TOGGLE CLAMP HAVING A LOCK MECHANISM ENGAGEABLE
AS AN OVER-CENTER POSITION IS APPROACHED

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This invention relates to a toggle-type of work engaging clamp device. An important object of the present invention is to provide a toggle locking type of clamp which is adjustable so as to automatically lock the clamping jaws thereof in a work engaging position for holding workpieces or objects of different sizes. An additional object of the present invention is to provide a toggle locking clamp device which is operative to rapidly engage an object to be clamped between the jaws thereof and then more slowly clamp the object with an increasing force until the jaws are locked in their clamped position. In accordance with the foregoing objects, the clamp device of the present invention features a yieldable link element by means of which the jaw members are rapidly engaged with a workpiece or object after which an increasing clamping force is applied until the jaw members are locked in their clamping position. Also, the clamping device features a clamp regulating lock mechanism which is engaged to render one of the jaw members rigid with one of the toggle locking handles as the toggle arms of the handles approach an over-center locking position. The locking mechanism is therefore held released by an adjustable cam mechanism by means of which the point at which locking occurs may be preadjusted in order to accommodate objects of different hardness or compressibility. These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein in like numerals refer to like parts throughout, and in which:

FIGURE 1 is a top plan view of the clamp device of the present invention.
FIGURE 2 is a side elevational view of the clamp device shown in a closed condition.
FIGURE 3 is a side elevational view of the clamp device shown in an open condition.
FIGURE 4 is an enlarged partial side sectional view of the clamp device in its open condition.
FIGURE 5 is a partial side sectional view of the clamp device in a working engaging condition.
FIGURE 6 is a partial side sectional view of the clamp device just prior to locking thereof in its working clamping condition.
FIGURE 7 is a sectional view taken substantially through a plane indicated by section line 7--7 in FIGURE 6.
FIGURE 8 is a sectional view taken substantially through a plane indicated by section line 8--8 in FIGURE 6.
FIGURE 9 is a perspective view of a rigid link member forming part of the clamp device.

Referring now to the drawings in detail and initially to FIGURES 1 through 3, it will be observed that the clamping device generally denoted by reference numeral 10 includes a pair of jaw members 12 and 14 which are connected to a toggle locking handle assembly generally referred to by reference numeral 16. Each of the jaw members pivotally mounts at the ends thereof, remote from the handle assembly, work engaging pads 18 and 20. When released, the jaw members are biased to an open position as illustrated in FIGURE 3. The jaw members may also be locked in a closed position as illustrated in FIGURE 2 by the handle assembly. The handle assembly includes a pair of handle members 22 and 24 as more clearly shown in FIGURES 6 and 7. The handle members extend generally parallel to each other when the jaw members are in the closed position illustrated in FIGURE 2 and diverge from each other as illustrated in FIGURE 3 when the jaw members are in the open position. As more clearly shown in FIGURES 6 and 7, the handle member 22 includes a toggle arm portion formed by a pair of laterally extending parallel spaced sides 26 which are interconnected by a link pin 28 to which the jaw member 12 is pivotally connected. The jaw member 12 is therefore provided with a pair of parallel spaced end portions 30 having aligned apertures through which the link pin 28 extends, said end portions 30 being received between the toggle arm sides 26 of the handle member 22 and including laterally extending projections 32 by means of which the handle assembly is released from its toggle locking condition as will hereafter be further explained. The other handle member 24 is also provided with a toggle arm portion formed by the sides 34 between which a second toggle link pin 36 is secured. The toggle arm portion of the handle member 24 is pivotally connected by the toggle joint pin 38 to the sides 26 of the toggle arm portion of handle member 22. Accordingly, the sides 26 of the toggle arm of handle member 22 have laterally widened portions 40 which straddle the sides 34 so that the toggle joint pin 38 may pivotally interconnect the handle members. The jaw members 12 and 14 are pivotally interconnected in spaced relation to the toggle joint pin 38 by means of the jaw pivot pin 42. While the jaw member 12 is directly pivotally connected to the handle member 22 by the link pin 28, the other jaw member 14 is connected to the handle member 24 by a pair of parallel spaced link elements 44 which form a rigid link connection between the jaw pivot pin 42 and the link pin 36 carried by the handle member 24. Accordingly, as more clearly shown in FIGURE 9, the rigid link elements are provided with apertures 46 and 48 for respectively receiving the jaw pivot pin 42 and the link pin 36. Also formed along one edge of the link elements 44, are laterally extending projections 50 by means of which the handle assembly may be released from its over-center locking position as will hereafter be explained. When the handle assembly is unlocked, as shown in FIGURE 3, the jaw members are moved to the open position illustrated by means of a jaw opening spring 52 the opposite ends of which are connected to the jaw members 12 and 14 between the toggle joint pin 38 and the jaw pivot pin 42. When the handle members 22 and 24 are pivotally displaced toward each other from the positions illustrated in FIGURE 3 to the positions illustrated in FIGURE 2, they will cause pivotal displacement of the jaw members about the jaw pivot pin 42 and against the bias of the spring 52 in order to bring the working engaging pads 18 and 20 toward each other. Inasmuch as the handle member 24 is connected to the jaw pivot pin 42 through the rigid link elements 44, pivotal displacement of the handle members toward each other will cause the jaw members to be pivotally displaced about the jaw pivot pin 42 only because of the constraint of yieldable link means 54 which in the illustrated embodiment of the invention is in the form of a relatively stiff tension spring. The opposite ends of the yieldable link spring 54 are therefore pivotally connected.
to the handle member 22 by means of the anchor pin 56 and to the jaw member 14 by means of the anchor pin 58. It will therefore be apparent, that as the handle members are pivotally disposed toward each other, the jaw members will move the work engaging pads into engagement with an object 60 for example, as illustrated in FIGURE 5, before any deformation of the yieldable link spring 54 occurs. Thereafter, continued displacement of the handle members toward each other will cause extension of the yieldable link spring 54 inasmuch as further pivotal movement of the jaw members will be resisted by the object 60. The extension of the yieldable link spring 54 will thereby permit clamping of objects of different thickness and allow movement of the jaw members until they are locked in their clamping positions. When the handle members displace the toggle joint pivot 38 to an over-center locking position just past the center line which joins the toggle link pins 28 and 36. In this over-center locking condition of the handle assembly, the projections 32 and 50 will be engaged by the laterally extending projections 62 and 64 formed on a release handle 66 to prevent further movement of the handle members toward each other. The release handle 66 is therefore pivotally mounted on the toggle joint pivot 38 and extends rearwardly therefrom between the handle members 22 and 24. It will therefore also be apparent, that release of the handle assembly from its over-center locked condition, may be effected by pivotal displacement of the release handle 66 toward either the first or the second 24 in which case either projection 62 or projection 64 cam the toggle arm portions of the handles and the toggle joint pivot 38 rearwardly away from the jaw pivot pin 42 in order to unlock the handle assembly.

A clamp regulating lock mechanism 68 is provided as more clearly seen in FIGURES 4 through 6, whereby the link element 44 may be directly coupled to the jaw member 14 in order to form a rigid link therewith as the toggle joint pin 38 approaches the over-center locking position. The lock mechanism includes a pawl element 70 one end of which is engageable with ratchet teeth 72 formed on an adjacent rear portion of the jaw member 14. The pawl element 70 is pivotally mounted on the link pin 36 between the end portion of the rigid link elements 44 through which the link pin extends. The rigid link elements are provided with a laterally extending portion 74 having aligned apertures 76 through which a pivot pin 78 extends for pivotally mounting thereon, a lock releasing cam element 80. The pawl element 70 is normally biased into engagement with the ratchet teeth 72 by the pawl spring 76 in order to form a rigid coupling between the link pin 36 and the jaw member 14 only when force is being transmitted in one direction from the handle member to the jaw member. Accordingly, during final movement of the handle members relative toward each other as the toggle joint pivot 38 approaches the over-center locking position, force is directly applied by the handle member 24 to the clamping jaw 14 in order to apply the final clamping force to the object being held between the pads. The point at which the pawl element 70 is permitted to engage the ratchet teeth 72 may therefore be adjusted so as to accommodate objects of different hardness which differently limit the pivotal closing stroke of the jaw members.

The handle member 24 is therefore provided with an adjustable element 84 rotatably mounting at one end follower roller 86 engageable with the cam surface 88 on the lock releasing cam element 80. Accordingly, as shown in FIGURES 4 and 5, the follower roller 86 engages the cam surface 88 on the cam element 80 so as to position the end stop portion 90 thereon in the path of a stop lug 92 which projects from the pawl element 70 in order to hold the engagement element out of engagement with the ratchet teeth against the bias of the pawl spring 82. Inasmuch as the cam element 80 is pivotally mounted by the rigid link elements 44, pivotal movement of the handle mem-

From the foregoing description, the construction, operation and utility of the clamp device of the present invention will be apparent. Objects of different sizes may therefore be clamped by the pads 18 and 20 on the ends of the jaw members 12 and 14 when the handle members 22 and 24 are displaced thereby. The jaw members 22 and 24 are inter-connected by clamping the jaw members by the yieldable link spring 54 against the bias of the pawl spring 82 which is therefore pivotally mounted by the pivot pin 94 securing the handle member 24. An adjustment of the jaw member 96 is thereby received within a nut element 98 connected to the adjust-

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A clamping device comprising, a pair of work engaging jaws, a jaw pivot interconnecting said jaws, a clamp opening spring interconnecting said jaws, a pair of handles having toggle link pins secured thereto, a toggle joint pivotally interconnecting said handles between the link pins, one of said jaws being pivotally connected to one of the handles by the link pin thereon, a rigid link member pivotally connected between the link pin of the
other of said handles and the jaw pivot, yieldable link means interconnected between the other of said jaws and said one of the handles for resisting displacement of the toggle joint toward an over-center position between the link pins after the jaws engage a workpiece, clamp regulating lock means mounted on the link member for rigid interconnection thereof to the other of said jaws after engagement of the workpiece and clamp adjusting release means mounted on link member and the other of said handles for holding the lock means disengaged until the toggle joint approaches said over-center position.

2. The combination of claim 1 wherein said lock means comprises a pawl pivotally mounted on the link pin of said other of the handles, ratchet teeth formed on the other of said jaws for engagement by the pawl and means biasing the pawl into engagement with said ratchet teeth.

3. The combination of claim 2 wherein said release means comprises, a cam element pivotally mounted on the link member and having a stop portion engageable with the pawl to prevent engagement thereof with the ratchet teeth, and a follower element mounted on the other of said handles and engageable with the cam element for effecting pivot displacement of the stop portion out of engagement with the pawl.

4. The combination of claim 1 wherein said release means comprises, a cam element pivotally mounted on the link member and having a stop portion engageable with the pawl to prevent engagement thereof with the ratchet teeth, and a follower element mounted on the other of said handles and engageable with the cam element for effecting pivot displacement of the stop portion out of engagement with the pawl.

5. A clamping device comprising a pair of pivotally interconnected jaws, means biasing said jaws to an open position, handle means, toggle means interconnecting said handle means with the jaws for locking the jaws in a clamping position, yieldable link means operatively connecting the handle means with one of the jaws for resisting displacement of the toggle means to an over-center position wherein the jaws are locked in the clamping position, clamp regulating means responsive to approach of the toggle means to said over-center position for rigidly connecting the handle means to the other of the jaws, and adjustment means mounted on the handle means and operatively connected to said clamp regulating means for varying the distance from the over-center position at which the handle means is rigidly connected to the other of the jaws, whereby workpieces of different hardness may be clamped between the jaws.

6. In a clamping device, a pair of work engaging jaws, a jaw pivot interconnecting said jaws, a pair of handles having toggle link pins secured thereto, a toggle joint pivotally interconnecting said handles between the link pins, one of said jaws being pivotally connected to one of the handles by the link pin thereon, a rigid link member pivotally connected between the link pin of the other of said handles and the jaw pivot, yieldable link means interconnected between the other of said jaws and said one of the handles for resisting displacement of the toggle joint toward an over-center position between the link pins in response to engagement of an object between the jaws, and clamp regulating means for rigidly connecting the rigid link member to the other of said jaws following elongation of the yieldable link means.

7. The combination of claim 6 including adjusting means operatively connected to the clamp regulating means for initiating operation of the clamp regulating means prior to arrival of the toggle joint at said over-center position.

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