This invention relates generally to manually operable gripping tools and more particularly to a compound leverage, toggle lock plier. 5

It is a still further object of the invention to provide a toggle operated plier, embodying a compound leverage action, which substantially eliminates the possibility of injury to the user.

Yet a further object of the invention is the provision of a compound leverage, toggle operated plier wherein the toggle elements are movable past a dead center position so as to enable the two gripping jaws to be clamped on a workpiece and wherein further the toggle mechanism is fully adjustable to permit locking thereof over a wide range of jaw openings while retaining a convenient handle separation.

Still another object of the invention is the provision of a toggle operated plier, embodying a compound leverage action, which substantially eliminates the possibility of injury to the user. Yet a further object of the invention is the provision of a compound leverage, toggle operated plier wherein the toggle elements are movable past a dead center position so as to enable the two gripping jaws to be clamped on a workpiece and wherein further the toggle mechanism is fully adjustable to permit locking thereof over a wide range of jaw openings while retaining a convenient handle separation.

These and other objects of the invention are attained in the illustrative embodiment thereof by the provision of a first handle member integrally carrying a first gripping jaw at one end and having pivoted to an intermediate point thereof one end of an arm integrally carrying a second gripping jaw at its other end, the second jaw being movable into gripping relationship with the first jaw upon pivotal movement of the arm. The arm and first handle member are formed with intersecting, relatively inclined cam slots in which are guided opposite ends of a pin carried at one end of a second handle member which extends into a space between the arm and first handle member. Toggle means are connected between the handle members for moving the pin along the slot in the first handle member upon movement of the handle portions of the members together, with the resultant movement of the second jaw toward the first jaw by virtue of a camming action between said pin and the walls of the slots. The pivotal connection of the toggle means to one of the handle members may be adjustable positioned in a manner to permit locking of the toggle means, for a given handle spacing, over a wide range of jaw openings.

Fig. 1 is a side elevation of the present plier with its jaws separated; Fig. 2 is a view similar to Fig. 1 but with the jaws closed to gripping engagement with a workpiece, the toggle locking position of the plier handles being shown in phantom lines; Fig. 3 is a side elevation of the present plier in toggle locking position with the toggle locking means set for maximum jaw opening; Fig. 4 is a section taken substantially along line 4--4 of Fig. 1; and Figs. 5-7 are line diagrams illustrating the operation of the present plier.

Reference is now made to Figs. 1--5 of the drawings wherein a preferred embodiment of the invention is shown as comprising a first handle 10 which is arcuately formed at one end, as shown at 11. Handle 10, adjacent its other end, is flattened, as at 12, and has a first gripping jaw 13 formed at said other end which jaw projects above the flattened portion as shown.

Handle 10 is stepped at the lower end of flattened portion 12 to provide, in effect, a boss 14 having an upper planar surface spaced above the flattened portion 12 but below the adjacent side surface of handle 10. Extending through boss 14 is a threaded bore 15 in which is fixed a pivot pin 15 for pivotally connecting one end of an arm 16 to the first handle 10. Pin 15 has an enlarged head flush with the outer surface of the arm.

Arm 16 is of a thickness to make its outer surface flush with the outer surface of arcuate portion 11, the opposite surface of the arm being spaced from the flattened portion 12 of handle 10 a distance equal to the height of the boss 14.

The other end of arm 16 is formed to provide a second
gripping jaw 17 which projects beyond said opposite surface of the arm so as to be coplanar with the first jaw 13 and 17. That jaw is 17 will be swung forcibly toward the first jaw 13 and 17, by a cam that is pivoted on arm 16 while the cam is in a camming action. The toggle means, comprising the toggle link 31, is provided for producing the aforementioned movement of pin 23 along slot 18, and resultant closing and opening of jaws 13 and 17, upon closing and opening movement of handle 18 and 20. Thus, it will be seen that as handle 20 is swung toward handle 10 about pin 23 as a pivot, toggle link 31 is pivoted toward handle 10 about its axis 32 with a resultant straightening out of the toggle linkage comprising the toggle link 31 and the portion of handle 20 between the upper toggle link pivot 25 and pin 23. This straightening out of the toggle link 31 results in a force being applied to pin 23 to move the latter along slot 18 toward jaw 13 and move jaw 17 toward jaw 13.

It will be apparent from Fig. 5 that the camming force exerted on arm 16, and hence the torque acting upon jaw 17 toward jaw 13, will be a function of the included angle A between the slots 18 and 19. It will also be apparent that the torque applied to arm 16, for a given closing force applied to the handles 10 and 20, and hence the mechanical advantage, or compound leverage action, of the plier, may be varied by changing the angle A.

Sufficient closing of the handles 10 and 20 will cause the upper toggle link pivot 35 to move past its dead center position (Figs. 6 and 7), that is, past a line extending through pin 23 and lower toggle link pivot 32, so that the toggle will lock and the jaws will remain locked during the work. The toggle link 31 is retained in this toggle locking position by abutment of its upper end against arm 16, as shown in Fig. 3.

From an inspection of the drawings, and especially Figs. 6 and 7 thereof, it may be seen that by adjustment of the position of lower toggle link pivot 32 toward or away from the jaws 13 and 17 by rotating adjusting nut 29 to axially position the threaded stem 23, the separation of the jaws 13 and 17, in the locking position of the toggle linkage may be varied so that the plier may be clamped on workpieces of various sizes. Also it will be observed that the handle separation remains substantially unchanged so that a convenient handle separation is maintained in all locking positions of the toggle linkage.

It will be apparent from the foregoing that there has been described and illustrated a compound leverage, toggle operated plier which is fully capable of attaining all of the objects and advantages heretofore set forth.

While a preferred embodiment of the invention has been disclosed, it is not intended that the invention shall be restricted thereto but only by the spirit and scope of the following claims:

1. A compound leverage, toggle operated plier comprising: a first handle member including a first gripping jaw, a jaw member pivoted on said handle member and including a second gripping jaw opposed to and movable toward the first gripping jaw upon pivotal movement of the jaw member, a second handle member, means rotatably and movably mounting one end of said second handle member on the first handle member for movement of said one end along a linear path with respect to the first handle member, means rotatably and movably mounting said one end of the second handle member on said jaw member for movement of said one end of the second handle member along a linear path in a direction to move said second gripping jaw toward the first gripping jaw upon movement of the handle members together.

2. A toggle operated plier comprising: a first handle member formed with a first gripping jaw at one end, an arm pivot at one end to an intermediate point of said first handle member and forming at said intermediate point a second gripping jaw opposed to and movable toward the first jaw upon pivotal movement of the arm, a second handle member, means mounting one end of said second
handle member on said first handle member and arm for rotation about an axis passing through said one end of the second handle member parallel to the pivotal axis of the arm and for movement along a first linear path with respect to the first handle member and movement along a second linear path with respect to the arm, said paths being relatively inclined, and toggle means connected between the handle members for moving said one end of the second handle member along said first path in a direction to move said arm and second gripping jaw toward the first gripping jaw upon movement of the handle members together.

5. A compound leverage, toggle operated plier comprising: a first handle member formed with a first gripping jaw at one end, an arm pivoted at one end to an intermediate point of the first handle member and formed at its other end with a second gripping jaw opposed to and movable toward the first gripping jaw upon pivotal movement of the arm, the arm and first handle member being laterally spaced adjacent their jaws, a second handle member having one end positioned between the arm and second handle member, said one end of said second handle member carrying a transverse pin, linear guide means in said arm and first handle member for rotatably and slidably receiving opposite ends of said pin, said guide means being relatively inclined in a manner to cause said second gripping jaw to be cammed toward the first gripping jaw upon movement of said pin in one direction along the guide means in said first handle member, and means connected between the handle members for moving the pin in said one direction upon pivotal movement of second handle member toward the first handle member about said pin as an axis.

4. The subject matter of claim 3 wherein said guide means comprises a slot formed in each of said arm and first handle member, said slots having ends adjacent the jaws and ends remote from the jaws, said slots being inclined toward the jaws of their respective parts in the direction of said adjacent ends thereof.

5. A compound leverage, toggle operated plier comprising: a first handle member formed with a first gripping jaw at one end, an arm pivoted at one end to said handle member and formed at its other end with a second gripping jaw opposed to and movable toward the first gripping jaw by pivotal movement of the arm, said arm and first handle member having laterally spaced, overlying portions adjacent said jaws, said overlying portions having linear, overlying slots formed therein, said slots having ends adjacent the jaws and ends remote from the jaws, said slots inclining toward the jaw on their respective parts in the direction of said adjacent ends, a second handle member having one end positioned between said arm and first handle member and carrying a transverse pin having opposite ends rotatably and slidably guided in said slots, and toggle means comprising a toggle link having one end pivoted to the first handle member and the other end pivoted to the second handle member at a point nearer said jaws than the pivot at one end of the link.

6. A compound leverage toggle operated plier comprising: a first handle having a gripping jaw at one end, an arm pivoted at one end to an intermediate point of said handle and formed at its opposite end with a jaw opposite to and cooperative with said first mentioned jaw, said handle and arm being formed with relatively inclined, overlying cam slots, a second handle having a pivot carried by the forward end portion thereof, said forward end portion of the second handle being positioned between said arm and first handle member, said pivot projecting beyond opposite sides of said end portion of the second handle and extending slideably and rotatably into said cam slots, said pivot being movable along the slot in said first handle to cam said jaw carrying arm toward or away from said first handle, a toggle link pivotally connected at one end to an intermediate point of said second handle and at its opposite end to said first handle, so that said second handle is movable toward and from said first handle by fulcrum action on said first handle and toggle straightening action occurs in the toggle formed by said toggle link and the portion of said second handle between the point of said fulcrum action and said intermediate point of said second handle to cause said movement of said pivot along said slot in the first handle.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Invented By</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>449,627</td>
<td>McNair</td>
<td>Mar. 31, 1891</td>
</tr>
<tr>
<td>1,010,479</td>
<td>Collison et al.</td>
<td>Dec. 5, 1911</td>
</tr>
<tr>
<td>1,499,186</td>
<td>Murphy</td>
<td>June 24, 1924</td>
</tr>
<tr>
<td>1,717,726</td>
<td>McGill</td>
<td>June 18, 1929</td>
</tr>
<tr>
<td>2,312,947</td>
<td>Westman</td>
<td>Mar. 2, 1943</td>
</tr>
<tr>
<td>2,366,015</td>
<td>Fischer</td>
<td>Dec. 26, 1944</td>
</tr>
<tr>
<td>2,465,721</td>
<td>Spencer</td>
<td>Mar. 6, 1949</td>
</tr>
<tr>
<td>2,600,512</td>
<td>Mead</td>
<td>June 17, 1952</td>
</tr>
</tbody>
</table>