 287—52.08)

This invention relates to an improved and very inexpensive, cross pin type coupler or fastener for quickly and demountably attaching impact wrench sockets, adapters and the like to driving spindles or tool heads of impact wrenches for the purpose of preventing the sockets from accidentally falling off during or between operations of the wrenches to tighten and loosen threaded fasteners.

Power and manually operated rotary impact wrenches usually have the end portions of their output spindles or tool heads shaped or formed as so called "drive squares" for slip-on or loose engagement with mating holes in the sockets which are otherwise suitably internally shaped drivingly to fit respective sizes and shapes of nuts and bolt heads. The drive squares and sockets at mating non-circular faces thereof carry all the torque, hence if the socket couplers operate as cross pins their principal functional or operational requirement is resistance to being jarred out of place accidentally as by impact-produced vibrational or other forces. Users of relatively light duty hence small size impact wrench equipment have indicated a growing need for simpler and lower cost (e.g., economically dispensible) yet effectual socket attaching devices than have been made available.

The principal object of the present invention is to provide a simple, inexpensive and light weight coupler or retainer for impact wrench sockets and the like, operating as a radially yieldable cross pin and having suitable provision for enabling safe and easy manipulation of it solely by human fingers and which will be strongly self-retaining in one of the coupled members solely by friction.

Frictionally operated retainer or keeper devices of the type known as ball-spring detents or ball locks are commonly mounted in the drive squares of ratchet and impact wrenches for the purpose of safeguarding associated wrench sockets etc. from accidentally falling off the drive squares. In addition to high cost and widely recognized installation and operational problems not necessary to consider here, suitably designed, freely working, ball-spring type detents require enough installation space so that, particularly in the smaller sizes of impact wrenches such as have for example, ½ inch drive squares, too much torsional strength of the drive squares must be sacrificed in providing installation space for the detent or detent assembly with its spring.

Conservation of drive square cross-sectional area, hence torsional, shock-resisting strength, presents an important problem in all socket coupler practice which requires formation of cross holes in the drive squares, as when removable cross-pins are used to retain the sockets. When rigid metallic socket-attaching cross-pins are so used (commonly held in place by elastic rings or tape) a receiving cross-hole larger in diameter than the pin is formed in the drive square (somewhat larger holes being formed in the wall or walls of the sockets since the coupler pin does not have to transmit any torque); and in the case of a drive square as small as ½ inch across its flats, a ⅛ inch nominal diameter hole therethrough is about as large as can be safely used, i.e., without danger of fracture of the drive square during normal service.

None of the many designs or types of presently available readily releasable fastener or locking pin devices having built-in spring detents or controllable, positively operated, latch or lock mechanisms could be made either small enough in diameter, rugged enough or at suitably low cost to be acceptable for operation in the cross holes of drive squares of the smaller sizes of impact wrenches. As the diametrical size of such fasteners is decreased the cost is enormously increased. None that I know of will go into a nominal ⅛ inch hole.

Elastically yieldable threadless and headless cross pin type fasteners for mutually telescoping shaft members and for attaching knobs and the like to supports of various kinds are supplied solely for permanent installation in registering holes in the shafts or other members and the fasteners are designed either to be pressed or driven into place in the holes. Equally strong axially applied forces are necessary for extraction if or when the fasteners are removed. With one exception, discussed later herein, the principles of construction of known yieldable cross pin devices are not capable of utilization in wrench and socket couplers operable solely by hand.

No simple and inexpensive, radially yieldable manually operable coupling or fastener pins have been made available for demountably attaching impact wrench sockets to their drive squares despite the above indicated long existing need therefor. The solution disclosed hereby includes provision of a simple and inexpensive, light weight, pin type coupler device having the necessary critical elastic yieldability, proportions and other features such as to enable large range interchangeability and easy manipulation without the use of tools and with assurance that the devices will be retained in place solely by friction despite vibrational and other influences common to the use of impact tools. Additionally the present solution provides inexpensively formed, frictionally associated manipulating head and stem members comprising the coupling device hereof, wherein manual turning of the head member about the longitudinal axis of the device in a predetermined—preferably uniform—direction greatly reduces the axially applied force which would otherwise be involved in inserting and withdrawing the stem members into and from holes in the coupled members which happen to be nearly too narrow (due e.g., to the stem members being oversize or the holes undersize) to accommodate the stem members, meanwhile advantageously increasing the frictional forces involved in anchoring the head and stem mebbers to each other.

In the accompanying drawing—

FIG. 1 is a perspective view of a reversible, manually operated impact wrench and a wrench socket coupled to a torque transmitting portion of the wrench, via a special adapter as will be described.

FIG. 2 is an enlarged longitudinal cross sectional fragmentary view showing a portion of the drive square of the impact wrench in direct engagement with a typical socket and secured by the coupler device hereof in one form.

FIG. 3 is a further enlarged somewhat diagrammatic axial central sectional view of said coupler device and

FIGS. 4 and 5 are cross sectional detail views taken as indicated by lines 4—4 and 5—5 respectively on FIG. 3.

The impact wrench W, as partially illustrated herewith, is one being sold by the assignee hereof under the registered trademark Swench. Wrench W has a handle 1 coaxially supporting for relative angular movement, as on bushings not shown, an output spindle or tool head T and an inertia member or unit assembly M. The conventionally squared extremities of spindle T, one shown at 2, usually fit into wrench sockets such as S, as in FIG. 2, but are frequently connected indirectly to the sockets via suitable adapters. Adapter O.D., FIG. 1, is a special

purpose, "offset drive" device such as is shown and claimed in an application of Oscar J. Swenson, Serial No. 75,385 filed December 12, 1960. That application also shows and describes substantially an operating equivalent of herewith illustrated reversible rotary impact wrench W but of a specifically different type.

The adapter O.D. has a square opening (not shown but similar to opening O thereof) receiving a drive square which is axially opposite illustrated drive square **2**, FIG. 1. One of the coupler devices **5** (represented in FIG. 1 solely by its head or head portion **6**) holds the adapter on its associated drive square. The adapter, in turn, via a drive square integral with the adapter and similar to drive square **2** and another coupler device **5**, carries interchangeably one of a set of conventional socket members S. Socket S, as shown, has a hexagonal end cavity or box *h* for customary engagement with a threaded fastener or bolt head not shown. Additionally the socket has aligned cylindrical cross holes *c*. The drive square portion **2** of the tool head T (see FIG. 2) has a cylindrical cross hole **8** cooperatively related in position to holes *c*, but considerably smaller in diameter, designed to receive, interchangeably and with appropriate snugness, radially yieldable exposed shank or stem portions **10'** of spring pin members **10** of the coupler devices **5**, the two parts of which (as illustrated) are preferably metal.

In the operation of impact wrench W the wrench socket S will be assumed to be coupled directly to one of the drive squares **2** of FIG. 1 or as shown in FIG. 2. Assuming the work is a "frozen" nut engaged by the socket S, the tool head or spindle T is operated pursuant to predetermined indexing or unidirectional angular movements of handle **1** about the axis of the work to cause inertia member or unit M (via ratchet pawls carried by the inertia member and operated by power spring and cam means not shown) to deliver a succession of sharp hammering blows to ratchet teeth not shown formed on the spindle or tool head T. The operation is essentially one of successive or alternate escapements and impacts of the pawls on the teeth of the tool head until the work (e.g., the fastener) is loosened or secured with the desired degree of tightness, depending upon which of the reversible drive square stubs **2** of the spindle is drivingly associated with the work, via socket S or otherwise.

Referring to FIGS. 3 through 5, the illustrated spring pin or stem member **10** of coupler device **5** is made as a spirally convoluted rectangular piece of light gage leaf spring stock as will be more fully described later herein. The manipulating head or head portion **6** of the coupler device **5** as shown is generally cylindrical and, as a preferred means operating securely to hold the head thereon, has an axial bore **7** considerably smaller in diameter than the average diameter of the stem **10** as originally coiled or formed (the blank, not illustrated). The head **6** is forced over the associated end portion **10''** of the blank, rendering that portion substantially solid by contracting its convolutions **15** and **16** into tight, high friction producing contact with each other.

Preferably each end of the head **6** (or at least the end remotely of the stem portion **10'**) is rounded and smooth as at **6'** so that, during rapid angular impact-producing movements of the socket S, likelihood of injury to an operator's fingers for example will be minimized. By making the head **6** symmetrical at its two ends the head has no preferential position on the blank which becomes the stem member **10**, resulting in considerable economization in assembly cost (assuming use of appropriate automatic assembling tools not shown). Such saving is also applicable in respect to the blank which forms the stem **10**; but, as already mentioned, endwise preferential placement of the stem has an operational advantage in facilitating torquewise manipulation of the coupler devices as sometimes becomes critically important.

The diameter of the head **6** as shown is about twice that of the stem member **10**. Manipulation of the head **6**, during insertion and extraction of the stem member **10** into and out of coupling positions, is facilitated by "roughening" treatment of the cylindrical surface of the head: e.g., as by provision of peripheral or other grooves **6''** therein.

The blank from which the radially yieldable shank or stem portion **10** is formed may comprise a product of C.E.M. Company of Danielson, Connecticut, being sold under its registered trademark Spirol as a generally cylindrical headless and threadless hollow fastener pin designed to be tightly driven or pressed into receiving cross bores of shaft elements, knob shanks, chain links, etc. Suitable stem members **10** hereof for ½" and ⅝" drive squares having cross holes **8** held for example within limits .135" and .137" can comprise Spirol pins made from metal spring stock of approximately .007" thickness ("light duty" if as presently furnished by C.E.M. Company) but openly wound or convoluted as exaggeratedly shown in FIG. 4. The outer diameters of such spring pins if used as blanks for coupler devices **5**, having conventionally tapered or chamfered end portions **13** and **13'**, can be furnished economically within principal diametrical limits: .140"–.145". The holes or bores **7** in the coupler head members **6** in such case would be held between .127" and .128", so that the force fitting of the spring pin blanks thereinto would be approximately as conventionally practiced for shaft coupling purposes as earlier above discussed. No auxiliary fastening means is required, but such (e.g., solder, cement, etc.) can be used additionally if desired.

During assembly, the rigid wall surface forming the bore **7** of the head **6** forces the illustrated slightly more than two convolutions **15** and **16** (FIG. 5) of the spring stock into tight mutual contact and causes the defining main or coil surfaces to scuff or skid on each other until the end portion **10''** lying wholly within the bore **7** is radially substantially rigid. Outwardly from the head **6** or along the exposed surface portion **10'** of the stem the convolutions **15** and **16** remain slightly spaced apart (shown exaggeratedly); and, usually at least, a large part of said surface portion **10'** is slightly tapered or of gradually expanding diameter away from the head **6**. Such taper has been observed to be of important positive advantage since any tendency for the stem portions **10'** to creep axially while in contact with the wall surfaces of the cross bores **8** of the drive squares will be in the direction to seat the heads against the associated sockets S. In automatically testing the coupling devices **5** hereof with thousands of impacts, repeatedly performed with the heads **6** projecting downwardly as in FIG. 2, no tendency was observed for the couplers to creep outwardly or drop out as one might expect them to through impact plus force of gravity.

Insertion of the coupler stems **10** into the cross holes **8** of the drive squares and removal therefrom is easily accomplished solely by hand via the heads **6**, particularly when the heads are turned during installation and removal about the longitudinal axes of coupler devices **5** in the required direction to tend to "wrap down" or contract the stems (per arrows on FIGS. 4 and 5). Such turning via heads **6** has the opposite effect on the force fitted joints between the spring pin convolutions **15** and **16** and the bores **7** of the heads, namely to make the joints tighter by expanding the convolutions.

Contraction or "wrap down" action of the stem portions **10'** by turning of the coupler devices **5** about their longitudinal axes as enabled by the heads **6** to facilitate installation and withdrawal would ordinarily require that the user must observe the direction in which the spring stock is convoluted as he holds a head **6** in his hand, hence which way the device must be turned. Otherwise the turning will tend to lock the stem in the hole. By selective assembly through instrumentation or otherwise (choice of ends of spring pin blanks to be secured in heads **6** so that, for example, the appropriate turning di-

rections indicated by the arrows in FIGS. 4 and 5 will always obtain), the user becomes accustomed to inserting and withdrawing the coupler devices while turning the heads **6** in a uniform direction to produce radial contraction of the stem. The direction is clockwise from user's point of view if the selection is made according to FIGS. 3 to 5. One manner of facilitating selective orientation during assembly is to form the exposed taper or chamfer **13** on the free end of leaf stem **10** with a "sharp" or narrow angle and the hidden taper **13'** with a "blunt" or considerably wider angle (not so shown). The difference then functions as a signal (optical or by appropriate instrumentation) to orient the blanks for assembly with the heads **6**.

The dimensions and relationships as earlier given above are those preferably practiced only in respect to light duty impact wrench equipment. For heavier duty wrenches, for example, larger than with 5/8" drive squares, the coupler stem portions **10** are preferably made from somewhat heavier gage leaf spring metal than .007" and in the magnitude of 3/16" principal outer diameter or larger. The exposed portions **10'** of devices **5** are of various lengths, i.e., longer for heavy duty impact wrench and socket equipment than for light duty and varying according to socket design as required. For the larger sizes of coupler devices **5** it is contemplated that more uniform diametrical dimensions (closer tolerances) and of course more nearly cylindrical shapes of exposed stem portions **10'** can be obtained by (e.g.) centerless grinding of the stems.

I claim:

1. For quickly detachably securing a wrench socket to a drive member at round cross holes in non-circular mating torque-transmitting portions of the socket and member, a threadless spring fastener having a stem comprising a generally circular, spirally and openly convoluted piece of light gage leaf spring metal normally of greater average diameter than the hole in the drive member, and a head having an axial bore sufficiently tightly receiving an end portion of the stem so that the convolutions thereof are maintained in tight mutual face-to-face contact within the bore of the head to the extent of being rendered radially rigid or solid.

2. A pin type spring fastener comprising an elongated generally circular stem member of convoluted openly wound metal leaf spring stock whereby the spring stock of the stem member tends to contract when turned in a predetermined direction about the longitudinal axis of the member while in frictional contact with a mating wall surface of one member to be fastened to another, and a rigid tubular relatively enlarged rigid head member having its bore in telescoping sufficiently tight force fitted frictional contact with a shank portion of the stem member to force the associated convolutions against each other, the spring stock of the shank portion being so related to the bore surface of the head member that the convolutions tend to expand in the head member when the latter is turned in said direction.

References Cited in the file of this patent

UNITED STATES PATENTS

273,385	Perkins	Mar. 6, 1883
2,147,163	Jimerson	Feb. 14, 1939
2,383,079	Reed	Aug. 21, 1945
2,737,843	Koehl	Mar. 13, 1956

FOREIGN PATENTS

155,021	Australia	Feb. 3, 1954