Dec. 3, 1968 E. R. SHINN 3,413,876

POWER WRENCH FOR TIGHTENING STUDS IN ENGINE BLOCKS AND THE LIKE

Filed July 12, 1967 2 Sheets-Sheet 1

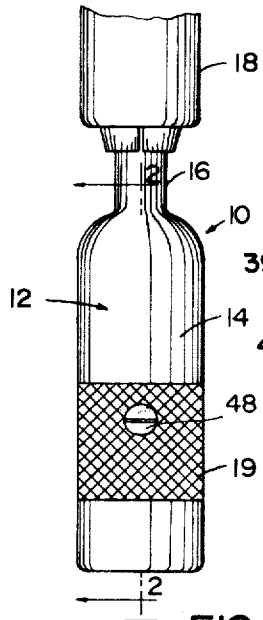



FIG. 1

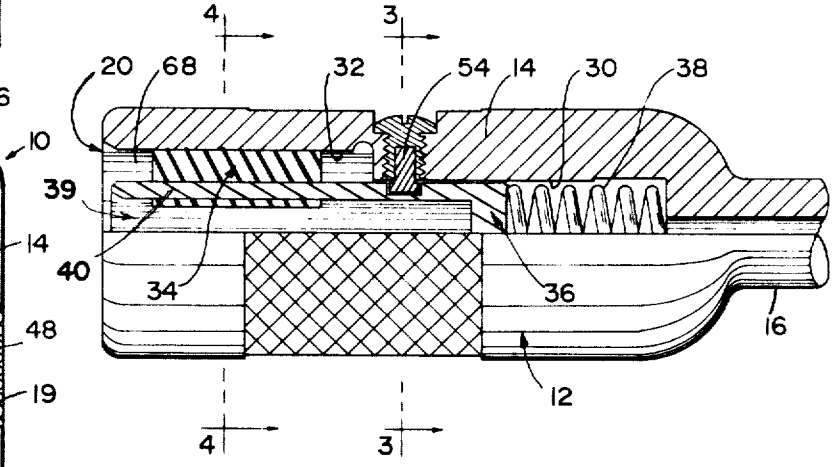
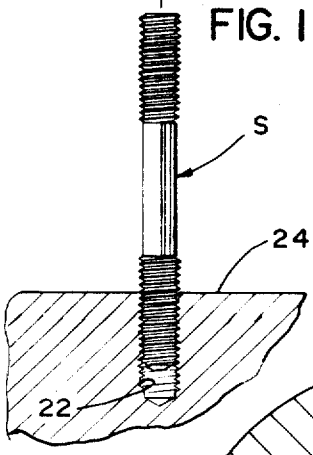



FIG. 2



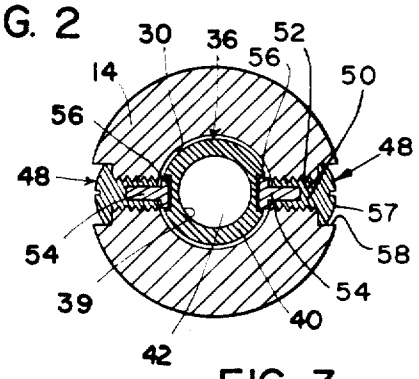




FIG. 3

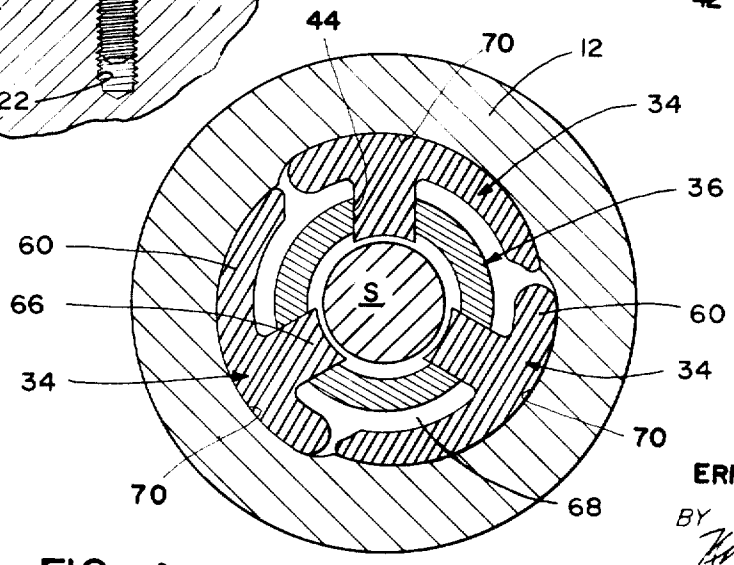



FIG. 4

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POWER WRENCH FOR TIGHTENING STUDS IN ENGINE BLOCKS AND THE LIKE

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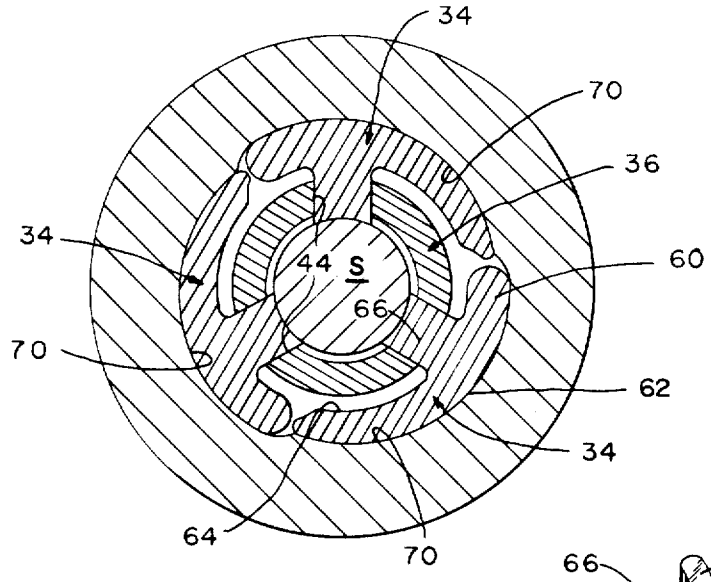



FIG. 5

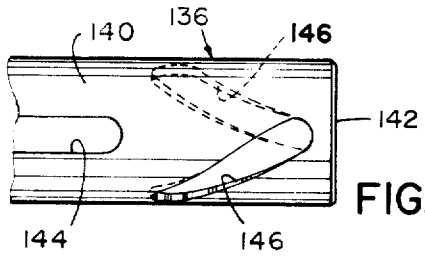



FIG. 7

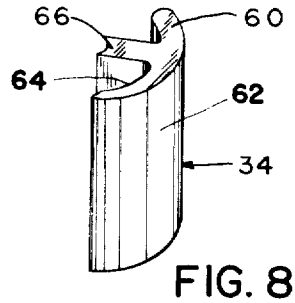



FIG. 8

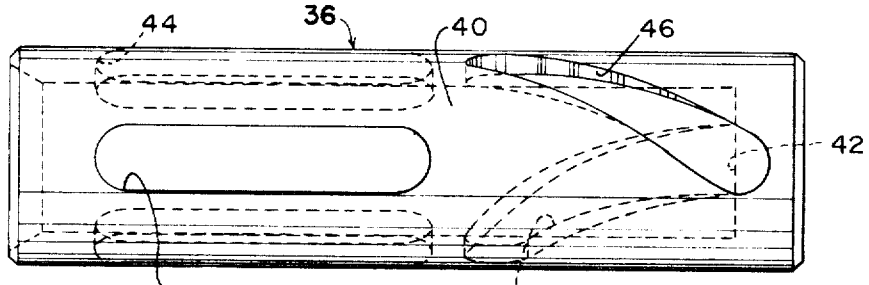



FIG. 6

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3,413,876

# POWER WRENCH FOR TIGHTENING STUDS IN ENGINE BLOCKS AND THE LIKE

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8 Claims. (Cl. 81—53)

## ABSTRACT OF THE DISCLOSURE

A power wrench for driving and tightening studs in engine blocks and the like. The wrench body has a shank suitable for mounting in a drill press chuck and a socket for telescopic reception over the stud to be tightened. As the stud bottoms in the socket of the continuously rotating wrench body, a cam controlled multiple jaw clutch closes inwardly upon the stud to engage and rotate it. Withdrawal of the wrench from the stud disengages the clutch.

The present invention relates to a power wrench for driving and tightening studs in the threaded holes or sockets which are provided for them in an engine block or the like.

Heretofore, it has been common practice in assembly line operation, as well as in automobile repair shops, to effect the installation of the various studs which project vertically upwardly from the engine block of an internal combustion engine for an automotive vehicle initially to thread the studs manually a slight distance into their respective threaded holes in the engine block, and thereafter to tighten the studs with a Stillson type wrench. This procedure is quite awkward inasmuch as the large number of closely arranged studs affords little freedom of wrench movement. The procedure also is time-consuming not only by reason of such lack of working space, but also by reason of the fact that to insure equality of stud height in the completed engine block, repeated measurement of stud height during the stud tightening operation must be resorted to. Stud removal or extraction operations are likewise hampered by close stud proximity. Still further, application of a self-energizing jaw type wrench to the studs may damage the studs to such an extent that difficulty is subsequently encountered in installing the cylinder head on the engine block to which the studs have been applied.

The present invention is designed to overcome the aforementioned difficulties that are attendant upon the current method of stud installation, and toward this end, the invention contemplates the provision of a novel power wrench in the form of a normally vertically extending, thimble-like casing having at the upper end thereof a shank portion by means of which it may be secured in the rotary chuck of a conventional or standard drill press stand. The aforesaid casing of the improved wrench presents a socket for telescopic reception over a given stud to be tightened and is possessed of internal moving parts including a cam-operated, stud-engaging, jaw type clutch, engagement and disengagement of which is effected under the control of insertion of the stud into and removal of the stud from the stud-receiving socket in the wrench casing. It is contemplated that the aforementioned wrench-supporting chuck will be continuously rotated and, since it is associated with a conventional drill press stand, it is merely necessary to index the engine block or other workpiece in such manner as to bring the various studs successively into vertical register with the wrench, whereupon, as each stud is moved beneath the wrench, the operating handle of the press is manipulated to lower the rotating chuck wrench downwards upon the stud so that



automatic stud-tightening will take place. A gauge on the drill press stand indicates the proper depth of stud-penetration into the engine block, and when this depth has been attained, the drill press chuck, and consequently, the wrench, is raised to withdraw the stud from the socket. Upon raising of the chuck and wrench, the tightened stud is released and the engine block or other workpiece is indexed to bring the next stud into position for tightening purposes.

The provisions of a stud-tightening wrench of the character briefly outlined above and possessing the stated advantages constitutes the principal object of the present invention.

The provision of a stud-tightening wrench which is extremely simple in its construction; a wrench which is possessed of a minimum number of parts and, therefore, may be manufactured at a low cost; a wrench which is rugged and durable and, therefore, will withstand rough usage; a wrench which is capable of ease of assembly and dismantlement for purposes of inspection and replacement of parts thereof; a wrench which requires no adjustment to accommodate studs of varying height or diameter; a wrench which will not deface or damage the studs to which it is applied; a wrench which will positively grip the studs securely even when the latter are made of hardened steel; and a wrench which, otherwise, is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Numerous other objects and advantages of the invention, not at this time enumerated, will readily become apparent as the nature of the invention is better understood from a consideration of the following detailed description.

In the accompanying two sheets of drawings forming a part of this specification, one illustrative embodiment of the invention is shown.

In these drawings:

FIG. 1 is a fragmentary side elevational view showing a stud-tightening wrench embodying the invention operatively installed in the rotary chuck of a drill press stand and in position over a stud preparatory to tightening of the latter;

FIG. 2 is an enlarged partial sectional view taken vertically and centrally through the wrench and on the line 2—2 of FIG. 1;

FIG. 3 is a horizontal or transverse sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is a horizontal or transverse enlarged sectional view taken on the line 4—4 of FIG. 2 and showing the stud-engaging jaw clutch of the improved wrench in its disengaged condition;

FIG. 5 is a sectional view similar to FIG. 4, but showing the stud-engaging jaw clutch engaged;

FIG. 6 is an enlarged side elevational view of the clutch actuator of the wrench;

FIG. 7 is a fragmentary side elevational view somewhat similar to FIG. 6 but showing a modified form of jaw actuator which is useable in connection with stud-removal operations; and

FIG. 8 is a perspective view of one of a series of three clutch jaw members which are employed in connection with the present invention.

Referring now to the drawings in detail and in particular to FIG. 1, a stud-tightening wrench embodying the principles of the present invention is designated in its entirety by the reference numeral **10**, such figure being a side elevational view so that only the outer wrench casing **12** is visible. This casing is generally of cylindrical configuration and includes an enlarged body

portion **14** from which there projects axially a shank portion **16**. The latter is located at the upper end of the casing **12** and is adapted for retention in a suitable chuck such as the rotatable chuck **18** which forms a part of a conventional or standard drill press stand (not shown).

The casing **12** is provided with an intermediate knurled section **19** in order to facilitate manual manipulation thereof during installation and removal of the wrench with respect to the chuck **18**. The casing **12** also is provided with a deep axially extending clutch-enclosing socket **20** (see FIG. 2) for telescopic reception over the upper end of a stud S. The latter is shown in the drawings as being loosely threaded in a threaded socket **22** in the upper portion of an automotive engine block **24** or the like. Preferably, in a commercially feasible installation, the drill press stand will be stationary while the engine block **24** will be suitably mounted on a bed plate which is capable of being indexed to bring the various upstanding studs into successive vertical register with the stud-tightening wrench **10** so that, upon descent of the wrench, the stud S will enter the socket **20** for stud-tightening purposes. It will be understood that the chuck **18** of the drill press stand will be continuously rotated and that upon each descent thereof, the rotating wrench will operatively engage the stud S to be tightened and effect the tightening operation automatically with no manipulative procedure on the part of the operator being required other than his manipulation of the usual drill press lever (not shown) or other operating instrumentality such as a foot pedal or the like (also not shown).

Referring now to FIGS. 2 to 6, inclusive, the aforementioned socket **20** consists of a bore **30** in the upper portion of the casing and an enlarged counterbore **32** in the lower portion of the casing, the adjoining ends of the bore and the counterbore being in communication with one another and the lower end of the counterbore being open. The clutch mechanism by means of which automatic stud-engaging and disengaging operations are effected is enclosed within the socket **20**. It is of an extremely simple nature and includes only five principal parts, namely, an annular series of three clutch jaw members **34**, a jaw actuator **36**, and a biasing spring **38**.

The jaw actuator **36** of the clutch mechanism of the wrench is in the form of an elongated, relatively deep, cup-shaped member which defines a stud-receiving socket **39** and consists of vertically extending cylindrical side wall **40** (see FIG. 6) and a circular, horizontally extending, top wall **42**. Three longitudinally extending and equally spaced slots **44** are formed in the lower end region of the side wall **40**, while two diametrically opposite, shallow, helical grooves **46** (see FIG. 6) of relatively long pitch are formed in the upper end region of said side wall. The jaw actuator **36** is disposed in and extends lengthwise of the socket **20** in the wrench casing **12** and is capable of limited axial sliding movement within the bore **30**, the upper end region of said jaw actuator being slidably disposed within said bore with a relatively snug but not a binding fit. During such sliding movement in either direction, the jaw actuator **36** is constrained to turn slightly about its longitudinal axis by reason of two horizontally positioned reaction guide pins **48** which are carried by the casing **12** and project into the helical grooves **46** in the upper end region of the side wall **40** of the jaw actuator **36**.

Specifically, the guide pins **48** are of two-piece construction and each consists of a hollow pin body **50** which is threadedly received in a radial bore **52** in the central or medial part of the body portion **14** of the casing **12** and, in addition, a rotatable guide shoe **54** which is in the form of a shank and an enlarged head portion **56** at the inner end of the shank. The shanks of the guide shoes **54** extend into and are rotatable with respect to the hollow pin bodies **50** of the guide pins **48** and the enlarged head portions **56** project respectively into the helical grooves **46**. The outer ends of the hollow pin bodies **56** of the guide pins **48** are provided with enlarged, kerf-equipped heads **57** which are received in countersinks **58** in the body portion **14** of the wrench casing in order to avoid radial projections on the outer cylindrical surface of said body portion. From the above description, it will be observed that upon axial sliding movement of the jaw actuator **36** in either longitudinal or axial direction, a relatively slight turning movement of the jaw actuator will take place. The biasing spring **38** of the clutch mechanism of the wrench is of the helical compression type. It is disposed within the upper region of the bore **30** and serves yieldingly to bias the jaw actuator **36** downwards with respect to the socket **20**, the extent of axial movement of which the jaw actuator is capable being determined by the length of the helical grooves **46**.

As best shown in FIGS. 4, 5 and 7, each of the three clutch jaw members **34** embodies a generally arcuate runner **60** having an outer convex side **62** and an inner concave side **64**. A jaw proper **66** projects radially from the inner concave side **64** of the runner of each clutch jaw member **34** and extends radially inwards through one of the three longitudinally extending slots **44** in the lower end region of the side wall **40** of the jaw actuator **36**, the runner **60** being disposed in the annulus **68** (see FIGS. 2 and 4) which exists between the side wall **40** of the jaw actuator **36** and the body portion **14** of the wrench casing **12**. The outer convex side **62** of each runner **60** is designed for cooperation with a complementary cam surface **70** which is formed as a part of the counterbore **32** in the lower portion of the body portion **14**, there being three such cam surfaces. These cam surfaces **70** are so designed that as the associated clutch jaw members **34** are shifted in a counterclockwise direction as viewed in FIGS. 4 and 5, the runners **60** will slide thereon and thus effect inward or centripetal movement of the jaw members bodily in unison so that the jaws proper **66** will engage the central portion of a stud S which has been projected into the socket **20** and thus securely clamp the stud clutch between them.

It is to be noted that the three clutch jaw members **34** are of appreciable longitudinal extent and that the runners **60** that are associated therewith and form a part thereof are of appreciable circumferential extent. Thus, in the first instance, a relatively long span of the central portion of the stud S undergoing tightening is engaged by the clutch jaw members during the tightening operation and this span is preferably disposed so that the jaw members will engage only that smooth surface portion of the stud which is disposed between the inner and outer threaded end regions of the stud. In this manner, damage to the stud threads is precluded. In the second instance, a broad area of surface contact between each clutch jaw member **34** and the surface which defines the counterbore **32** is attained so that the outward radial reaction thrust that is exerted by the clutch jaw members on such surface is widely distributed, thus contributing toward minimum frictional wear of the involved parts of the wrench.

In the operation of the herein described stud-tightening wrench **10**, as each stud S is brought into a position of vertical register with the chuck-supported stud-tightening wrench under the influence of the aforementioned indexing mechanism which supports the engine block **24** as previously described, the operator will actuate the control lever of the drill press stand in such a manner as to lower the rotating chuck and wrench so that the wrench is moved into telescopic relationship with respect to the subjacent stud S. The extreme upper end of the stud will thus engage the top wall **42** of the cup-shaped jaw actuator **36** and prevent further downward movement of said jaw actuator while the casing **12** will continue to descend over the stud. This will cause compression of the spring **38** which normally is extended so that the jaw actuator **36** assumes the position wherein it is shown in FIG. 2

with the upper ends of the helical grooves **46** engaging the guide pins **48** and thus limiting the extent of projection of the jaw actuator **36** by the spring **38**. The relative movement thus occasioned by descent of the casing **10** while the jaw actuator **36** remains stationary will shift the position of the jaw actuator **36** until such time as the lower ends of the helical grooves **46** engage the guide pins **48**. During this shifting of the jaw actuator **36**, a slight rotational movement in a counterclockwise direction as viewed in FIGS. 4 and 5 of the jaw members **34** with respect to the casing **12** will take place, thus causing the runners **60** to slide on their respective cam surfaces **70**, and as a consequence, causing the jaws proper **66** to move radially inwards and engage the outer surface of the stud S as shown in FIG. 5 so as firmly to clamp the stud therebetween. Since the entire wrench **10** is continuously rotating, the stud will at this time be seized within the socket **20** and, consequently, rotated in a stud-tightening direction within the threaded socket **22** in the engine block **24**. The downward pressure exerted upon the wrench **10** as a whole by the drill stand will suffice to maintain the necessary jaw pressure to effect operative jaw engagement. The various cam surfaces **70** are of very slight helical pitch in the circumferential direction of the counterbore **32** so that a powerful inward gripping action will be exerted by the jaws proper **66** on the stud with but light pressure by the operator upon the operating lever of the drill press stand.

As soon as the stud S has been threaded into the socket **22** to the predetermined required degree, as evidenced by the aforementioned automatic gauge that is associated with the drill press stand, the operator will relieve the downward pressure and raise the chuck **18**, whereupon the spring **38** will force the jaw actuator **36** axially with respect to the wrench casing **12** in a direction to restore the former to its inoperative position of jaw clutch release. As soon as the wrench has cleared the upper end of the stud S, the indexing mechanism which supports the engine block **24** may be actuated to bring a new stud S into position beneath the wrench for a subsequent stud-tightening operation.

The herein described stud-rotating wrench **10** is capable of modification so that it will function as a stud removal device. It is contemplated that in the commercial exploitation of the invention, the wrench will be sold in pairs, one wrench being employed for stud installation and the other being employed for stud removal. The only modification which is necessary to cause the wrench to function as a stud removal device is the use of a modified form of jaw actuator **36**. When the wrench is to be so employed for stud removal purposes, a jaw actuator such as is shown fragmentarily in FIG. 7 and designated by the reference numeral **136** will be substituted for the jaw actuator **36**. In the actuator **136**, the general contour of the actuator **36** will be maintained, but the two helical slots **146** will have an opposite pitch direction, albeit, the same pitch angle. Obviously, the drill press stand will be equipped with mechanism for reversing the direction of rotation of the chuck **18**. The actuator **136** of FIGURE 7, in other respects, is similar to the previously described actuator **35** and, therefore, in order to avoid needless repetition of description, similar reference numerals, but of a higher order, have been applied to the corresponding parts as between the disclosures of FIGURES 7 and 6, respectively.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. For example, wherein in FIGS. 2 and 6, the jaw actuator **36** is shown as being provided with helical grooves or slots **46** which are not cut completely through the side wall **40** of the jaw actuator **30**, it is within the purview of the invention to employ helical slots which extend completely through said side wall and through which the guide pins **48** project. Similarly, although in the illustrated embodiments of the invention, the extent of shifting movement of the jaw actuator **36** with respect to the casing **12** is limited by engagement of the guide pins **48** with the opposite ends of the helical grooves **46**, such shifting of the jaw actuator may be limited by the provision of internal shoulders or stops suitably disposed within the socket. Therefore, only insofar as the invention is particularly pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

**1.** A power-actuated stud-tightening wrench comprising a vertically extending, generally cylindrical casing embodying means at its upper end for connecting it to a continuously rotating chuck, and having extending axially inwardly from its lower end a socket into which a stud is adapted to be projected endwise, a generally cylindrical tubular stud-encircling jaw actuator axially slidable in said socket between upper and lower positions, means yieldingly biasing the actuator toward its lower position, said actuator being capable of limited turning movement within the socket bodily between first and second angular positions and being formed with a series of circumferentially spaced axially extending slots therein, a jaw member slidable radially in each slot and having its inner end engageable with a stud which has been projected into said socket and its outer end engageable with the wall of said socket, first interengaging cam means on the wall of said socket and the outer end of each jaw member effective when the actuator is in said second angular position to force the jaw members radially inwardly into stud-engaging position and when the actuator is in said first angular position to allow the jaw members to move to their stud-releasing position, second interengaging cam means on the wall of said socket and the jaw actuator effective during movement of the jaw actuator between its upper and lower axial positions to effect turning movement of the actuator between its first stud-releasing and its second stud-engaging positions, and a shoulder formed internally of the actuator and engageable with the end of a stud during projection thereof into the socket for moving the actuator toward its inner axial position against the action of said biasing means.

**2.** A power-actuated stud-tightening wrench as set forth in claim **1**, wherein said socket establishes an upper bore and a lower enlarged counterbore, wherein the tubular jaw actuator is slidable in the upper bore and projects into the counterbore so as to define an annulus between the latter and the wall of the jaw actuator, and wherein each jaw member is provided with an arcuate runner portion which is engageable with the wall of the counterbore, and a radially extending jaw proper which projects through the associated slot in the jaw actuator and has its inner end engageable with the stud.

**3.** A power-actuated stud-tightening wrench as set forth in claim **2** and wherein said first interengaging cam means comprises cooperating involute helical surfaces of relatively long pitch and wide expanse on each runner portion and the wall of the counterbore.

**4.** A power-actuated stud-tightening wrench as set forth in claim **1** and wherein said second interengaging cam means comprises a series of elongated helical guide tracks in the jaw actuator and a series of cooperating guide pins carried by the casing and projecting into said helical guide tracks.

**5.** A power-actuated stud-tightening wrench as set forth in claim **1** and wherein said jaw actuator is in the form of an elongated cup-shaped member having a cylindrical tubular side wall and a top wall which establishes said stud-engaging shoulder.

6. A power-actuated stud-tightening wrench as set forth in claim 5 and wherein said guide tracks are in the form of grooves which are formed in the tubular wall of the actuator.

7. A power-actuated stud-tightening wrench as set forth in claim 5 and wherein said biasing means comprises a compression spring interposed between the upper end of the casing and the top wall of the jaw actuator.

8. A power-actuated stud-tightening wrench as set forth in claim 4 and wherein said axial slots are three in number and said helical guide tracks are two in number.



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MYRON C. KRUSE, *Primary Examiner.*