May 15, 1956 M. G. REIFFIN 2,745,305

WRENCHES WITH ADJUSTABLE JAWS RESPONSIVE TO HANDLE ACTUATION

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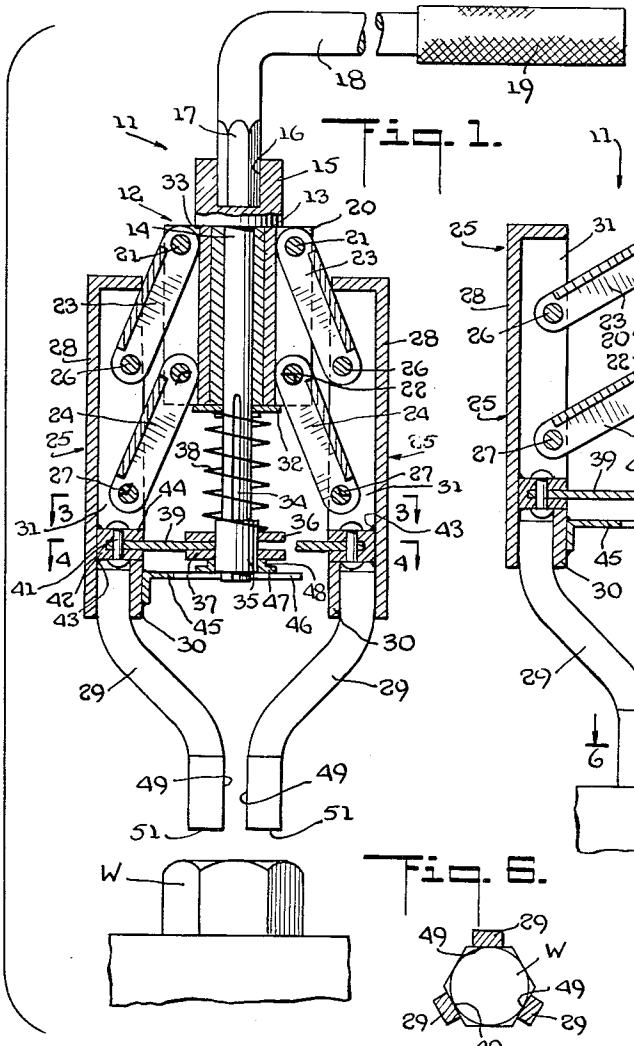


Fig. 1.

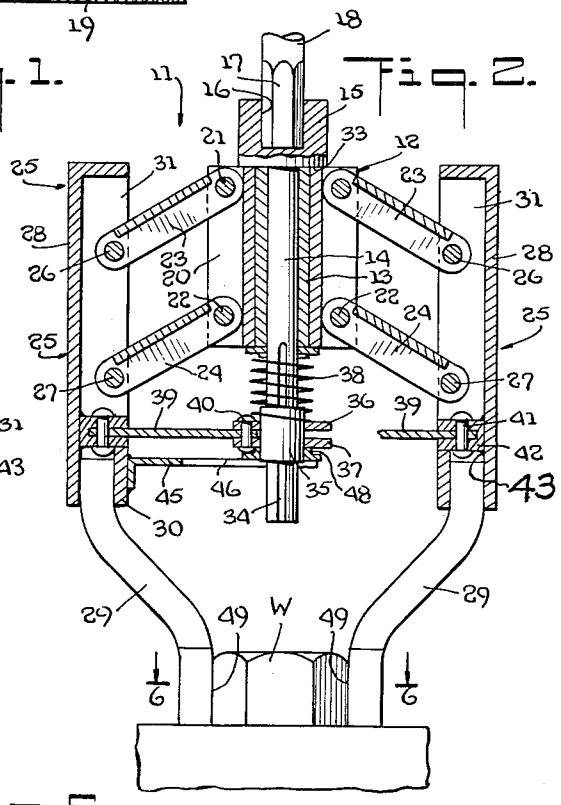


Fig. 2.

Fig. 6.

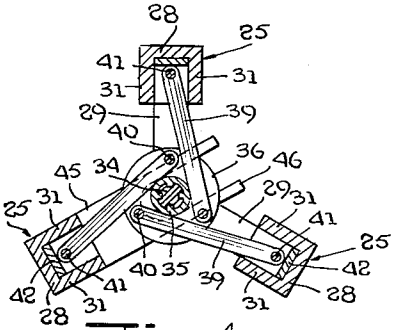


Fig. 4.

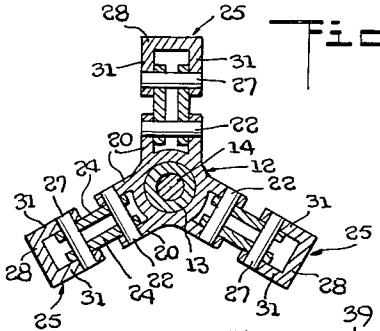


Fig. 3.

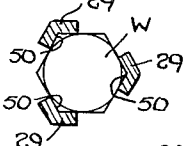


Fig. 7.

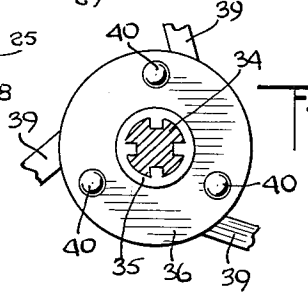


Fig. 5.

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FIG. 8

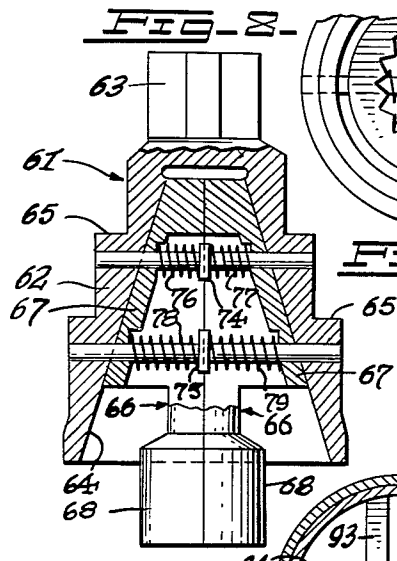


FIG. 10

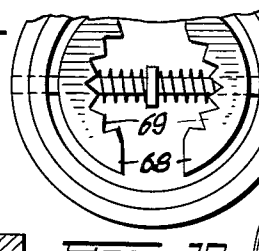


FIG. 16

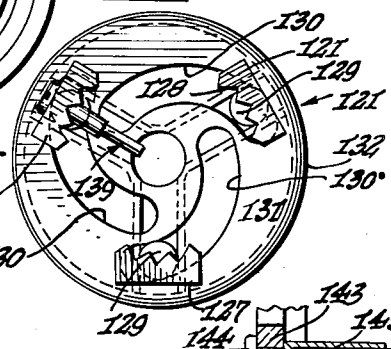


FIG. 17

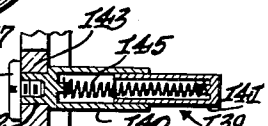


FIG. 18

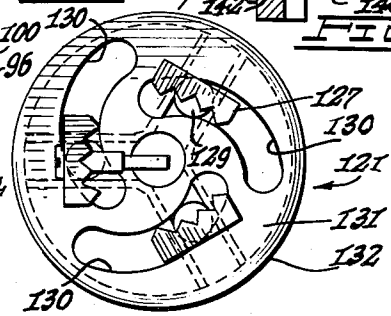


FIG. 9

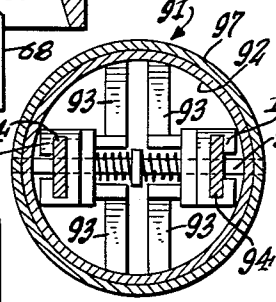


FIG. 14

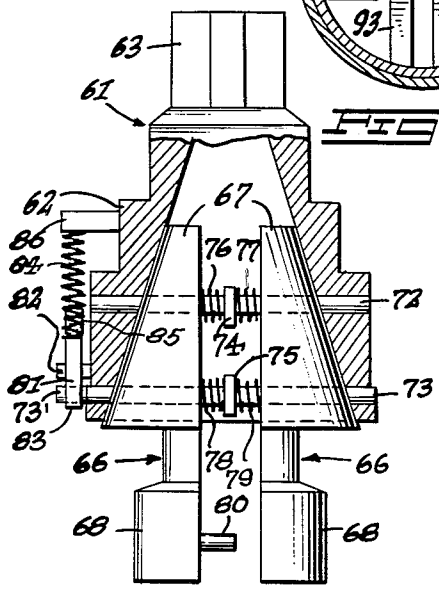


FIG. 15

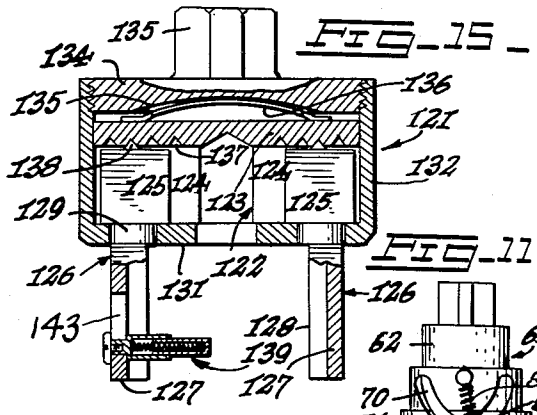


FIG. 11

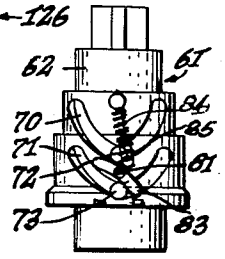


FIG. 12

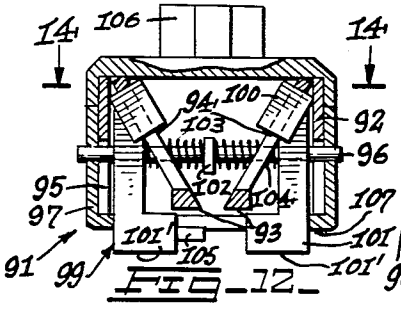
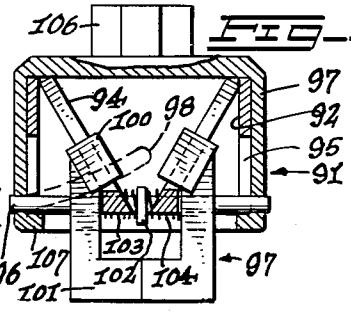


FIG. 13



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FIG-19-

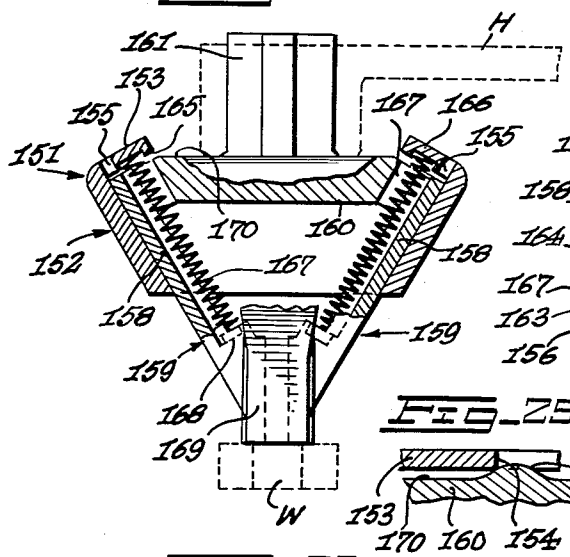


FIG-24-

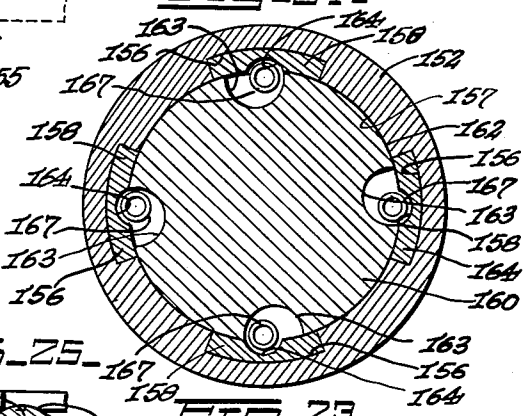


FIG-25-

FIG-23-

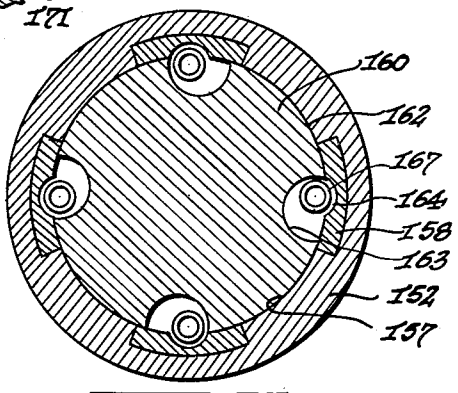


FIG-20-

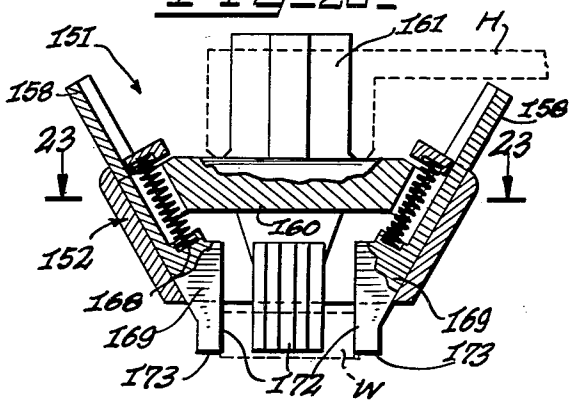


FIG-22-

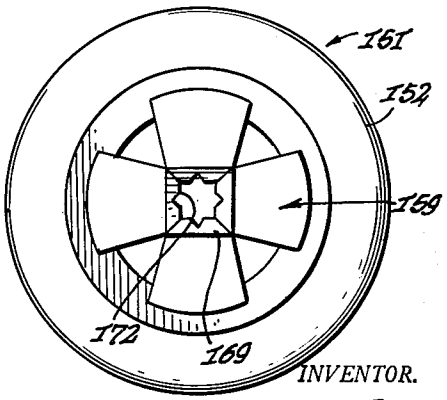
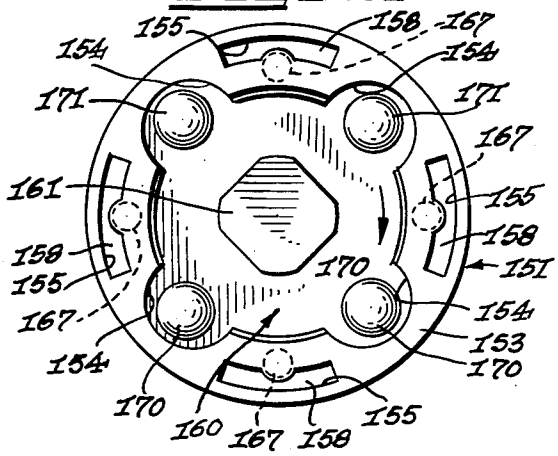


FIG-21-



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United States Patent Office 2,745,305 Patented May 15, 1956

2,745,305

WRENCHES WITH ADJUSTABLE JAWS RESPONSIVE TO HANDLE ACTUATION

Martin G. Reiffin, Brooklyn, N. Y.

Application October 28, 1953, Serial No. 388,859

26 Claims. (Cl. 81—128)

This invention relates to a wrench of the type having movable jaws adapted to grip various different sizes of nuts, bolts and other workpieces to be rotated thereby.

Wrenches as heretofore constructed in the prior art have several defects and disadvantages which the present invention is intended to obviate. More specifically, skilled mechanics and others who employ wrenches have heretofore found it necessary to use wherever possible socket wrenches of the type wherein many sockets of various sizes are provided in a set, each socket having an opening adapted to receive and grip a particular size of nut and mountable on a wrench handle. That is, the size of each socket is fixed and the proper socket must be selected from the set of many sockets to correspond with the particular workpiece and must then be mounted on the wrench handle.

This socket type of wrench, although superior to other wrenches of the prior art, presents several disadvantages. It is necessary that the socket set include many sockets in order to assure that all standard sizes of nuts and bolts may be accommodated. The large number of sockets thus required results in a complete socket set being of a high cost and also of great bulk and weight, which is of inconvenience to the mechanic who is frequently required to transport his tools.

An even greater disadvantage of the conventional socket set is the fact that it is necessary for the mechanic to select the exact size socket to fit the individual nut or bolt. This usually involves a selection by trial and error, much wasted time and inconvenience being caused by the application of different sockets to the workpiece until one of the sockets is found to fit snugly over the nut or bolt. This trial and error process must then be repeated when a workpiece of different size is to be rotated. Another disadvantage of the socket set type of wrench is the fact that the sockets are numerous and loose and are easily misplaced and lost, rendering the set incomplete. Still another disadvantage is the tendency of the serrated gripping surfaces on the interior of the socket opening to become worn with use, thereby causing the socket to slip with respect to the nut or bolt when it is attempted to rotate the latter. This slipping rounds off the corners of the nut or bolt and destroys the usefulness of the workpiece, and may also cause serious injury to the mechanic when the wrench suddenly yields under pressure, permitting his hands or arms to strike a sharp projection on the apparatus.

In order to avoid the necessity for selecting the proper size socket and also the other inconveniences of the socket set type of wrench noted above, less conscientious or less skilled mechanics are frequently tempted to employ adjustable wrenches of the type having a fixed jaw and a movable jaw such as the well-known "monkey wrench," although this is generally recognized as bad practice, except where unavoidable, for several reasons. The movable jaw, because of its inherent mounting and actuating mechanism, cannot be absolutely fixed and rigid with respect to the fixed jaw and the jaws will spread

apart as a torque is applied to the workpiece. Furthermore, the greater the applied torque, the greater will be the spread of the jaws. This frequently causes the wrench to slip with respect to the workpiece with the resulting injury to both the corners of the workpiece and the hands of the mechanic.

This slipping tendency of prior art wrenches having a pair of adjustable jaws is even more pronounced than in the case of the socket type because of the fact that only two opposite faces of the nut or bolt are engaged by the pair of jaws of the monkey wrench as distinct from the socket type which completely surrounds and engages the exterior of the workpiece. Also, the mechanic usually does not spend the required time and effort to adjust the movable jaw into a tight gripping engagement with the workpiece, thereby further tending to result in slipping of the wrench. Another important disadvantage of the "monkey wrench" and other prior art wrenches of the type having a pair of adjustable movable jaws is the inconvenience and time required to adjust the jaws every time a different size workpiece is to be gripped.

It is therefore a primary object of the present invention to provide a novel wrench construction free of the above-noted defects of wrenches as heretofore conceived in the prior art.

More specifically, the preferred wrench embodiments of the present invention are provided with a plurality of movable jaws adapted to surround and grip the workpiece on several sides thereof and are provided with a novel mounting arrangement whereby the jaws automatically adjust themselves to the particular size of the workpiece when placed in contact therewith. That is, instead of selecting a proper size socket from a set or manually adjusting the space between a pair of movable jaws as heretofore necessary in the prior art, the mechanic merely moves the wrench of the present invention downwardly to bring the jaws into contact with the top surface of the nut or bolt, the latter then reacting against the jaws to move them automatically to the proper spaced position to snugly fit around and grip the workpiece.

Another highly significant feature of the present invention resides in the novel arrangement whereby the greater the turning effort or torque or applied to the wrench by the mechanic the greater will be the gripping pressure of the jaws on the workpiece, to counteract the tendency of the high torque to cause slipping of the jaws relative to the workpiece. That is, the harder the mechanic pulls on the wrench handle, the tighter the jaws will grip the nut or bolt being turned, as distinct from the conventional wrench wherein the movable jaws tend to separate and slip on the workpiece as torque is applied.

A further object of the present invention is to provide a wrench of the character described having several different embodiments or forms, in some of which the jaws are pivotally mounted and in the other embodiments the jaws being slidably mounted to provide opening and closing movements thereof.

Another object is to provide a wrench of the character described which may be selectably adjusted for driving engagement with the workpiece to rotate the latter in either direction. That is, in one position of adjustment the jaws will tightly grip the nut or bolt in response to turning the wrench in one direction so as to tighten the nut or bolt, and alternatively, in another selected position of adjustment the jaws will be urged toward closed gripping engagement in response to rotation of the wrench in the opposite direction so as to loosen the nut or bolt if so desired.

A further object is to provide a wrench having a plu-

rality of jaws coacting to form a segmented socket to surround and grip the workpiece on several sides thereof but being adjustably movable toward and away from each other to vary the size of the socket so as to accommodate nuts and bolts of different sizes.

Still another object is to provide a wrench of the character described wherein the jaws automatically expand to slip or ratchet around the workpiece when the wrench is rotated in a direction opposite to the direction of driving engagement with said workpiece.

Other objects and advantages of the present invention are inherent in the structure disclosed and claimed or will become apparent to those skilled in the art as the detailed description proceeds in connection with the accompanying drawings wherein are illustrated merely a few of the many possible embodiments and modifications of the invention within the scope of the appended claims and which will readily occur to those skilled in the art after seeing the present disclosure.

In the drawings:

Fig. 1 is a sectional view of an embodiment of the invention showing the jaws closed and about to engage the top surface of a nut or bolt head;

Fig. 2 is a sectional view similar to Fig. 1 but showing the jaws surrounding and in gripping engagement with the nut;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged partial sectional view similar to Fig. 4, the jaws not being included;

Fig. 6 is a horizontal sectional view on the line 6—6 of Fig. 2 and shows the jaws in engagement with the exterior faces of the nut;

Fig. 7 is a sectional view similar to Fig. 6 but showing a modified form of the jaws for gripping the corners of the nut;

Fig. 8 is a vertical sectional view of a different embodiment of the invention wherein the jaws are slidably mounted and showing the jaws in a closed position;

Fig. 9 is a sectional view similar to Fig. 8 but showing the jaws in an open position;

Fig. 10 is a bottom plan view of the embodiment of Fig. 9;

Fig. 11 is a side elevational view of the same;

Fig. 12 is a vertical sectional view of another modified form of the invention having sliding jaws shown in open position;

Fig. 13 is a view similar to Fig. 12 but showing the jaws closed;

Fig. 14 is a horizontal sectional view on the line 14—14 of Fig. 12;

Fig. 15 is a vertical sectional view of still another form of the invention, the jaws being open;

Fig. 16 is a bottom plan view of the same;

Fig. 17 is a view similar to Fig. 16 but showing the jaws partially closed;

Fig. 18 is an enlarged sectional view of a workpiece engaging device adapted to be mounted on a jaw of any of the embodiments of the invention;

Fig. 19 is a vertical sectional view of another modified form of the invention, the jaws being in normal closed position and engaging the top surface of a nut or bolt head;

Fig. 20 is a sectional view similar to Fig. 19 but showing the jaws in gripping engagement with the workpiece;

Fig. 21 is a top plan view of the embodiment of Figs. 19 and 20;

Fig. 22 is a bottom plan view of the same;

Fig. 23 is a horizontal sectional view on the line 23—23 of Fig. 20;

Fig. 24 is a sectional view similar to Fig. 23 but showing the relative positions of the elements when the wrench is rotated in the opposite direction to that of Fig. 23; and

Fig. 25 is a sectional detail view showing a cam means for locking the jaws in their adjusted position in gripping engagement with the workpiece.

Referring now to the drawing in more detail, and first to Figs. 1 to 7 thereof, the reference numeral **11** indicates generally a preferred embodiment of the present invention comprising a frame **12** which is of hollow cylindrical configuration. A vertical cylindrical bearing sleeve **13** is fixedly secured within frame **12** and receives a vertical shaft **14** rotatably mounted therein. The upper end of shaft **14** is provided with an enlarged head **15** having a hexagonal socket **16** which receives the hexagonal end **17** of a handle **18** having at its outer end a knurled hand-grip portion **19**.

Frame **12** is provided with a plurality of pairs of radially outwardly projecting extensions **20**, the extensions of each pair being in spaced parallel relation to each other. A plurality of pivot pins **21** are mounted at their opposite ends in suitable openings provided in the upper portions of extensions **20**, each pin **21** extending horizontally between a respective pair of extensions **20**. A second series of pivot pins **22** are similarly provided but are spaced below pivot pins **21**.

A first series of links **23** of U-shaped cross-section are each pivotally mounted at its inner end to a respective pivot pin **21** and a second series of links **24** are similarly pivoted on pins **22**. It will be noted that each link **23** is parallel to and spaced vertically above a respective one of links **24**.

The outer ends of links **23**, **24** are pivotally connected to a plurality of jaws **25** by horizontal pivot pins **26**, **27** respectively. It is to be understood that although three jaws **25** are illustrated in the form of the invention shown in Figs. 1 to 7, and the other embodiments shown in Figs. 8 to 25 have two, three or four jaws, any practical desired number of jaws may be provided for any of the embodiments.

Each jaw **25** comprises a shank **28** of U-shaped cross-section the lower end of which has fixedly secured therein the upper end of a workpiece-engaging member **29**. The lower end of shank **28** is provided with an integral portion **30** extending across the side walls **31** thereof so as to completely enclose the upper end of member **29** and hold the latter securely within shank **28**. Pivot pins **26**, **27** extend horizontally between side walls **31** and are mounted in suitable openings formed in the latter.

It will thus be seen that jaws **25** may swing upwardly and divergingly outwardly on links **26**, **27** from the lower closed position shown in Fig. 1 to an upper open position shown in Fig. 2. This movement is one of translatory motion whereby jaws **25** are maintained in vertical parallel relation.

It is to the understood that motion of the jaws **25** is described with reference to frame **12** and such should be the interpretation throughout the specification and claims unless it is clearly otherwise. In the actual operation the jaws **25** remain vertically fixed while frame **12** moves upwardly and downwardly with respect to jaws **25**.

The shaft **14** has a collar **32** secured thereto and abutting against the lower ends of frame **12** and sleeve **13** so as to prevent upward sliding movement of shaft **14** relative to frame **12**, the lower shoulder surface **33** of shaft head **15** bearing against the upper ends of frame **12** and sleeve **13** to prevent relative downward sliding movement of shaft **14**. The lower end of shaft **14** is splined at **34** and has slidably mounted thereon an internally splined cylindrical member **35** having welded thereto a pair of annular spaced horizontal crank plates **36**, **37**. A coil spring **38** surrounds splined shaft portion **34** and has an upper end reacting against collar **32** and a lower end reacting against upper crank plate **36**. Spring **38** is in compression so as to urge crank means **35**, **36**, **37** downwardly toward its lowermost position shown in Fig. 1.

A plurality of connecting elements 39 has inner ends extending between crank plates 36, 37 and are pivotally connected thereto by pivot pins 40 which are located at points eccentric with respect to the vertical axis of rotation of shaft 14. The outer end of each connecting element 39 is pivotally connected by a pivot pin 41 to a U-shaped bracket 42 secured to each of jaw shanks 28 as by welding at 43, the outer end of each connecting element 39 extending between the spaced horizontal bracket portions 44 and pivot pins 41 being mounted vertically in suitable openings formed in the latter.

It will thus be seen that as crank means 35, 36, 37 is rotated by shaft 14 in a clockwise direction as viewed in Fig. 4, tension will be exerted on connecting elements 39 to pull jaws 25 inwardly in toward their closed position. Furthermore, when jaws 25 are moved upwardly and outwardly by engagement with the top surface of a nut in a manner to be explained below, crank means 35, 36, 37 will be rotated in a counterclockwise direction as viewed in Fig. 4.

One of the jaws 25 has secured thereto a member 45 having an inwardly extending bifurcated portion 46 through which lower shaft portion 14 may extend, bifurcated portion 46 engaging the lower surface of a washer 47 mounted on member 35 and having a reduced shoulder portion 48 engaging the lower surface of lower crank plate 37.

It will thus be seen that as jaws 25 move upwardly and outwardly, crank means 35, 36, 37 will be moved upwardly therewith by member 45 on shaft 14 so as to maintain connecting elements 39 horizontal and thereby obviating any twisting forces on pivot pins 40, 41. Similarly, as spring 38 urges crank means 35, 36, 37 downwardly on shaft 14, member 45 will transmit a downward force to the jaw 25 to which it is secured, thereby pushing on the connecting element 39 associated with this particular jaw 25 to rotate crank means 35, 36, 37 and shaft 14 with respect to frame 12 and thereby urging the other two jaws 25 inwardly and downwardly by exerting tension on the two connecting elements 39 connected thereto. That is, spring 38 serves to resiliently urge jaws 25 toward the lower closed position shown in Fig. 1 but is yieldable to permit jaws 25 to move upwardly and outwardly to an open position as shown in Fig. 2.

Referring now to Figs. 6 and 7, the former shows a nut, bolt head or similar hexagonal workpiece indicated by the reference letter W. Each jaw member 29 is provided at its lower end with a vertical substantially planar gripping surface 49, the three gripping surfaces 49 engaging alternate flat exterior side faces of workpiece W and forming a segmented socket for surrounding and gripping the latter. In the modification shown in Fig. 7, jaw members 29 are each provided with a V-shaped gripping surface 50 adapted to engage alternate corners of workpiece W instead of the flat side faces thereof as in Fig. 6. It will be obvious that gripping surfaces 49, 50 may be grooved, notched or serrated in various manners as heretofore applied to the construction of the workpiece-engaging opening of integral socket wrenches, gripping surfaces 49, 50 in effect forming a socket which is segmented so as to provide for expansion or contraction of the segments to vary the size thereof.

The lower ends of jaw members 29 are further provided with end faces 51 adapted to engage the top surface of workpiece W to react thereagainst so as to urge jaws 25 upwardly and outwardly. The workpiece-engaging faces 51 are preferably smooth and have a low coefficient of friction so as to permit jaw members 29 to slide freely outwardly on the top surface of workpiece W as the jaws 25 move outwardly with respect thereto.

The mode of operation of wrench 11 will now be briefly described. The mechanic grasps hand-grip 19 and swings the entire wrench 11 downwardly in the manner of wielding a hammer so that end faces 51 of jaw members 29 contact the top surface of workpiece W. Continued downward pressure on wrench handle 18, or instead the momentum of wrench 11, causes workpiece W to react upwardly against jaw members 29 to move jaws 25 upwardly with respect to frame 12. As noted above, jaws 25 actually do not move upwardly except with relation to frame 12, the latter moving downwardly while jaws 25 remain vertically stationary with respect to workpiece W.

During this relative movement of jaws 25 and frame 12, jaws 25 swing outwardly toward the open position shown in Fig. 2, end faces 51 sliding on the top surface of workpiece W. When jaw members 29 are spread sufficiently far apart to receive workpiece W, jaw members 29 will then snap down to surround workpiece W with the latter snugly engaged within the segmented socket formed by jaw-gripping surfaces 49 or 50. Spring 38 urges jaws 25 downwardly toward the closed position and maintains jaw members 29 in press-fitted relation to workpiece W.

The mechanic then applies a turning effort to handle 18 thereby tending to rotate shaft 14 and crank plates 36, 37. Rotation of the latter induces tension on connecting elements 39 thereby pulling jaws 25 inwardly toward the closed position. It will be seen that the greater the turning effort applied by the mechanic the tighter will jaw members 29 be drawn together into gripping engagement with workpiece W. Connecting elements 39 also transmit a torque to jaws 25 and as handle 18 is rotated the entire wrench 11 together with the gripped workpiece W will rotate therewith to tighten or loosen workpiece W as may be desired.

When wrench 11 is to be removed from workpiece W, the mechanic merely lifts wrench 11 upwardly therefrom by handle 18, jaw members 29 sliding upwardly off the lateral faces of workpiece W and spring 38 then urging jaws 25 together toward the normal closed position shown in Fig. 1. The above-described mode of operation may then be repeated on another workpiece to be tightened or loosened.

It will be seen in Fig. 4 that wrench 11 must be rotated clockwise in order to exert tension on connecting elements 39 to pull jaws 25 inwardly to grip the workpiece. If wrench 11 is rotated counterclockwise there will be exerted a slight compressive force on connecting elements 39 thereby tending to spread jaws 25 and allow them to ratchet or slip around the workpiece. This ratcheting action, of course, requires some frictional resistance to rotation of the workpiece when the latter is still tight. When the workpiece is loose and rotates freely, this ratcheting action, although unobtainable, is unnecessary since the loose workpiece is usually rotated by hand without the use of a wrench.

It will thus be seen that if the workpiece has a right-hand thread, wrench 11 as arranged in Fig. 4 may tighten the workpiece by rotating it clockwise. In order to permit wrench 11 to loosen the workpiece, the following simple procedure is employed. Jaws 25 are grasped in one hand and handle 18 in the other hand so as to rotate shaft 14 relative to frame 12 until the dead-center position of crank means 35, 36, 37 is reached wherein pins 40 are in line with the respective pins 41 and the axis of shaft 14. This movement is continued past this dead-center position, spring 38 then serving to continue the closing movement until a final closed position is obtained with crank means 35, 36, 37 displaced 180° from the position shown in Fig. 4. Wrench 11 will then drivingly engage the workpiece when rotated in a counterclockwise position to loosen a right-hand thread and will ratchet when rotated in the clockwise direction. In other words, wrench 11 may be quickly and easily adjusted so as to drivingly engage workpiece W in either direction of rotation to tighten or loosen nuts and bolts as may be desired.

It will be readily apparent that the moving jaws 25 of wrench 11 automatically adjust themselves to any size nut, bolt or other workpiece within a wide range of sizes by merely striking or pressing the lower jaw end faces

51 against the top surface of the workpiece, thereby providing a convenient, automatic, and almost instantaneous mode of adjustment.

Reference is now made to Figs. 8 to 11 inclusive wherein is illustrated another embodiment of the invention indicated generally by the reference numeral 61 and comprising a frame 62 having at its upper end an integral hexagonal lug 63 for engagement with a wrench handle (not shown). Frame 62 is hollow and the interior wall surface 64 is provided with a contical upwardly tapered configuration. The exterior surface of frame 62 is shown as having a series of stepped shoulders at 65 but may be of any convenient shape. The lower end of frame 62 is open.

A pair of jaws 66 are provided with upper portions 67 in the shape of conical segments and adapted to both slide and rotate in contact with the conical surface 64 of frame 62. The lower portions of jaws 66 comprise jaw members 68 having oppositely facing workpiece engaging surfaces 69 which coact to form a segmented socket to receive and grip the workpiece.

As best seen in Fig. 11, the wall of frame 62 has extending therethrough on opposite sides thereof two pairs of slots 70, 71. Only one of said pairs of slots 70, 71 is shown in Fig. 11, it being understood that a similar pair of slots is formed on the oppostie hidden side of frame 62. Slot 70 of each pair extends above and parallel to slot 71. Each of slots 70, 71 comprises two portions communicating at their lower ends and extending upwardly therefrom in opposite direction in the form of a helix.

An upper horizontal pin 72 extends transversely across the interior of frame 62 and has opposite ends extending within the slot 70 of each pair of slots. Conical jaw portions 67 are provided with horizontal openings therethrough slidably receiving pin 72. A lower pin 73 is similarly engaged with the lower slot 71 of each opposite pair and also extends through suitable openings in jaw portions 67.

Each pin 72, 73 has secured to the intermediate portion thereof a collar 74, 75 respectively. A pair of coil springs 76, 77 are mounted on pin 72 and engage opposite sides of collar 74 and a second pair of coil springs 78, 79 are similarly mounted on lower pin 73. Coil springs 76, 77, 78, 79 are in compression and normally urge jaws 66 outwardly and downwardly toward the lower open position shown in Fig. 9.

It will thus be seen that as jaws 66 moves upwardly within frame 62, the interior conical surface 64 engages conical jaw portions 67 to cam jaws 66 together in sliding relation to pins 72, 73. Furthermore, rotation of frame 62 with respect to jaws 66 and pins 72, 73 will cause the latter to move in slots 70, 71 and thereby move pins 72, 73 together with jaws 66 vertically with respect to frame 62 and thereby vary the spacing between jaws 66 to close or open them.

One of the jaws 66 may be provided with a workpiece abutment means 80 extending horizontally toward the opposite jaw. Abutment means 80 may be of a telescoping construction as illustrated in Fig. 18 and to be described in detail below or may be of one integral piece in which case the opposite jaw 66 is provided with a horizontal opening (not shown) to receive abutment means 80 when jaws 66 are closed. Abutment means 80 is preferably, but not necessarily, vertically slidably adjustable on said one jaw 66 by any well-known conventional means.

A dog 81 is pivotally mounted to the exterior of frame 62 by a pivot pin 82 and is provided with spaced arms 83 adapted to engage alternatively a projecting end portion 73' of pin 73. A compression spring 84 engages a lug 85 on dog 81 and a lug 86 welded to the exterior of frame 62. Spring 84 urges dog 81 to either of two selectable positions in which one of the dog arms 83 engages pin portion 73' toward and into either of the helical portions of slot 71, pin 72 being also moved thereby into the corresponding portions of slot 70. It will thus be seen that by manually selecting the inclination of dog 81, pins 72, 73 may be started into either of the communicating helical portions of slots 70, 71 so as to enable jaws 66 to be urged toward the closed gripping position when frame 62 is rotated in either direction as may be desired. That is, dog 81 is moved to one position when it is desired to tighten a workpiece having a right-hand thread and to the opposite position when it is desired to loosen said workpiece.

The operation of wrench 61 will be briefly described. Springs 76, 77, 78, 79 normally urge jaws 66 outwardly, conical surface 64 camming jaws 66 downwardly to the lowermost initial open position shown in Fig. 9. Wrench 61 is then moved downwardly toward the workpiece until the top surface of the latter contacts abutment means 80 and reacts upwardly thereagainst to push jaws 66 up with respect to frame 62 until jaw members 68 tightly grip the workpiece. A turning effort is then applied to frame 62 and the cam effect of slots 70, 71 on pins 72, 73 will urge the latter together with jaws 66 in a direction upwardly with respect to the frame 62 and hence jaws 66 will be urged toward each other to grip the workpiece with a gripping pressure proportional to the turning effort or torque applied to wrench 61. When wrench 61 is rotated in the opposite direction slots 70, 71 and pins 72, 73 will coact together with the biasing effect of springs 76, 77, 78, 79 to move jaws 66 slightly outwardly to permit the latter to slip or ratchet about the workpiece, the downward pressure of abutment means 80 on the workpiece being relieved to permit jaws 66 to spread apart a sufficient amount. When it is desired to drivingly engage the workpiece in said opposite direction dog 81 is manually pivoted to the other angular position as explained above.

Referring now to Figs. 12, 13 and 14, there is disclosed still another modified wrench embodiment indicated generally by the reference numeral 91 and comprising a cylindrical hollow frame 92. The latter has two pairs of spaced parallel horizontal support members 93 extending within the lower interior thereof, the outer ends of members 93 being secured to frame 92 and the inner ends thereof being secured to the lower ends of a pair of inclined downwardly converging slide members 94. The upper ends of slide members 94 are secured to the upper portion of frame 92.

The latter is further provided with vertical slots 95 in the opposite wall portions thereof and slide members 94 are bifurcated throughout the lower portions thereof to receive a pin 96 which has opposite ends projecting through and outwardly of slots 95. A hollow cylindrical sleeve 97 encloses frame 92 and is rotatable with respect thereto. Sleeve 97 is provided at its opposite sides with a pair of slots 98 each having two helical portions communicating at the bottom and extending upwardly in opposite directions. Each of said slots 98 is similar to slot 70 or slot 71 of wrench 61 described in detail above and shown in Fig. 11. The opposite ends of pin 96 engage within said slots 98. A dog (not shown) similar to dog 81 of wrench 61 may be pivotally mounted on the exterior of sleeve 97 of wrench 91 to start pin 96 in either of the portions of slot 98. This arrangement has already been described with reference to wrench 61 and will be understood without further explanation.

A pair of jaws 99 are provided at the upper ends thereof with channel shaped portions 100 slidably mounted on slide members 94. The lower ends of jaws 99 comprise jaw members 101 forming a segmented socket for gripping a nut, bolt or similar workpiece, the lower end faces 101' of members 101 being adapted to engage the top surface of the workpiece. The intermediate portions of jaws 99 have horizontal openings therethrough slidably receiving pin 96.

The latter has a collar 102 secured thereon and coil

springs 103, 104 are secured at their inner ends to collar 102 and at their outer ends to jaws 99 to pull the latter inwardly. An abutment means 105 structurally similar to abutment means 80 of wrench 61 but differing as to function may be mounted on one of the jaw members 101. Instead of serving to open the jaws as is the function of abutment means 80 of wrench 61, the abutment means 105 serves as a stop engaging the top surface of the workpiece to limit the depth to which the latter projects upwardly within the interior of the socket formed by jaw members 101. The upper end of sleeve 97 is provided with an integral lug 106 for driving engagement with a wrench handle (not shown). The lower end of sleeve 97 is flanged inwardly at 107 to engage the lower edge of frame 92 and thereby retain the latter within sleeve 97.

The mode of operation of wrench 91 is as follows. In the normal inoperative condition, springs 103, 104 are in tension to pull jaws 99 inwardly to the lower closed position shown in Fig. 13. The pivoted dog (similar to dog 81 in Fig. 9) is moved to the proper position depending upon whether it is desired to tighten or loosen the nut, bolt or other workpiece. Wrench 91 is then moved downwardly toward the workpiece to bring lower end faces 101' of jaws 99 into contact with the top surface thereof, thereby forcing jaws 99 upwardly and outwardly until they are spread sufficiently far apart to snap down around the workpiece.

A torque or turning effort is then applied to sleeve 97 through lug 106 and the torque is transmitted through pin 96 to jaws 99. The cam effect of helical slots 98 also urges pin 96 together with jaws 99 downwardly thereby causing jaws 99 to be urged inwardly into tighter gripping engagement with the workpiece, the gripping pressure on the workpiece being proportional to the applied torque. The reverse direction of driving engagement obtained by actuating the pivoted dog to the opposite position and described above in detail with reference to wrench 61 is also obtainable with wrench 91. The latter may also slip or ratchet with respect to the workpiece when rotated in a direction opposite to the direction of driving engagement.

Referring now to Figs. 15, 16 and 17 there is shown a wrench 121 embodying still another form of the invention and comprising a frame 122 having a circular horizontal top wall 123 and three pairs of spaced parallel walls 124 extending downwardly therefrom. Each pair of walls 124 forms therebetween a horizontal channel or guideway extending radially and slidably receiving the upper rectangular-shaped portion 125 of a respective one of three jaws 126.

The lower portions 127 of jaws 126 are provided with inwardly oppositely facing gripping surfaces 128 coacting to form a segmented socket for receiving the workpiece. The intermediate portions 129 of jaws 126 are cylindrical and engage within spiral slots 130 formed in the bottom wall 131 of a hollow cylindrical sleeve 132 enclosing frame 122 and rotatable with respect thereto. Frame 122 is also vertically slidable within sleeve 132 to a limited extent.

The upper open end of sleeve 132 is internally threaded to receive the threaded plate 134, the latter having integral therewith a lug 135 for driving engagement with a wrench handle (not shown). The lower surface of plate 134 is formed with a concave spherical recess 135 to receive the arcuate flexure spring 136, the latter being secured at its opposite ends to the top surface of frame top wall 123.

The lower surface of the latter is provided with a plurality of notches 137 arranged in three radially extending rows. The upper surface of the rectangular portion 125 of each jaw 126 is provided with a V-shaped detent 138 engageable within the notches 137, each detent 138 successively engaging the notches of a respective one of said radial rows as its jaw 126 moves radially inwardly or outwardly. Spring 136 reacts against plate 134 to urge frame 122 downwardly so as to resiliently maintain detents 138 in engagement with notches 137. The successive notches 137 of each row are spaced apart a distance equivalent to one-half the difference in head diameter dimensions between one standard size nut or bolt head and the next standard size, whereby jaw portions 127 will be spaced apart a predetermined distance to properly receive a particular standard size of workpiece when detents 138 are engaged within those recesses 137 corresponding to said standard size of workpiece.

One of jaw portions 127 may be provided with an abutment means 139 comprising a pair of telescoping tubes 140, 141. Tube 140 has a shank 142 slidable within a vertical slot 143 formed in the jaw portion 127. A knob 144 engages the outer face of said jaw portion 127 and is threaded to shank 142. Tightening knob 144 secures abutment means 139 in any selected vertical position whereby the height to which the workpiece projects upwardly into the socket formed by jaw portions 127 may be predetermined. Tube 141 is resiliently urged outwardly by a spring 145, the latter yielding to permit contraction of tube 141 within tube 140 when the other two jaw portions 127 are close to the jaw portion 127 which has abutment means 139 attached thereto.

Wrench 121 may be operated in several ways. First, sleeve 132 may be rotated to move jaws 126 to the proper position to receive the particular nut or bolt to be turned. The wrench 121 with its jaws 126 preadjusted to the proper size is then slipped over the workpiece and rotation of sleeve 132 will transmit the applied torque through slots 130 and cylindrical jaw portions 129 to rotate the workpiece gripped by jaws 126. The latter will be urged inwardly into tighter gripping engagement with the workpiece by the cam effect of spiral slots 130 on jaw portions 129 and the greater the turning effort the greater the gripping pressure of jaws 126 on the workpiece.

Alternatively, another and simpler method of employing wrench 121 is to first rotate sleeve 132 until it is obvious that jaws 126 are spread far enough apart to receive the workpiece and jaws 126 are then positioned around the latter. Sleeve 132 is then rotated manually until jaws 126 close sufficiently to engage the workpiece and a torque is applied to wrench 121 through the handle (not shown). It will thus be seen that wrench 121 differs from wrenches 11, 61 and 91 dscribed above in that wrench 121 does not automatically move its jaws to the proper spaced position to grip the workpiece, in addition to other differences which will readily be apparent.

Referring now to Figs. 19 to 25, there is disclosed another wrench embodiment indicated generally by the reference numeral 151 and comprising a frame 152 having a hollow conical downwardly-tapered configuration. The upper end of frame 152 is provided around the periphery thereof with an integral inwardly-extending flange 153 having a plurality of arcuate recesses 154 and also openings 155 therethrough.

The latter are aligned with channels 156 formed in the interior wall surface 157 of frame 152, channels 156 extending in a downwardly-converging direction and having slidably mounted therein the shanks 158 of jaws 159. The upper ends of shanks 158 extend upwardly through openings 155 when jaws 159 are in the upward position shown in Fig. 20. It will further be noted that openings 155, channels 156 and shanks 158 extend arcuately and have centers of curvature coincident with the axis of frame 152.

A conical member 160 is rotatably mounted within frame 152 and is provided at it upper end with an integral lug 161 for driving engagement with a wrench handle shown in dashed lines and indicated by the reference letter H. The exterior wall surface 162 of member 160 has formed therein a plurality of semi-circular recesses 163 and the inner surfaces of jaw shanks 158 are provided with smaller semi-circular recesses 164 facing and communicating with said recesses 163. The lower surface 165 of frame flange 153 is provided with spring-retaining

recesses **166** engaging the upper ends of coil springs **167** which extend within the hollow enclosure formed by recesses **163** and **164**. The lower ends of springs **167** engage within recesses **168** formed in the upper surfaces of jaw members **169** formed integral with the shanks **158**. Coil springs **167** are in compression and urge jaws **159** downwardly toward the lower closed position shown in Fig. 19.

As best seen in Figs. 21 and 25, the upper surface **170** of conical member **160** is provided with a plurality of spherical cam projections **171** each of which is normally centrally located within the area circumscribed by a respective one of said arcuate recesses **154** when no torque is being applied to wrench **151**.

Jaw members **169** are provided with notched or otherwise serrated inwardly-facing gripping surfaces **172** which coact to form a segmented socket for receiving and engaging the workpiece, as best seen in Fig. 22. It will be obvious that as jaws **159** slide upwardly with respect to frame **152**, they will also spread apart to enlarge the size of said socket. The lower ends of jaw members **169** are provided with smooth bottom faces **173** to engage and slide outwardly in contact with the top surface of workpiece W indicated in dashed lines.

The mode of operation of wrench **151** is as follows. Springs **167** normally retain jaws **159** in the closed position of Fig. 19. Wrench **151** is moved downwardly to bring jaw end faces **173** into contact with the top surface of workpiece W which then reacts upwardly to open jaws **159** until the latter are sufficiently spread apart to snap down over the sides of workpiece W. A turning effort is then applied to handle H to rotate conical member **160** with respect to frame **152**. Arcuate recesses **154** of frame flange **153** are thereby engaged by cam projections **171** to move frame **152** upwardly with respect to conical member **160**. This results in wedging the jaw shanks **158** between the outer surface **162** of member **160** and the inner surface **157** of frame **152** so as to grip shanks **158** therebetween and lock them in the fixed position in proper spaced relation to snugly receive workpiece W.

It is preferable to provide conical member outer surface **162** with a greater coefficient of friction than frame inner surface **157** whereby as frame **152** moves upwardly with respect to member **160** jaws **159** will not move upwardly therewith but will be engaged by lower portions of frame surface **157** and thereby be urged inwardly a slight amount to grip the workpiece with greater pressure. It will be obvious that cam projections **171** may engage either side of the arcuate recesses **154** whereby the above-described locking effect and increased gripping pressure of jaws **159** is obtained when torque is applied to member **160** in either direction to tighten or loosen workpiece W as may be desired.

It is to be understood that the several specific embodiments of the invention shown in the drawing and described above are merely illustrative of some of the many forms which the invention may take in practice without departing from the scope of the invention delineated in the appended claims. For example, it will be obvious that any practical number of jaws may be employed in wrenches **61** and **91** instead of merely two jaws as shown for purposes of convenience in disclosure. Instead of the cam means for actuating the jaws of these wrenches, there may be substituted the crank means and connecting elements of wrench **11** and the jaws of the latter may be actuated by the cam means shown in wrenches **61** and **91**. Many other modifications and variations will readily occur to those skilled in the art and are not disclosed herein in order to avoid an unduly voluminous specification, but it is intended that the scope of the invention include all of the possible modifications which fall within the express limitations of the claims and all equivalents thereof.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A wrench comprising a frame, a plurality of jaws extending downwardly from the frame and having gripping surfaces at their lower ends coacting to form a segmented socket therebetween, said jaws being movably mounted on the frame for movement toward and away from each other, means responsive to pressure of a workpiece on said jaws to move the latter to relatively spaced positions to receive and grippingly engage the workpiece, and means responsive to torque applied to the wrench to urge the jaws inwardly to grip the workpiece with a gripping pressure proportional to the extent of said applied torque.

2. A wrench as recited in claim 1 wherein each of said jaws is movably mounted to the frame by means of a pair of parallel links, each of said links having one end pivotally connected to the frame and the other end pivotally connected to a respective one of said jaws.

3. A wrench as recited in claim 1 wherein said torque responsive means comprises cam means rotatable with respect to the jaws to urge the latter inwardly in response to said torque applied to the wrench.

4. A wrench as recited in claim 3 and comprising means slidably mounting said jaws on the frame for movement of the jaws toward and away from each other.

5. A wrench as recited in claim 4 wherein said jaw mounting means comprises a plurality of inclined downwardly converging slideways, each of said jaws being freely reciprocally mounted for movement along a respective one of said slideways.

6. A wrench as recited in claim 5 and comprising spring means urging said jaws in a direction tending to move the jaws downwardly and inwardly toward a relatively closed position, said spring means being yieldable to permit said jaws to move upwardly and outwardly along the slideways in response to upward pressure exerted on the jaws by a workpiece or by the operator.

7. A wrench as recited in claim 1 and comprising means slidably mounting said jaws on the frame for movement of the jaws towards and away from each other, said mounting means comprising a plurality of inclined downwardly converging slideways, each of said jaws being freely reciprocally mounted for movement along a respective one of said slideways, and spring means urging said jaws in a direction tending to move the jaws downwardly and inwardly toward a relatively closed position, said spring means being yieldable to permit said jaws to move upwardly and outwardly along the slideways in response to upward pressure exerted on the jaws by a workpiece or by the operator.

8. A wrench comprising a frame, a plurality of jaws extending downwardly and each having adjacent its lower end a gripping surface for engagement with a workpiece, means mounting the jaws to the frame for upward outwardly-diverging opening movement of the jaws in a direction away from each other or downward inwardly-converging closing movement in a direction toward each other, spring means urging said jaws in the direction of said downward closing movement, rotating means mounted to the frame for rotatable movement with respect thereto about a vertical axis, jaw-actuating means coacting with said rotating means and said jaws and responsive to rotation of the former to impart a force to the latter tending to move the jaws in said direction of downward closing movement and also tending to rotate the jaws together with the frame about said vertical axis so as to transmit thereto a torque applied to said rotating means, and means on said rotating means for connecting the latter to a wrench handle to transmit a torque thereto.

9. A wrench as recited in claim 8 wherein said mounting means comprises a plurality of links each pivotally connected at one end to said frame and pivotally connected at the other end to one of said jaws.

10. A wrench as recited in claim 8 wherein said mounting means comprises a plurality of pairs of links, both links of each pair being pivotally connected at one end to a respective one of said jaws and at the other end to

said frame, the links of each pair extending parallel to each other and spaced vertically with respect to each other.

11. A wrench comprising a frame, a plurality of jaws extending downwardly and each having adjacent its lower end a gripping surface for engagement with a workpiece, means mounting the jaws to the frame for upward outwardly-diverging opening movement of the jaws in a direction away from each other or downward inwardly-converging closing movement in a direction toward each other, spring means urging said jaws in the direction of said downward closing movement, rotating means mounted on the frame for rotatable movement with respect thereto about a vertical axis, jaw-actuating means coacting with said rotating means and said jaws and responsive to rotation of the former to impart a force to the latter tending to move the jaws in said direction of downward closing movement and also tending to rotate the jaws together with the frame about said vertical axis so as to transmit thereto a torque applied to said rotating means, and means on said rotating means for connecting the latter to a wrench handle to transmit a torque thereto, said jaw gripping surfaces facing horizontally inwardly toward each other so as to form therebetween a socket for surrounding and engaging the exterior side walls of a nut, bolt head, or similar workpiece, the lower ends of the jaws each having a bottom face for engaging the top surface of the workpiece so as to react thereagainst and thereby impart an upward opening movement to the jaws.

12. A wrench as recited in claim 11 wherein said actuating means comprises a crank means non-rotatably engaged with said rotating means and a plurality of connecting elements each having one end pivotally connected to a respective one of said jaws and the other end pivotally connected to said crank means at a point thereof eccentric to said vertical axis of rotation.

13. A wrench as recited in claim 12 wherein said crank means is vertically slidable with respect to said rotating means so as to move upwardly and downwardly with the jaws as the latter open and close.

14. A wrench as recited in claim 13 and having means connected to one of said jaws for moving the crank means upwardly and downwardly therewith.

15. A wrench comprising a frame, a plurality of jaws extending downwardly and each having adjacent its lower end a gripping surface, said gripping surfaces facing horizontally inwardly toward each other so as to form therebetween a socket for surrounding and engaging the exterior side walls of a nut, bolt head or other workpiece, the lower end of each jaw having a bottom face for engaging the top surface of the workpiece so as to react thereagainst when the wrench is moved downwardly to impart an upward force to said jaws, means mounting the jaws to the frame for relative upward outward opening movement of the jaws with respect to the frame in response to said upward force, rotating means rotatably mounted on the frame for rotation about a vertical axis, means for applying a torque to said rotating means, and jaw-actuating means coacting with said jaws and said rotating means to transmit the torque applied to the latter to said jaws and to urge the latter inwardly to grip the workpiece with a gripping pressure proportional to the extent of said torque.

16. A wrench as recited in claim 15 wherein said mounting means comprises a plurality of pairs of links, both links of each pair being pivotally connected at one end to a respective one of said jaws and at the other end to said frame, the links of each pair extending parallel to each other and spaced vertically with respect to each other.

17. A wrench as recited in claim 16 wherein said actuating means comprises a crank means non-rotatably engaged with said rotating means and a plurality of connecting elements each having one end pivotally connected to a respective one of said jaws and the other end pivotally connected to said crank means at a point thereof eccentric to said vertical axis of rotation.

18. A wrench as recited in claim 17 and comprising yieldable spring means normally urging said jaws downwardly and inwardly with respect to the frame toward a closed position.

19. A wrench comprising a frame, a plurality of jaws, a first means normally retaining said jaws in a closed position, a second means movably mounting said jaws on the frame and responsive to pressure of the jaws against the workpiece to open the jaws to receive the workpiece, and a third means responsive to the application of a torque to the wrench to cause the jaws to grip the workpiece with a gripping pressure proportional to said torque.

20. A wrench as recited in claim 19 wherein said third means comprises a rotatable member adapted to receive said torque and a plurality of connecting elements each having one end pivotally connected to said rotatable member and the other end pivotally connected to a respective one of said jaws.

21. A wrench as recited in claim 19 wherein said second means comprises a plurality of links each pivotally connected at one end to said frame and pivotally connected at the other end to one of said jaws.

22. A wrench comprising a frame, at least three downwardly-extending jaws, said frame having a vertical hollow cylindrical sleeve, a vertical shaft extending through said sleeve and non-slidably rotatably mounted therein about the vertical axis thereof, means on the upper end of the shaft for receiving the application of both a torque thereto and a downward thrust thereon, means movably mounting the jaws on the frame for translatory movement with respect thereto either in an upward outwardly-diverging opening movement or in a downward inwardly-converging closing movement, spring means normally urging said jaws in said downward closing movement toward a closed position, said jaws each having at their lower ends a face engageable with a horizontal top surface of a workpiece so as to react thereagainst when said downward thrust is applied to said shaft, said spring means being yieldable to permit the reaction of said workpiece to move said jaws upwardly and outwardly with respect to the frame and the shaft as the frame and shaft are moved downwardly with respect to both the workpiece and said jaws, reacting thereagainst by said downward thrust applied to the shaft, and means coacting with the jaws and the shaft and responsive to torque applied to the latter to urge said jaws inwardly to grip the workpiece with a gripping pressure proportional to said torque and to transmit said torque to said jaws and thereby to the workpiece to rotate the latter.

23. A wrench as recited in claim 22 wherein said mounting means comprises a plurality of pairs of links, both links of each pair being pivotally connected about horizontal axes at one end thereof to a respective one of said jaws and at the other end thereof to said frame, the links of each pair extending parallel to each other and spaced vertically with respect to each other.

24. A wrench as recited in claim 22 wherein said last-recited means comprises a crank member vertically slidable on said shaft, means preventing rotation of said crank member relative to the shaft, and a plurality of horizontal connecting elements each having one end pivotally connected to one of said jaws about a vertical axis and the opposite end pivotally connected to said crank member about a vertical axis eccentric to the shaft axis.

25. A wrench as recited in claim 24 wherein one of said jaws has attached thereto means engaging said crank member for urging the latter upwardly on said shaft as the jaws move upwardly in their opening movement.

26. A wrench as recited in claim 25 wherein said spring means comprises a coil spring, said shaft having a lower portion extending downwardly below the lower end of said sleeve, said spring surrounding said shaft lower portion and having an upper end reacting against the lower end of the sleeve and a lower end reacting

against said crank member to resiliently urge the latter downwardly on the shaft and to thereby urge the jaws downwardly to their closed position.

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