TOGGLE-TYPE HAND TOOL

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References Cited
UNITED STATES PATENTS
3,314,319 4/1967 Schmidt 81/367

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ABSTRACT
A hand tool of the toggle link or vice grip type provided with a workpiece. Such structure takes two basic forms, namely, (a) the compression member of the toggle linkage being swivelly connected at its opposite ends to the handles, or (b) the provision of structure for limiting closing movement of the members that carry the work engaging elements, whereby such limiting action will result in reactive forces equivalent to the work engaging elements being loaded against a workpiece by closing movement of the handles. Such structure for limiting closing movement of the members can be such as to be subjected to compressive, shear or tensile stresses in the performance of its movement limiting function.

In addition to the foregoing, the invention extends to the provision of special work engaging elements that move apart during closing movement of the handles, as well as to various forms of work engaging elements that are detachably mounted, adjustably mounted and pivotally mounted upon the members that are directly attached to the handles.

The invention in its various forms involves the centers which are directly connected to the handles being either directly connected about a single pivotal axis as is customary, or being connected by a link, such link having its opposite ends pivotally connected to the members whereby the members are afforded a degree of angular freedom with respect to each other. A pair of such links can optionally be employed to prevent angular movement of members.

10 Claims, 21 Drawing Figures
TOGGLE-TYPE HAND TOOL

This is a division of Ser. No. 627,496, filed Mar. 31, 1967 and entitled, Toggle Link-Type Hand Tool, the same now being U.S. Pat. No. 3,496,808, granted on Feb. 24, 1970.

The present invention relates to new and useful improvements in hand tools of toggle link or vice grip type, and is related to and involves certain improvements on an invention disclosed in my copending U.S. application Ser. No. 466,911, entitled Improved Pliers-Type Hand Tool, and filed June 25, 1965; the disclosure of such copending application being incorporated herein by reference. More specifically, the present invention pertains to improvements in vice grip-type pliers or hand tools such as to enable the work-engaging elements thereof to be releasably secured against relative movement both forward and away from each other, with the spacing of such elements being adjustable. The invention also involves improvements in the means for adjusting the spacing at which the work-engaging elements can be releasably secured, structure for preventing relative angular movement of the work-engaging elements, and specific improvements in the work-engaging elements, their mounting and/or adjustment.

One of the paramount objects of this invention is to provide a toggle link-type hand tool wherein the toggle linkage and the handles connected thereby are releasably retained by engaging means carried thereby against movement from the relative positions occupied thereby when in locked position.

Another paramount object of this invention is the provision of a toggle link-type hand tool wherein the closing movement of the members that carry the work-engaging elements can be adjustably limited, and wherein the spacing of such members when the toggle linkage is in locked condition is adjustable.

Yet another paramount object of the invention is to provide a tool of the character specified above wherein the angular relationship of the work-engaging elements is not predetermined by the spacing thereof.

A final object to be specifically enumerated is the provision of a tool of the character specified above wherein a work-engaging element is movable relative to the member carrying the same whereby the same can be adjustably positioned or be caused to serve a ratcheting function.

A broad aspect of the invention involves, in a toggle link-type hand tool including pivotally connected members for carrying coacting work-engaging elements, and actuating handles for the members that are movable toward and away from each other and which handles are connected by toggle link means for releasably securing the members against relative pivot movement in the direction corresponding to opening movement of the handles when relative pivot movement of the members in the opposite direction is opposed, the combination therewith of means for releasably retaining the toggle link means in member-securing position.

Still another broad aspect of the invention involves, in a toggle link-type hand tool including pivotally connected members for carrying coacting work-engaging elements, and actuating handles for the members that are movable toward and away from each other and which handles are connected by toggle link means for releasably securing the members against relative pivot movement in the direction corresponding to opening movement of the handles when relative pivot movement of the members in the opposite direction is opposed, the combination therewith of means for releasably retaining the toggle link means in member-securing position.

Yet another broad aspect of the invention involves, in a toggle link-type hand tool including pivotally connected members for carrying coacting work-engaging elements, and actuating handles for the members that are movable toward and away from each other and which handles are connected by toggle link means for releasably securing the members against relative pivot movement in the direction corresponding to opening movement of the handles when relative pivot movement of the members in the opposite direction is opposed, the combination therewith of means for releasably retaining the toggle link means in member-securing position.

These, numerous other objects and aspects of the invention, as well as many important features and advantages will manifest themselves during the ensuing description of various preferred embodiments of the invention, such description being given in relation to the accompanying drawings illustrative of such embodiments, wherein:

FIG. 1 is a side elevational view of an embodiment of the invention employing a compressively loaded, adjustable stop means, hidden details being shown in dashed outline;

FIG. 2 is a side elevational view of another embodiment of the invention employing a tension-loaded, adjustable stop means, and showing an oscillatably mounted work-engaging element, hidden details being shown in dashed outline;

FIG. 3 is an enlarged detail sectional view taken upon the plane of the section line 3—3 of FIG. 2;
FIG. 4 is a side elevational view of another embodiment employing a tension-loaded, adjustable stop means, such means including a lost motion provision, this embodiment of the invention including detachable work-engaging elements and a release means, hidden details being shown in dashed outline;

FIG. 5 is a side elevational view of another embodiment of the invention employing a tension-loaded, adjustable stop means, and having a lost motion connection to one of the pivotally connected members, hidden details being shown in dashed outline;

FIG. 6 is an enlarged fragmentary isometric view of the connection of the tension-loaded element to the adjustment means therefor shown in FIG. 5;

FIG. 7 is a side elevational view of another embodiment of the invention employing a tension-loaded, adjustable stop means, hidden details being shown in dashed outline;

FIG. 8 is an enlarged sectional view taken upon the plane of the section line 8—8 in FIG. 7;

FIG. 9 is a side elevational view of another embodiment of the invention employing tension-loaded, adjustable stop means, this embodiment being provided with release means, hidden details being shown in dashed outline;

FIG. 10 is an enlarged fragmentary top view of the adjustment means shown in FIG. 9;

FIG. 11 is a side elevational view of another embodiment of the invention employing a detent means to releasably secure the toggle link to one of the handles in their respective locking condition, this embodiment of the invention including coacting work-engaging elements wherein one of such elements is bifurcated to enable passage of the other element therethrough, hidden details being shown in dashed outline;

FIG. 12 is an enlarged and fragmentary top elevation view of a portion of the toggle link of the tool of FIG. 11, and shows the profile of the detent ball therein;

FIG. 13 is an enlarged detail sectional view taken upon the plane of the section line 13—13 in FIG. 11;

FIG. 14 is a sectional view taken upon the plane of the section line 14—14 in FIG. 11;

FIG. 15 is a fragmentary top elevation of the work-engaging elements of the tool shown in FIG. 11;

FIG. 16 illustrates another invention embodiment and is a fragmentary side elevation of a conventional toggle link or vice grip-type pliers especially provided with shear-loaded, adjustable stop means, hidden details being shown in dashed outline;

FIG. 17 illustrates another embodiment of the invention and is a fragmentary side elevational view of a conventional toggle link-type hand tool provided with improved work-engaging elements usable for either engaging elements usable for either gripping or spreading workpiece surfaces engaged thereby;

FIG. 18 illustrates another embodiment of the invention and is a fragmentary side elevational view illustrating a movably mounted work-engaging element with worn gear means for positioning and holding the same in adjusted position;

FIG. 19 is a top elevation of the structure shown in FIG. 18;

FIG. 20 illustrates another embodiment of the invention, and is a fragmentary side elevational view of a conventional vice grip-type hand tool modified by the provision of a pair of parallel links connecting the members, rather than by the single common connecting pivot, to prevent relative angular movement of such members;

FIG. 21 illustrates another embodiment of the invention and is a fragmentary side elevation of a conventional vice grip-type hand tool modified by one of the work-engaging elements being pivotally mounted to obtain a ratchettike function, a portion of the structure being broken away and dashed lines being used to reveal and indicate details otherwise hidden.

Referred to the drawings wherein like reference numerals designate like parts throughout the various views, attention is initially directed to the embodiment of the invention shown in FIG. 1. In particular, this embodiment of the invention constitutes an improvement on the stop means disclosed in my copending U.S. application Ser. No. 465,911, entitled "Improved Pliers-Type Hand Tool," filed June 25, 1965. More specifically, the present improvement has to do with the configuration of the surface against which the adjustable screw abuts, and as will be seen such configuration results in a smooth and continuous transition from one position of stop or limiting adjustment to another throughout the range of adjustment, and the positioning of the stop means in such a manner to enable, if desired, closer placement of whatever form of work-engaging elements are employed to the pivotal connection of the members.

The embodiment of the invention illustrated in FIG. 1 comprises a hand tool of the well-known toggle link or vice grip-type designated generally at 10, such tool 10, except as specifically pointed out hereinafter, is essentially the same as the tool disclosed in U.S. Pat. No. 2,280,005, entitled Wrench, which issued to Peterson Apr. 14, 1942, the same being modified to include a pivoted release lever such as disclosed in U.S. Pat. No. 2,514,130, entitled Locking Wrench and Pliers, which issued to Jones July 4, 1950. The use of the release lever is optional, and is not essential to the tool 10.

The tool 10 comprises a handle 12 that is integral with a fixed or stationary member 14 that carries a conventional toothed work-engaging element 16 fixed thereto. The handle 12 and the integral jaw 14 are of inverted U-shape in the region of their juncture, the arrangement being such that a movable jaw or member 18 is pivotally mounted at 19 on the fixed member 14 and is pivotally connected to the pivot pin 20 that extends through aligned openings in the jaw 18 and the walls 20 and 22, the pin 24 having its remote ends upset to bear against the remote sides of the walls 20 and 22 to prevent dislodgement thereof.

A second handle 26, also of U-shaped transverse cross section, receives therein a portion of the jaw 18, and is pivotally connected thereto by a pivot pin 28 in the same manner as the pin 24 pivotally connects the integral handle and jaw 12 and 14 to the jaw 18.

The handle 26 forms a part of a toggle linkage for enabling a great mechanical advantage in urging closing movement of the jaws or members 14 and 18, the other part of such toggle linkage comprising a toggle link or compression member 30 having its opposite ends received within the transversely channel-like handles 12 and 26, one end of the compression member 30 being pivotally secured to the handle 26 intermediate the ends of the latter by a pivot pin 32 and having its other end arranged to abut an end of an adjustment screw 36 threaded longitudinally into the end of the handle 12 remote from the member 14.

The toggle linkage compression member 30 includes a lateral enlargement 38 which engages or bears against the inner side of the web portion 40 of the handle 26 when the handles 12 and 26 and the toggle linkage is in locking condition as shown in FIG. 1, that is, when the pivot pin 32 is disposed slightly closer to the handle 12 than a straight line passing from the point of engagement of the toggle link 30 with the screw 36 to the pivot pin 28. A release lever 42 is disposed in the handle 26, and is pivotally connected thereto by a pin 44 in such a manner that the lever can be rocked or fulcrumed about the pin 44 to urge the enlargement 38 from engagement with the handle web portion 40 and thus force the handles 12 and 26 and the toggle link 30 from what is throughout this specification referred to as "locking condition."

As thus far described, the tool 10 is entirely conventional and is in wide public usage; the operation thereof being well-known. Briefly, the operation of such conventional tools is that upon closing movement of the handles, that is, movement towards each other such as caused by squeezing the same together in the user's hand, the members 14 and 18...
3,635,107 (together with the work-engaging elements 16 and 19 carried thereby) are caused to move toward each other about the pivot pin 24. Upon the elements 16 and 19 forcibly engaging a workpiece (not shown) therebetween, with the screw 36 adjusted so that the handles 12 and 26 must be tightly squeezed to force the pin 32 through the previously mentioned straight line (that is, through dead center) to the position shown thereof in FIG. 1, the workpiece will have been subjected to a very substantial gripping force during movement of the pivot pin 32 through the dead center position, and such gripping force is only slightly reduced where the pin 32 has passed to the illustrated position slightly above dead center, whereby the inherent resiliency of the handles 12 and 26, the compression toggle link 36, and of the jaws 14 and 18 maintain forces originating in the reactive forces from the workpiece maintain the tool in locked condition with the enlargement 38 bearing against the handle 26.

The tool 10 will thereafter remain in its locked condition with the workpiece firmly gripped until the pivot pin 32 is forced to the other side of its dead center position. Such movement of the pin 32 to the other side of its dead center position can be caused by actuation of the lever 42.

As mentioned above, the structure of the tool 10 as thus far described and its operation are conventional and well known. The tool 10 differs generally from prior art devices and specifically from the disclosure of my previously mentioned copending application by the hereinafter described stop or limiting means incorporated therein enabling the tool 10 to be stressed into and releasably retained in its locked condition without any necessity for reactive forces originating from any workpiece gripped thereby.

The stop or limiting means of this embodiment of the invention comprises an elongated threaded stop member or screw 46 having an integral, preferably knurled knob 48 at one end thereof. The axis of the screw 46 is coplanar with the medial plane of the tool 10, and is threaded through an opening 50 in the member or jaw 41 to extend an adjustable extent into the space between the spaced sidewalls 20 and 22.

The portion 52 of the jaw 18 between the walls 20 and 22 has parallel opposite sides in sliding engagement with the parallel adjacent faces of the walls 20 and 22, and said portion is provided with a concave edge 54 facing toward the screw 46, such concave edge 54 having a curvature such that during progressive opening movement of the members 14 and 18 such as to progressively increase the spacing of the work-engaging elements 16 and 19, it is necessary to concurrently and progressively turn the screw 46 in such a direction as to advance into the member 14 and 18 to continuously maintain the free end 56 of the screw 46 in engagement with the concave edge 54 of the member 18. Preferably, but not necessarily, the relative rates of advance of the screw 46 and opening of the members 14 and 18 are such that the portion of the edge 54 engaged by the screw 46 is approximately perpendicularly thereto so that such arrangement enables the screw 46 to pass substantially close to the pivot 24 and thereby enable the positioning or placement of work-engaging elements on the members 14 and 18 relatively nearer the pivot 24 than would otherwise be the case.

The function of the adjustable stop or limiting means constitutes the curved edge 54 and the screw 46 will be readily understood. The screw 46 can be positioned so as to engage the curved edge 54 for a desired spacing of work-engaging elements 16 and 19, and upon appropriate adjustment of the screw 36, the handles 12 and 26 can be caused to close to the locking condition shown in FIG. 1, with the screw 46 being compressively loaded against the curved edge and thereby generating of reactive forces to releasably retain the tool in such locked condition; the enlargement 66 bearing against the handle 26. The tool 10 is then locked upon itself, so to speak, and can be in such condition as a fixed or rigid tool and used to apply the adjustably fixed work-engaging elements 16 and 19 in any desired manner. Obviously, the work-engaging elements 16 and 19 in the tool 10 can have the forms illustrated thereof in FIG. 10, or alternatively, such elements 16 and 19 can take any desired form or configuration deemed desirable. For example, it will be understood by those skilled in the art that the work-engaging elements 16 and 19 can take such forms as the corresponding parts shown in the yet to be described other embodiments of the invention shown in FIGS. 2, 4, 7, 9, 11, 17, 18 and 19.

The tool 10 is made of such steels as are customarily employed in conventional toggle link or vice grip-type pliers or hand tools. Inasmuch as the compressive loading on the screw 46 may be substantial, a steel reinforcement block 58 is fitted between the walls 20 and 22 and secured thereto in any suitable manner such as spot welding and the block 58 is provided with a threaded opening 60 therethrough in alignment with the threaded opening 50. The screw 46, which is of less diameter than the spacing of the walls 20 and 22 is threaded through the opening 60.

It will be evident that the tool 10 can be released from being locked upon itself on use of the lever 42 in the same manner as when the tool 10 is locked upon a workpiece in the ordinary manner. If desired, the screw 46 can be retracted and the tool 10 used in the ordinary manner of use of extant tools.

The screw 46 affords another use and that consists in use of the same to space the elements 16 and 19 a measured extent while the screw 36 is being adjusted. For example, when it is desired to lock the tool 10 upon a workpiece having a particular dimension, the screw 46 is adjusted so that the elements 16 and 19 have a slightly closer spacing than such dimension, and the screw 36 is then tightened with the enlargement 38 held in contact with the handle 26. With the screw 36 thus adjusted, the screw can be left in its position or retracted as desired, and the tool is then applied to grip the workpiece with the result of locking thereon (the firmness of the grip being a function of the reduction of the spacing of the elements 16 and 19 from such workpiece dimensions preset by the screw 46).

Whereas the embodiment of the invention shown in FIG. 1 employs a stop or limiting means that is subjected to compressive loading during the performance of its function, the embodiment of the invention shown in FIG. 2 employs adjustable stop or limiting means that is subjected to tension in the performance of its function. The embodiment of the invention shown in FIG. 2 comprises a tool designated generally at 62, such tool 62 comprising a handle 64 having an integral jaw or member 66, such handle 64 and jaw 66 being generally similar to the handle 12 and the jaw 14 of the tool 10, and in particular such handle 64 and jaw 66 are of an integral U-transverse configuration, that is, such handle 64 and jaw 66 are of a downwardly opening channellike configuration. A movable jaw or member 68 is provided which includes a portion 70 received within the handle 64 and being pivotally connected thereto by means of a pivot 72 in a manner generally corresponding to the pivot 24 mounting of the jaw 18 in the structure shown in FIG. 1.

The end of the jaw or member 66 remote from the handle 64 is provided with a toothed work-engaging element 74 that presents a downwardly facing concave and toothed surface 76 for coating with a work-engaging element 78 carried by the jaw 68. The work-engaging element 78 includes depending transversely spaced ears 80 that straddle or are disposed on opposite sides of the jaw 68, and a pivot pin 82 extends through the jaw 78 and through the ears 80 on opposite sides thereof, so that the work-engaging element 78 is oscillatably carried by the jaw 68. As will be evident on inspection of FIG. 2, the base 84 of the work-engaging element 78 is spaced a short interval above a flat upper end 86 of the jaw 68 in such a manner as to facilitate such oscillation of the work-engaging element 68.

The work-engaging element 78 is provided with an upwardly facing arcuate toothed portion 88 that directly opposes the concaved teeth region of the work-engaging element 74. It will be noted that the pivotal connection 82 of the work-engaging element 78 is disposed at the end of the element 78.
The end of the tension element 110 remote from the pivot pin 92 is disposed within the handle 64 and spaced above the toggle link 94, and as such end disposed within a recess 114 in the collar 102 above the screw portion 100, and the tension element 110 is prevented from withdrawal from the recess 114 by means of a pin 116 (see FIG. 3) extending through the collar 102 and extending through the recess 114 and the tension element 110 therein.

As in the case of the tool 10, the tool 62 is provided with a coiled tension spring 118 having its opposite ends connected between the jaw 68 and the handle 64 so as to yieldingly urge relative movement of the jaws 66 and 68 corresponding to opening movement of the handle 64 and 90.

The operation of the tool 62 will be readily understood. The handles can be opened initially at least to an extent sufficient to pass the pivot pin 96 to a position below its dead center position as viewed in FIG. 2, and the screw 98 then adjusted to obtain the desired spacing of the work-engageing elements 74 and 78, it being noted that threading the screw 98 in a direction such as to extend the screw 98 into the handle 64 serves to cause a closing movement of the jaws 66 and 68, and vice versa. The tension element 110 while being capable of sustaining substantial tensile forces may be relatively weak under compressive loading, but does possess sufficient strength in compression to accomplish such adjustment of spacing of the work-engageing elements 74 and 78. After such adjustment of the spacing of the work-engageing elements 74 and 78, the handles 64 and 90 are squeezed so that closing movement is accomplished to place the tool 62 in its locked condition, it being noted that the tension element 110 serves under tension to oppose closing movement of the jaws 66 and 68 and thereby constitutes a load against which the toggle linkage comprised of the handle 90 and the toggle link 94 can be loaded. With the tool 62 in its locked condition, that is, with the tension of the tension element 110 serving as a sufficient load to retain the toggle linkage at least lightly loaded to cause the enlargement 106 to bear against the handle 90, the tool 62 can then be applied in a ratcheting manner analogous to the function of a conventional pipe wrench. It is to be especially noted that the arrangement is such that the single adjustment means constituted of the screw 98, the collar 102 carried by the screw 98, and the relationship of the collar 102 to both the toggle link 94 and the tension element 110 simultaneously serve to adjust both the stop means and the position of which the toggle linkage can be placed in its locking relationship with respect to the spacing of the jaws 66 and 68 as set by the stop means. Thus, the user of the tool 62 can set the screw 98 to set the spacing of the work-engageing elements 74 and 78 and then without any further or additional adjustment being necessary close the handles 64 and 90 to afford all the mechanical advantages of the strength of the toggle linkage so as to effectively enable the tool 62 to be applied with great force to a pipe or the like without such stresses caused by such use of the tool forcing separation of the jaws 66 and 68.

It will be evident that the tool 62 is not limited to use of the specific form of the work-engageing elements shown in FIG. 2, but in lieu of such specific form of work-engageing elements 74 and 78, the work-engageing elements 16 and 19 can be employed as well as any of the other work-engageing elements previously described as being suitable for use in the tool 10 in lieu of the work-engageing elements 16 and 19.

Attention is now directed to the embodiment of the invention shown in FIG. 4 wherein there is disclosed a tool designated generally by the reference numeral 120. The tool 120 is, like the tool 62, of similar character as employing an adjustable stop or limiting means such as to be subjected to tensile forces in the performance of its function. The tool 120 includes a handle 122 of inverted U transverse configuration, such handle 122 being integral with jaw member 124. The tool 120 includes a movable jaw or member 126 which extends into the handle 122 and is pivotally secured thereto by a pivot pin 128. A handle 130 is pivotally connected to the jaw 126 by a pivot pin 132, a toggle link or compression member 134 has

nearest the pivotal connection 72 of the jaws 66 and 68, the arrangement being such that oscillation of the element 78 in a counterclockwise direction as viewed in FIG. 2 is accompanied by a slight movement of the toothed surface 88 from the toothed concave surface 76, and conversely, counterclockwise oscillation tends to bring the opposed toothed surfaces of the elements 74 and 78 closer to one another. Such arrangement is well suited for employment of the tool 62 as a pipe wrench, such function of ratchetlike character being made possible by the oscillatable mounting of the work-engaging element 78.

Assuming the jaws 66 and 68 to be fixed in their angular relationship, a pipe or the like (not shown) disposed between the elements 74 and 78 can be forcibly turned in the counterclockwise direction as viewed in FIG. 2, as such an application of torque by the tool 62 will tend to oscillate the work-engaging element 78 into closer proximity to the work-engaging element 74, and the tool 62 can then be swung in a counterclockwise direction without any accompanying turning movement being imparted to the pipe as the work-engaging element 78 is then oscillated to its position of further spacing from the work-engaging elements 74. It will therefore be readily appreciated that the work-engaging elements 74 and 78 and the pivotal mounting of the latter can be substituted for the work-engaging elements 16 and 19 of the tool 10, it being deemed evident that the tool 10 can readily serve the function of maintaining the jaws in a selected fixed angular relationship to each other.

The tool 62 is provided with a handle 90 generally similar to the previously described handle 26, such handle 90 being pivotally connected by a pivot pin 92 to the jaw or member 68.

A toggle link or compression member 94 is provided which has its opposite ends disposed within the handles 64 and 90, the end of the link disposed within the handle 90 being pivotally connected thereto by a pivot pin 96. An adjustment screw 98 is threaded into the handle 64 through the end of the latter remote from the jaw 66, and the free inner end portion 100 of the screw 98 is reduced in diameter and is provided with a collar 102 rotatably positioned thereon, such collar 102 being retained on such reduced portion 100 of the screw 98 by the innermost end of the screw portion 100 being radially enlarged as indicated at 104. The end of the compression member or toggle link 94 remote from the pivot 96 bears against the collar 102 as shown. It will be appreciated insofar as the toggle linkage is concerned that the relationship of the toggle link 94 to the collar 102 is substantially the same that as existing between the toggle link 30 and the free end of the screw portion 100, that is, the screw 98 is substantially such as to extend the free end portion of the toggle link 94 is free to move to the right as viewed in FIG. 2.

The toggle link 94 is provided with a lateral enlargement 106 which engages against the inside of the handle 90 when the tool 62 is in its locked condition. As in the case of the previously described embodiment of the invention, the tool 62 is in locking condition when the pivot pin 96 is disposed nearer the handle 64 than its center line position, that is, nearer the handle 64 than a straight line extending through the pivot pin 92 and the position of engagement of the link 94 with the collar 102. As in the case of the tool 10, the tool 62 is provided with a release lever 108 pivotally connected to the arm 90, whereby the enlargement 106 can be forced from engagement with the handle 90 so as to release the tool 62 from a locking condition.

The previously mentioned adjustable stop or limiting means of a tension character comprises an elongated tension element 110 which has one end positioned to one side of the jaw 68 and pivotally secured upon the previously mentioned pivot pin 92, the tension element 110 being disposed within the handle 90, it being understood that the latter is U-shaped in transverse section, that is, the handle 90 being of channel-like configuration and opening upwardly as viewed in FIG. 2. If desired, the end of the tension element 110 nearest the jaw 68 can be bifurcated so as to be engaged on the pivot pin 92 on opposite sides of the jaw 68. 
one end disposed within the handle 130, the latter having a channellike transverse configuration that opens upwardly, and the toggle link 124 is pivotally connected to the handle 130 by a pivot pin 136. The end of the toggle link 136 remote from the pivot pin 136 is disposed within the handle 122 and abuts against a collar 138 that is rotatably mounted on the reduced inner end portion 140 of a screw 142 threaded into the end of the handle 122 remote from the jaw 124. The extremity 164 of the reduced portion 140 of the screw 142 is radially enlarged so as to retain the collar 138 on the reduced portion 140 of the screw 142.

The tool 120 is provided with an elongated tension element 146 which is provided intermediate its ends with a telescoping or lost motion connection 148. One end of the tension element 146 is pivotally mounted on the pivot pin 136 in the same manner as the tension element 110 of the tool 62 is secured to the pivot pin 92 in FIG. 2, and the other end portion 150 of the tension element 146 is pivotally secured to the collar 138 by a pivot pin 152, such manner of securing being quite similar to that in which the tension element 110 is pivotally secured to the collar 102 in the tool 62. The telescoping type joint 148 or lost motion connection is comprised of a hollow low cylinder 154 (shown in section in FIG. 4) into the opposite ends of which slidably project adjacent portions of the tension element 146. Such adjustment portions of the tension element 146 are enlarged at their adjacent extremities within the hollow cylinder or sleeve 154 in a manner such as to prevent their withdrawal from the reduced opposite ends of the sleeve 154. The arrangement is such that the sleeve 154 serves to limit the overall extent or length of the tension element 146, but will permit telescoping of a portion of the tension element 154 into the cylinder or sleeve 154. Thus, the tension element 146 of the tool 120 differs functionally from the tension element 110 of the tool 62 only in that it enables the additional function of being able to admit readily of a predetermined reduction in its overall length.

It will be understood that when the tension element 146 is fully extended as shown in FIG. 4, the relationship is such that the tension element 146 is under a sufficient degree of tension so as to retain the toggle linkage comprised of the handle 130 and the link 124 in their locking condition. The lost motion connection 148 enables on releasing the toggle linkage the opening movement of the jaws 124 and 126 to the extent permitted by the lost motion connection 148. This is, of course, in contrast to the operation of the tool 62 in that the relative positions of the jaws 66 and 68 are constrained to a very small degree of relative movement except upon adjustment of the screw 66 which forms the function of the tool 120, the lost motion connection 148 enables the jaws or members 124 and 126 to open to some extent from the positions occupied thereby when the tension element 146 is actually under tension and the toggle linkage in locking condition, whereby the tool 120 may be readily positioned with respect to a workpiece prior to the toggle linkage being placed in locking condition by closure of the handles 122 and 130.

The jaws or members 124 and 126 can be respectively provided with work-engageable elements such as those shown at 74 and 78 in relation to the jaws 66 and 68 of the tool 62, or such work-engageable elements such as subsequently to be described in connection with the embodiements of the invention shown in FIGS. 11, 17 and 18 as will become evident. The tool 120 is illustrated as being provided with detachable work-engageable elements 158 and 160, such elements being respectively detachably secured to the jaws or members 124 and 126. The detachable work-engageable element 158 is detachably secured to the jaws 124 by means of a threaded fastener 162 that is threaded through a threaded opening 166 in a boss 168 that is integral with the work-engageable element 158. The boss 165 is received within a recess 170 in the jaw 124. The work-engageable element 158 can be detached from the jaw 124 by unthreading the same from the threaded opening 166, whereupon the element 158 can be replaced when the teeth thereof have become worn, or when it is desired to replace the same with a work-engageable element having a differently contoured toothed portion facing toward the work-engageable element 160. In its attachment to the jaw 124, the work-engageable element 158 is prevented from rotation by having an edge 172 thereof abutting a portion of the jaw 124 as clearly shown in the drawing. The work-engageable element 158 is detachably secured by analogous means comprising a threaded fastener 174 threaded through an opening 176 in the jaw 124 and into an internally threaded opening 178 in a boss 180 integral with the work-engageable element 160. As shown, the work-engageable element 160 is recessed in the upper edge of the jaw 126, and since the work-engageable element 160, like the work-engageable element 158, has a noncircular periphery, the work-engageable element 160 is prevented from rotation about the axis of the threaded fastener or screw 174. Accordingly, the work-engageable element 160 can be readily replaced when worn, or when it is desired to employ a work-engageable element presenting a different configuration toward the work-engageable element 158.

The tool 120 is provided with a release means substantially differing from the release means 42 and 108 of the described tools 62 and 120. Whereas the release means provided in the tools 10 and 62 is of such character as to force a separation between the toggle link components comprised of the compression toggle link and the handle to which the latter is pivotally connected, the release means incorporated in the tool 120 serves to effect a separation between the tension element 146 and the compression toggle link 134. Before proceeding with a detailed description of the release means provided in the tool 120, it should be pointed out that the release means provided in the tool 120 can be equally as well applied in connection with the tool 62 in lieu of the release means 108. The release means incorporated in the tool 120 comprises an elongated, generally elliptically cam or separating element 192 disposed between the tension element 146 and the compression link 134 of the toggle linkage. The cam 182 is provided with trunnions 184 extending from its opposite sides which are journeled in openings, not shown, in the opposite sides of the handle 122. The major axis of the elliptically shaped cam 182 is sufficiently smaller than the spacing between the tension element 146 and the link 134 that the same will not interfere with the tool 120 being placed in the locking condition shown thereof in FIG. 4; however, the major dimension of the elliptically shaped cam 182 is sufficiently great that rotation of the cam 182 about the axis defined by its trunnions 184 will serve to force the tension element 146 and the toggle link 134 apart so as to release the tool 120 in its locking condition, it being noted that such spreading action forces the pivot pin 136 away from the handle 122 and through its dead center position. It is to be observed that when the toggle link 134 is forced toward the tension element 146 on closing movement of the handle 122 and 130 so as to approach the locking condition shown with the tool 120, a torque will be produced on the cam 182 so as to orient the same in the position shown thereof in FIG. 4.

The cam 182 is provided with an actuating arm or lever which extends upwardly therefrom within the handle 122 and at one side of the tension element 146, such lever or arm 185 extending through and projecting upwardly from an opening 188 in the top center of the arm 122. The upper free extremity of the lever 186 is provided with a button 190. The button 190 can be pressed downwardly from the position shown thereof in FIG. 4 to effect a turning movement of the cam 182 to accomplish the aforementioned separating action. The opening 188 is sufficiently elongated to accommodate such movement of the arm or lever 186.

Attention is now directed to yet another embodiment of the invention, which like the tools 62 and 120 includes stop or limiting means such as to be subjected to a tension load in the performance of its function. Of the two tools 62 and 120, the tool designated generally at 192 in FIG. 5 is most similar to the
tool 120 in that the stop or limiting means of tensile character includes a provision for lost motion. The tool 120 differs substantially from any of the previously described tools 10, 62, and 120 with respect to the character of the adjustment means provided for the toggle linkage.

The tool 120 includes a handle 194 that is integral with a jaw or member 196. The handle 194 and the jaw or member 196 are of generally channellike transverse configuration that opens downwardly, the same including a web 198, and spaced sidewalls 200 and 202. A movable jaw 204 is provided that extends into the handle jaw structure 194 and 196, and is pivotally connected thereto by a pivot 206 in the same general manner as previously described in connection with the tools 10, 62 and 120. The jaws or members 196 and 204 are provided with working-engaging elements 208 and 210 which can be of whatever character desired. For example, the work-engaging elements 208 and 210 can be such as previously described in connection with the tools 10, 62 and 120, or be of the character of the yet to be described work-engaging elements disclosed in FIGS. 11, 17, 18 and 21.

A handle 212 is pivotally connected to the jaw 204 by a pivot pin 214, and a compression toggle link 216 is provided which has one end disposed within the channellike configuration of the handle 212 and is pivotally connected thereto by means of a pivot 218. The other end of the compression toggle link 216 is pivotally connected by a pivot pin 220 to a collar or jamming loop 222 that embraces the handle 194. The jamming loop 222 is such as to be slidable a considerable interval along the longitudinal extent of the handle 194 when the loop 222 is free from the application of any torque thereto with respect to the handle 194; however, the jamming loop 222 is of such character that when a torque is applied thereto, the same will jam in its position on the handle 194 and will not move when so jammed along the handle 194. For example, when the compression toggle link 216 exerts a force to the loop 222 through the pivot pin 220, the lower portion of the loop 222 shifts to the right relative to the upper portion of the loop 222 so as to jam upon the handle 194 and oppose such force exerted by the link 216 without any further movement of the loop 222 to the right. When the toggle linkage constituted of the handle 212 and the link 216 in released from the locking condition shown thereof in FIG. 5, the loop 222 freed from the application of any force thereto through the link 216, the loop 222 can be moved to any selected position along the handle 194, and upon the handles 194 and 212 being thereafter caused to close or move towards each other, a force will be exerted upon the loop 222 through the pivot pin 220 so as to oppose movement of the link 216 to the right as viewed in FIG. 5.

Accordingly, it will be appreciated that the slide or jamming loop 222 serves functionally the same adjustable interrelationship between the handle 194 and the toggle link 216 insofar as constituting an abutment for the latter as does the screw 36 in the tool 10 shown in FIG. 1. Further detailed description as to the function of the slide or jamming loop 222 to the handle 194 and the toggle link 216 is believed unnecessary in view of such form of adjustment for the toggle linkage is well known in the prior art as exemplified by U.S. Pat. No. 2,997,903, entitled "Pliers with Self-Adjusting Toggle Means," which issued to Rommel et al. Aug. 29, 1961, and reference may be had to such patent for a more complete understanding of the principles involved if necessary, and the disclosure of such patent is incorporated herein by reference.

As in the case of the previously described embodiment of the invention, the end of the handle 194 remote from the jaw or member 196 is closed, and an adjustment screw 224 is threaded into the interior of the handle 194 through an internally threaded opening 226 provided in such closed end of the handle 194. The inner end of the adjustment screw 224 has a reduced end portion 228 on which is rotatably mounted a collar 230, such collar 230 being retained on the screw 224 by means of the inner extremity of the screw 224 being enlarged as indicated at 232.

The bifurcated end 234 of a tension element 236 is fixedly secured to the collar 230 as by welding or the like 238, and the end of the tension element 236 remote from the collar 230 extends to a position on one side of the jaw 204, and is provided with a laterally projecting pin 240 extending through an elongated arcuate slot 242 in the jaw 204, the end of the pin 240 remote from the tension element 236 being enlarged so as to prevent dislodgement of the pin 240 from the slot 242. If desired, the end of the tension element 236 nearest the jaw 204 can, if desired or deemed expedient, be bifurcated so as to have portions disposed on opposite sides of the jaws 204, and the pin 240 be connected through the slot 242 to such bifurcated portions. The pin 240 is slidable along the elongated dimension of the slot 242, the arrangement being such that the tension element 236 will not prevent opening movement of the jaws 196 and 204 throughout the range of movement or lost motion afforded by movement of the pin 240 to the other end from that which the same is shown as disposed in FIG. 5. However, when the pin 240 is disposed at the end of the slot 242 remote from the work-engaging element 210, the tension element 236 will prevent relative closing movement of the jaws 196 and 204. Accordingly, the tension element 236 together with its pin 240 disposed in the slot 242 constitute the aforementioned stop or limiting means that are adjustable by means of the screw 224. It is to be understood that the fitting of the collar 230 upon the screw 224 is sufficiently loose so as to enable such small degree of rocking movement as may occur due to upward and downward movement of the pin 240 in the operation of the tool 192.

The tool 192 is shown in locked condition, that is, the pivot pin 281 being disposed above its dead center position and with the compression toggle link 216 pushing the pin 220 to the right as viewed in FIG. 5 so as to cause the jamming function of the slide or jamming loop 222. Such loading of the toggle link means constituted of the handle 212 and the link 216 against the jamming loop 222 is brought about by the reactive force generated by the tension applied to the tension element 236 between the jaw 204 and the screw 224.

Upon the forcing of opening movement of the handles 194 and 212, the jaw 204 can be swung open with respect to the jaw 196 without any necessity for changing the adjustment of the screw 224, and when desired, the handles 194 and 212 can be forced together to restore the tool 192 to the locked condition shown thereof in FIG. 5. Thus, the tool 192 can be restored to a locked condition as many times as desired with the work-engaging elements 208 and 210 having a predetermined spaced relation, with the jaws being permitted to open intermediate each restoration of the tool 192 to the locked condition.

Attention is now directed to the embodiment of the invention shown in FIG. 7, this embodiment of the invention also being directed to a conventional vice grip-type hand tool such as includes a jamming loop of the same general character as shown in FIG. 5 and as exemplified in U.S. Pat. No. 2,997,903. This embodiment of the invention constitutes a departure from the form of the invention shown in FIG. 5 in that adjustment of the jamming loop concurrently adjusts the adjustment of a tension-type stop or limiting means for limiting the extent of closure of the jaws or members which carry work-engaging elements. The embodiment of the invention shown in FIG. 7 comprises a tool designated generally at 224 comprised of a handle 246 integral with a jaw or member 248. As in the case of the previously described invention, the handle 246 and the member 248 are of an inverted U transverse configuration, that is, of a channellike configuration opening downwardly as viewed in FIG. 7. As in the case of the tool 192 shown in FIG. 5, the tool 244 can employ work-engaging elements 250 as those previously described in connection with FIGS. 1, 2, 4 and FIG. 5 as well as those yet to be described in conjunction with the embodiments of the invention shown in FIGS. 11, 17, 18 and 21, however, the tool 44 is shown as being provided with a work-engaging element 250 having a concave toothed lower surface 252 which is cooperatively associated with a planar work-engaging element 254 fixed to a jaw 256 that extends into and is pivoted to the handle 246 by means of a pivot.
A handle of U-shaped transverse configuration 258 is pivotally connected to the jaw or member 256 by means of a pivot pin 260, and a compression toggle link 262 extends into the handle 258 and is pivotally secured thereto by means of a pivot pin 264 in the same manner as previously described in connection with the pivot pin 32 which secures the link 30 to the handle 26 in the tool 10 shown in FIG. 1.

A slide or jamming loop 266 embraces the handle 246 and the loop 266 is pivotally secured to the compression toggle link 262 by means of a pivot pin 268. As in the case of the slide or jamming loop 222 described in connection with the tool 192 shown in FIG. 5, the jamming loop 266 is slidably on the handle 246, and serves the function of limiting movement of the pivot pin 268 to the right as viewed in FIG. 7 when the link 262 is compressively loaded thereagainst. In view of the foregoing description of the operation of the toggle linkage shown in FIG. 5 and as described in connection with the jamming loop 222, particularly in view of the operation of the structure shown in U.S. Pat. No. 2,997,903, it is believed that no further description of the coaction of the jamming loop 266 with the toggle link means constituted of the handle 258 and the toggle link 262 is necessary.

Elongated slots 269 are provided in the opposite sides of the handle 246, and a pin 270 is fixedly attached to the opposite sides of the jamming loop 266, such pin 270 being slidable along the longitudinal extent of the slots 269.

A tension element 272 has one end pivotally connected to the pin 270 at a position intermediate the opposite sides of the handle 246, and the other end of the element 272 is pivotally connected to the previously mentioned pivot pin 260, the tension element 272 being preferably bifurcated adjacent the jaw 256 with the bifurcated portions being disposed upon the opposite sides of the jaw 256 as to be disposed about the pivot pin 260 on the opposite sides of the jaw 256 and interposed between the jaw 256 and the opposite sides of the handle 258.

The operation of the tool 244 will be readily understood, especially in the light of the previously described operations of the tools 10, 62, 120 and 192. With the handles 246 and 258 opened from the closed condition shown thereof in FIG. 7, the spacing of the work-engaging elements 250 and 254 can be adjusted by simply sliding the jamming loop 266 along the handle 246. With the jamming loop 266 positioned so as to achieve the desired spacing of the work-engaging elements 250 and 254, the handles are closed by gripping the same in the hand while initially holding the upper end of the loop 266 in position by the thumb or in any other suitable way until a sufficient load has been imposed on the loop 266 to achieve the jamming function thereof, whereas upon the tool 244 can be placed in the locked condition shown in FIG. 7. In such locked condition, the tension element 276 is stressed in tension, with the toggle linkage being effective to compressively load the compression 262 against the pivot pin 268.

In view of the foregoing, the single adjustment of the position the jamming loop 266 along the extent of the handle 246 will achieve a desired fixed spacing of the elements 250 and 254 when the tool 244 is placed in its locked condition.

If desired or deemed expedient, the end of the tension element 272 remote from the pivot pin 270 can, rather than being attached to the pivot pin 260, be connected to the jaw 256 in the same manner that the tension element 236 of the tool 192 is attached to the jaw 204 of such tool 192, that is, by means of engagement of a pin carried by the tension element operating in a slot provided in the jaw 256.

Attention is now directed to yet another embodiment of the invention as shown in FIG. 9. The tool designated generally at 274 in FIG. 9 is comprised of a handle 276 having an integral jaw or member 278, such handle 276 and jaw 278 being, as in the case of the previously described embodiments of the invention, of an inverted U-shape in transverse action. A jaw or member 280 is provided which extends into the handle 276 and is pivotally connected thereto by means of a pivot pin 282.
wardly as viewed in FIG. 9, the jaws or members 278 and 290 can be opened to the extent limited by the nut and its turn-

nions 304 sliding along the slots 306 to ends of the latter most remote from the ball 312. Thus, the operative relationship of the turnnions 304 to the slots 306 is such as to constitute a last motion connection equivalent to the freedom afforded the pin 240 in the slot 242 in the tool 192, and that afforded by means of the lost motion connection 145 previously described in connection with the tool 120. Therefore, the tool 274 constitutes structure such that the work-engaging elements 284 and 286 can be releasably secured in a predetermined spatial relationship with the jaws intertumingly been opened to an extent limited only by the degree of freedom afforded by the lost motion connection. Such function is quite analogous to that previously described in connection with the tool 192.

Attention is now directed to still another embodiment of the invention which is shown in FIG. 11. The tool designated generally at 320 in FIG. 11 is comprised of a handle 322 that is integral with a jaw or member 324, such handle and jaw being, as in the case of the previously described embodiments of the invention, of inverted U-shape transverse configuration. A jaw or member 326 extends into the open underside of the handle 322, and is pivoted thereto by a pivot pin 328. A handle 330 of the U-shaped transverse configuration is pivotally connected to the jaw or member 326 by means of a pivot pin 332. A compression link 334 has one end extended into the handle 330 and is pivotally secured thereto by a pivot pin 336. The end of the compression link 334 remote from the pivot pin 336 is disposed within the hollow interior of the handle 332, and such end of the compression link 334 is provided with a cavity 338 in which is disposed the enlarged free end 340 of a reduced extension 342 of an adjustment screw 344. The ad-

justment screw 344 is threaded through the end of the handle 322 remote from the jaw 324 so as to extend into the hollow interior of the handle 322. Thus, a swivel connection is provided between the compression link 334 and the screw 334, the arrangement being such that positive movement to both the right and left direction is imparted to the toggle link 334 upon turning movement of the screw 344 in opposite directions. The looseness of the fit of the latter in the cavity 338 is sufficient to allow an adequate degree of vertical freedom of movement of the pivot pin 336 in the use of the tool 320.

As in the case of previously described embodiments of the invention, the toggle link 334 is provided with a lateral en-

largement 346 which abuts against the web 348 of the handle 330 when the tool 320 is in locked condition. The web portion 348 extends laterally spaced opposite sidewalls 350 and 352 of the handle 330.

The toggle link 334 is provided with a transverse opening 354therethrough, and a ball 356 is disposed within the opening 354, the ball 356 having a diameter substantially greater than the thickness of the toggle link 334. If desired, the toggle link 334 can be swaged about the periphery of the opening 354 so as to firmly retain the ball 356 therein as will be apparent upon inspection of FIG. 13.

In order to releasably retain the toggle link 334 in the relative position occupied thereby with respect to the handle 330 when the tool 320 is in locked condition, the sidewalls 350 and 352 of the handle 330 are inwardly struck as respectively shown at 350 and 360, the spacing of the inwardly struck portions 360 and 362 being less than the diameter of the ball 356 when the walls 350 and 352 are in repose. It will be un-

derstood that the handle 330 is of steel and is of a sufficiently resilient character so as to be capable of at least a minor degree of flexure from its condition or position of repose and will resiliently flex to its original condition upon removal of the stress causing such initial flexure.

The special relationship of the ball 356 with respect to the inwardly struck portions 360 and 362 is such that the ball passes from one side of to the other side of the inwardly struck portions 360 and 362 as the toggle linkage is respectively in and out of locked condition.
As in the case of the previously described jaw or member 14, the jaw or member 402 is of a generally inverted U-transverse configuration, and the same is provided with a set of openings such as those indicated at 412, 414 and 416 extending entirely therethrough. The spatial arrangement of the set or array of openings 412, 414 and 416 is such that various ones of such openings are brought into alignment with a curved edge 418 of the jaw 404 during angular adjustment of the jaws 404 and 402 with respect to each other. A stop pin or shear pin 420 is carried by a flexible metal chain 422 that is in turn secured to the pivot pin 406, whereby the shear pin 420 is secure against becoming lost or strayed from the tool 400. The pin 420 can be extended entirely transversely through the jaw 402 through any selected one of the openings such as those indicated at 412, 414 and 416. Passing the pin 420 through an opening disposed above the curved edge 418 of the jaw 404, such as the openings 412 will positively limit the extent to which the jaws 402 and 404 can be closed, that is, moved toward each other. Thus, assuming the pin 420 to be extended through the openings 412, the tool 400 can be placed in a locked condition by virtue of the reactive forces generated upon the pin 420 being subjected to shearing forces on engagement with the curved edge 418 of the jaw 404. Accordingly, by appropriate selection of one of the openings such as those indicated at 412, 414 and 416, the tool 400 can be locked upon itself, so to speak, at any one of a plurality of adjusted spacings of the work-engaging elements 408 and 410.

The tool 400 accordingly affords many of the advantages of the previously described embodiments of the invention, and differs substantially therefrom in that the stop or limit means incorporated therein is such that shear forces, rather than compression of tension forces enable the tool to be locked upon itself.

Attention is now directed to FIG. 17 wherein there is illustrated an alternative form of work-engaging elements, the work-engaging elements shown in this figure being suitable for use in lieu of the tool-engaging elements illustrated in connection with any of the previously described tools. FIG. 17 is a fragmentary illustration in side elevation of the toggle link or vice grip type of hand tool, and the tool is designated generally by the reference numeral 430, the same comprising a jaw 432 integral with a handle 434 which respectively may be considered to correspond generally to the jaw 14 and handle 16 of the previously described tool 10. The tool 430 additionally includes a jaw 436 which extends into the hollow interior of the handle 434 and is pivotally connected to the latter by means of a pin 438. The jaw or member 432 is provided with a multifunction work-engaging element 440 which includes an arcuate, downwardly convex portion 442 terminating in its extremity remote from the pivot pin 430 in a straight portion 444. The lower surfaces of both the arcuate portion 442 and the straight portion 444 are provided with teeth such as those indicated at 446 and the straight portion 444.

The jaw or member 436 is provided with a coating multipurpose work-engaging element 448 which includes an arcuate, upwardly concave portion 450 which at its extremity remote from the pivot pin 430 terminates in a straight portion 452. The upper surfaces of the arcuate and straight portions 450 and 452 of the work-engaging element 448 are provided with teeth such as those indicated at 454 in connection with the straight portion 452. The work-engaging elements 440 and 448 are somewhat similar to the work-engaging elements 370 and 374 of the tool 220 in that the lowermost work-engaging element 448 is bifurcated so that the straight portion 444 of the uppermost work-engaging element 440 is free to move upwardly and downwardly between the transversely spaced portions of the bifurcated work-engaging element 448 as will be readily understood by those skilled in the art.

The work-engaging elements 440 and 448 are referred to as being multipurpose for the reason that the arcuate portions 442 and 452 thereof are adapted for compressively engaging or gripping a workpiece or for closing movement of the handles of the tool 430, that is, when the jaws 432 and 436 are caused to move toward each other. On the other hand, the straight portions 444 and 452 are adapted to place tensile loads on a workpiece or to force portions of a workpiece apart during closing movement of the handles. It will be quite evident that the teeth 454 and 448 can be caused to bear, for example, against the inner surfaces of a hollow cylinder at diametrically opposed positions on the jaws 432 and 436 being forcibly urged toward each other.

Attention is now directed to the form of the invention shown in FIGS. 18 and 19. As in the case of the form of the invention shown in FIG. 17, the FIGS. 18 and 19 only partially illustrate respectively in side elevation and top plan, a toggle link or vice grip type of hand tool, and such tool is generally designated in such figures by the reference numeral 460. The toggle link or vice grip type of hand tool 460 includes a fixed or stationary jaw or member 462 that is pivotally connected to a movable jaw or member 464 by means of a pivot pin 466. The movable jaw 464 is provided with a large flat work-engaging element 468 having an upper surface that is substantially coplanar with the axis of the pivot pin 466, and the lower work-engaging element 468 is operatively associated with a similarly shaped upper work-engaging element indicated at 470, such work-engaging element 470 being movable justly carried by the fixed jaw or member 462. The lower planar surface of the upper work-engaging element 470 is parallel to the upper surface of the lower work-engaging element 468, and the lower surface of the upper work-engaging element 470 is of course coplanar substantially with the axis of the pivot pin 466 when the work-engaging elements 468 and 470 are in engagement as shown in FIG. 18. The upper work-engaging element 70 is mounted for reciprocating motion in a direction perpendicular to the plane of its undersurface. For this purpose, the upper work-engaging element 470 is provided with integral upwardly extending surfaces having mating and dovetailed guide channels means 474 connecting the same to the jaw 462, the arrangement being such that the work-engaging element 470 is slindingly guided for vertical movement as viewed in FIG. 18. The jaw is provided with a transverse opening 476 therethrough in which is disposed a helical gear 478, the helical gear 478 being mounted for rotation about a pin 480 fixed to the jaw 462. Accordingly, the helical gear 478 while being restrained against endwise movement is free to rotate about the axis of the pin 480, such axis of the pin 480 being perpendicular to the plane of the underside of the work-engaging element 470. A slot is defined in the jaw 462 intermediate the cavity 476 and the upwardly extending structure 472 of the work-engaging element 470, and the structure 472 of the work-engaging element 470, and the structure 472 includes an integral rib 482 passing through such slot and having rack gear teeth 484 thereon that mesh with the helical gear 478. The relationship is such that the helical gear 478 can be turned manually (it being noted that the diameter of such gear is such as to project laterally from both sides of the jaw 462 as shown in FIG. 19), with the result that the helical gear 478 by virtue of its meshing engagement with the rack gear 484 will cause vertical movement of the work-engaging element 470 as guided by the guide structure or guide ways 474. Thus, when the tool 476 is in locked condition, the spacing of the work-engaging elements 468 and 470 can be adjusted varliably by means of the helical gear 478. It is particularly of interest and quite advantageous in some uses of the tool 460 that the angular relationship of the work-engaging elements 468 and 470 can be established by appropriate adjustment of the toggle link adjustment means and of the adjustment of the stop or limiting means with which it is to be understood that the tool 460 is provided, such angular relationship of the work-engaging elements 468 and 470 will be maintained throughout the adjustment range afforded by the use of the helical gear 478.

Attention is now directed to the form of the invention shown in FIG. 20, this form of the invention constituting a departure from the previously described forms of the invention in that the jaws or members are not connected for relative movement about a single pivotal axis, but are rather pivotally connected in such a manner as to preclude relative angular
3,635,107

movement of the jaws or members that carry the work-engaging elements. FIG. 20 is a fragmentary side elevational view of a toggle link or vice grip-type hand tool and is designated generally at 490, and except to the extent specifically hereinafter explained, the tool 490 is identical to the previously described tool 62, through if desired or deemed expedient, the adjustable stop or limit means incorporated in the tool 62 including the tension element 110 can be omitted or deleted therefrom. Those skilled in the art will appreciate that the specifically pointed out details of the tool 490 have wide applicability to a wide variety of varying forms of toggle link or vice grip-type hand tools other than the previously described hand tool 62, such as the previously described tools 120, 274 and 320, as well as to tools such as disclosed in the previously mentioned U.S. Pat. Nos. 2,280,005 and 2,997,903.

In the previously described embodiments of this invention, as well as in the tools disclosed in the two patents, are such that adjustment of the spacing of the jaws or members which carry the work-engaging elements necessitates relative angular movement of such jaws or members for the reason that such movement is about a single pivotal axis. Inasmuch as it is not always desirable that spacing adjustment be accompanied by relative angular movement of the jaws and the work-engaging elements carried thereby, and indeed in many circumstances may be undesirable, it is the specific purpose of the hereinafter described improvement disclosed in FIG. 20 to either constrain the relative movement of the jaws or members to be such during spacing movement thereof to such that no relative angular movement occurs therebetween, or to enable a degree of relative angular freedom as to the relative angular positions occupied by such members when the work-engaging elements thereof are applied with force to a workpiece.

The partially illustrated tool 490 includes as is conventional a handle 492 and an integral jaw or member 494, such handle 492 and jaw 494 being of inverted U-transverse section so as to include parallelly spaced side walls 496 and 498. Also as is conventional, the jaw 494 is provided with a work-engaging element 500. Additionally, as is also conventional, the tool 490 includes a jaw or member 502 that is pivotally connected to the jaw 494, such jaw 502 being provided a work-engaging element 504 for cooperation with the work-engaging element 500. Also, as is conventional, a handle 506 is pivotally connected by means of a pivot pin 508. It will be appreciated by those familiar with the art that the jaw 502, the handle 506, and the pivot pin 508 correspond generally to the respective jaw 18, handle 26 and pivot pin 28 of the tool 10 shown in FIG. 1. In other words, the handle 506 constitutes a portion of the toggle link operatively connected to the handle 492 whereby closure of the jaws 494 and 502 will result with great mechanical advantage the forcing of the pivot pin 508 to the left with respect to the jaw 494 as viewed in FIG. 20.

As suggested above, the crux of the distinction of the tool 490 from previously described embodiments of the invention and extant toggle link-type hand tools resides in the differing character of the pivotal connection of the jaw or member 502 to the jaw or member 494. As in the case of conventional tools of this character, the jaw 502 extends into the hollow interior of the jaw 490 and the handle 492 in the region of the juncture of the jaw 490 with handle 492, that is, the jaw 502 is disposed in part between the spaced parallel sidewalls 496 and 498. The portion 510 of the jaw 502 disposed between the sidewalls 496 and 498 is of substantially lesser thickness than the spacing of the adjacent surfaces of the sidewalls 496 and 498 for the purpose of accommodating between such portion 510 of the jaw 502 and the sidewall 496 a pair of parallel links 512 and 514. The links 512 and 514 have ends disposed above the upper edge of the jaw portion 510, and such upper ends of the links 512 and 514 are pivotally secured to the handle 492 and jaw structure 492 and 494 by means of pivot pins 516 and 518 extending therethrough and secured to the sidewalls 496 and 498. The lower ends of the links 512 and 514 are pivotally secured at spaced positions on the jaw portion 510 by the pivot pins 516 and 522. The spatial arrangement of the pivot pins 516, 518, 520 and 522 are such that the axes of such pins define apices of a parallelogram. Obviously, such form of parallel linkage constrains relative movement of the jaws 494 and 502 to be such that relative angular movement occurs between such jaws. Relative movement of the jaw 502 with respect to the jaw 494 will occur upon the pivot pin 508 being caused to move to the right or the left as viewed in FIG. 20 with respect to the jaw 494. Movement of the pivot pin 508 to the left as can be caused and which will be caused to forcibly occur during operation of the toggle linkage of the tool 490 will result in the links 512 and 514 being moved in a clockwise direction away from each other pivot pins 516 and 518, and this in turn results in relative closing movement of the jaws 494 and 502 in a manner to a large extent analogous to the operation of the jaws of conventional toggle link-type hand tools, except in this case because of the specially provided pivotal connection between such jaws, such closing movement of the jaws occurs without any relative angular movement of the jaws.

If it is not necessary or deemed expedient that the jaws 494 and 502 be absolutely prevented from any relative angular movement, either one or the other of the links 512 or 514 can be omitted or deleted from the illustrated structure with the result that a degree of angular freedom of relative positions assumed by the jaws 494 and 502 can be obtained. In this type of operation or function of the tool 490 (one of the links 512 and 514 being omitted), the handle 506 will be subject to a degree of freedom in that the pivot 508 can move along arc about a center defined by the position of abutment of the toggle linkage against the adjustment means thereof, for example, the engagement of the toggle link 94 with the collar 102 in the tool 62. It is to be observed that such degree of freedom of the handle 506 and the pivot pin 508 will not disturb the locking condition of the toggle linkage. Such degree of freedom afforded the pivot pin 508 accommodates the work-engaging elements 500 and 504 assuming a position angularly with respect to each other that is compatible with the inclination of surfaces of a workpiece engaged thereby.

Whereas only two links have been described in connection with FIG. 20, it will be abundantly clear that two links such as the links 512 and 514 can be provided, such duplicate links being disposed in parallel opposition to each other and disposed on opposite sides of the jaw portion 512, such additional link 512 and 514 being identical pivotal connections. Similarly, the link 512 can be duplicated on the other side of the jaw portion 510 with the result that the tool 490 will be symmetrical about its medial plane.

Attention is now directed to the form of the invention shown in FIG. 21. FIG. 21 is a fragmentary side elevational view of a toggle link or vice grip-type of hand tool provided with an improved work-engaging element, such tool being designated generally at 540, the same comprising a handle 542 having an integral jaw or member 544 integral therewith, such arm 542 and member 544 being as in the previously described embodiments of the invention of inverted U-transverse configuration, the arrangement being such that the member 544 includes spaced sidewalls 546 and 548 connected by a web 550. A jaw or member 552 is disposed in part between the spaced sidewalls 546 and 548 and is pivotally connected thereto by means of a pivot pin 544.

The parts of the structure shown in FIG. 21 thus far described are entirely conventional, and it is to be understood that the jaws 544 and 552 are provided with toggle link means, not shown, such as for example has been disclosed and described in connection with the other embodiments of this invention whereby the jaws can be forcibly urged to close towards each other with the mechanical advantage afforded by a toggle linkage. In addition, it is to be clearly understood that the tool 540 is provided with stop or limiting means such that the tool 540 can be locked upon itself, so to speak, with the jaws 544 and 546 being releasably retained in a fixed spatial and angular relationship.
The jaw 552 is provided with a hardened work-engaging element 560 which can have a planar upper surface as shown, or be toothed if desired. The work-engaging element 560 is disposed for coaction with a ratcheting-type work-engaging element carried by the jaw 544. The ratcheting-type work-engaging element just referred to comprises an articulated or pivotally mounted auxiliary jaw structure 562 that is disposed to be in contact received within the jaw 544, and such portion 564 of the jaw 552 disposed within the jaw 546 is pivotally connected to the latter by means of a pivot pin 566. A coiled tension spring 568 has one end attached to the jaw portion 564 above the pivot pin 566, and has its other end secured about a catch 570 set inwardly from the web 550, the arrangement being such that the tension spring 568 disposed within the jaw 546 urges clockwise motion of the jaw 546 as viewed in FIG. 21 to the limiting position shown thereof, such limiting action occurring by reason of the jaw 546 coming into engagement with the web at the position indicated at 576. The jaw 552 is forced against the yielding resiliency of the spring 568 in a counterclockwise direction about the pivot 566 so that a work-engaging element 580 fixed to the jaw 552 swings to a position nearer the work-engaging element 560. As in the case of the work-engaging element 560, the work-engaging element 580 can have its undersurface toothed if desired.

It is to be particularly noted that the toothed element 580 is disposed at a position with respect to the pivot pin 566 such that a force on the work-engaging element 580 having a very large component directed to the right or at least directed so as to produce a counterclockwise torque on the jaw 562 results in relative closure of the work-engaging elements 560 and 580. On the other hand, a force on the work-engaging element 580 directed to the left as seen in FIG. 21 will tend to rotate the jaw 562 in the same direction as urged by the spring 568.

It will be readily appreciated on consideration of the foregoing that the auxiliary jaw structure 562 and the work-engaging element 580 thereof will serve to ratchet a ratcheting function by virtue of the mounting of the jaw 562 illustrated and described. For example, with the tool 540 locked upon itself so that the work-engaging elements 560 and 580 make a very loose fit upon a workpiece such as a round piece of pipe when the auxiliary jaw 562 is in the position shown thereof in FIG. 21, the tool 540 can then be turned in a clockwise direction about the axis of the workpiece or pipe without the application of any appreciable torque to the workpiece because of the loose fit of the tool thereon, it being noted that such forces as may be applied by reaction to the work-engaging element 580 are applied in such a direction as to tend to withdraw the work-engaging element 580 from the work-engaging element 560. When the tool 540 is applied by turning the same in a counterclockwise direction as viewed in FIG. 21, such reactive force of the workpiece upon the work-engaging element 580 is such as to tend to cause counterclockwise movement of the auxiliary jaw 562 about the pivot 566 which results in the work-engaging element 580 tending to approach the work-engaging element 560, whereupon the work-engaging elements 560 and 580 progressively tend to bite tighter or bear against the workpiece tighter so that slippage therebetween is prevented. Accordingly, alternate clockwise and counterclockwise turning movement of the tool 540 will produce a ratchellike application of torque to the workpiece and intermittent further counterclockwise turning of the workpiece.

Referring again to the embodiments of the invention shown in FIGS. 1, 2 and 5, it will be evident that the rotatable collars can be denied axial separation from the adjustment screws by means other than the described and illustrated radial enlargements of the free end of the cylindrical end portion of the screw on which the collar is rotatably mounted. An equivalent and conventional means, which might be more convenient in manufacturing in some circumstances, can be employed in lieu of the radial enlargement of the end of the screw such as the provision of a circumferential groove in the cylindrical portion of the screw, and the provision of a radial screw in the collar which is adjusted to extend with a sliding fit into the groove. Such a screw and groove structure is well known in the art and would enable ready assembly and disassembly of the collar with respect to the screw, and will be readily understood.

In connection with the configurations of the work-engaging elements shown in FIGS. 11 and 17, it is deemed within the skill of the art that the slots defined by the bifurcations can be closed adjacent the free ends of such elements provided the slots are of such size that the coating element can slide and move therethrough upon relative movement of the jaws carrying such elements.

All the embodiments of the invention have been described in rather elaborate detail, perhaps more than necessary so as to assure conveying a full and complete understanding of the structures involved and their operating functions. Any narrowness of scope of the invention should therefore not be inferred by the extent of the detail of the description.

Manifestly, each and every embodiment of the invention is susceptible to numerous variations in detail without departing from the basic inventive principles involved, and accordingly, attention is directed to the appended claims in order to ascertain the actual scope of the invention.

I claim:

1. In a toggle link-type hand tool including pivotally connected members for carrying work-engaging elements, and actuating handles for the members that are movable toward and away from each other and which handles are connected by toggle link means for releasably securing the members against relative pivotal movement in the direction corresponding to opening movement of the handles when relative pivotal movement of the members in the opposite direction is opposed, the combination therewith of said tool including means for adjustably limiting opposite movement of the members, whereby opposite movement of the members can be opposed, said means comprising one of said members being provided with a selectively positionable element projecting laterally therefrom in a direction generally parallel to the axis of the pivotal connection of the members and into the travel path of a portion of the other member to obstruct said opposite movement of the members, said selective positions of said element corresponding to obstructing said opposite movement of the members at differing relative pivotal positions occupied by the members, the arrangement being such that the selectively positionable element is subject to shearing forces subjected the members when limiting said opposite movement thereof, whereby, for any selected one of a plurality of relative member positions, the tool can be operated to cause the members to be positively prevented from moving in a direction corresponding to closing movement of the handles and concurrently be releasably secured against movement in the opposite direction, with releasable security of the members not requiring the application of any force whatsoever to a workpiece by any work-engaging elements which may be carried by or form a part of the members.

2. The combination of claim 1, wherein said adjustably limiting means comprises said one member having a plurality of openings therein, with said selectively positionable element being selectively receivable in said openings.

3. The combination of claim 1, wherein said members are pivotally connected by a coupling element, said coupling element, said pair of spaced and parallel pivot pins respectively connecting the members to said coupling element, the arrangement being such that the members can be maintained in parallel relationship during opening and closing movement of the handles.

4. The combination of claim 1, wherein each of said members is provided with a work-engaging element, with at least one of said work-engaging elements being movably mounted relative to its respective member.

5. The combination of claim 4, wherein said work-engaging element is movably mounted on its respective member by means of a pivot pin, with means for limiting relative move-
3,635,107

6. The combination of claim 4, including meshed rack and helical gear means for causing relative movement of said work-engaging element and its respective member.

7. The combination of claim 1, wherein said members are respectively provided with first and second work-engaging elements, said first work-engaging element having an elongated slot therein, and said second work-engaging element being movable in and projecting through the slot during relative movement of the members.

8. The combination of claim 1, wherein each of said members is provided with a work-engaging element, with at least one of said work-engaging elements being movably mounted relative to its respective member.

9. The combination of claim 8, wherein said work-engaging element is movably mounted on its respective member by means of a pivot pin, with means for limiting relative movement of said one work-engaging element and its respective member.

10. The combination of claim 8, including meshed rack and helical gear means for causing relative movement of said work-engaging element and its respective member.

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