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2,743,634

FLEXIBLE TOGGLE LINK ACTUATED CRIMPING TOOL

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Fig. 1.

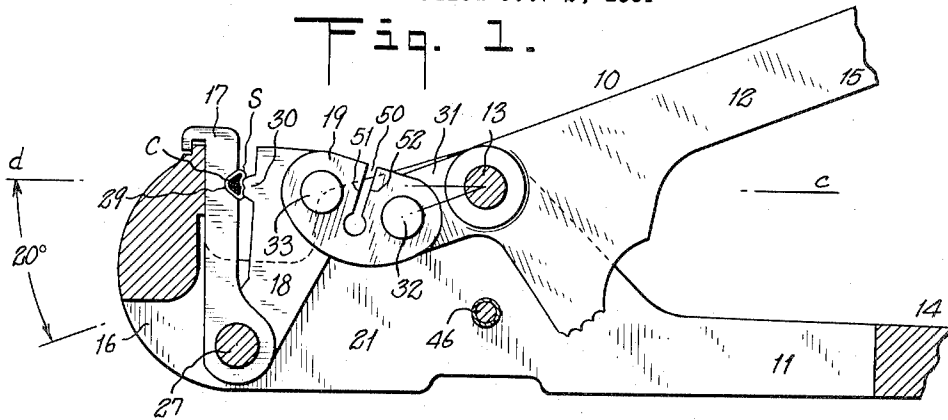


Fig. 2.

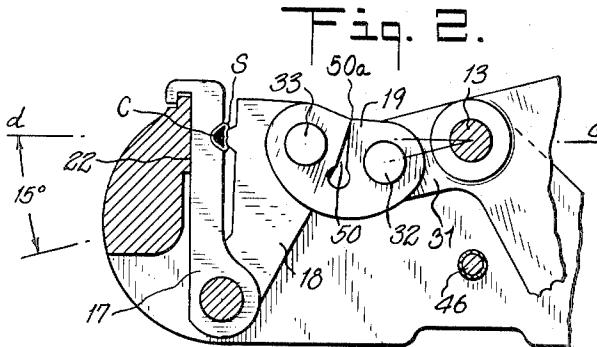


Fig. 3.

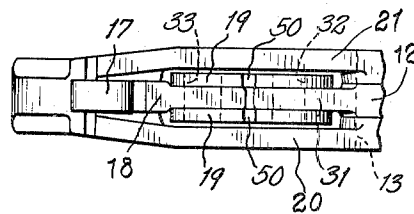
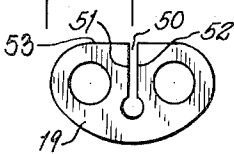
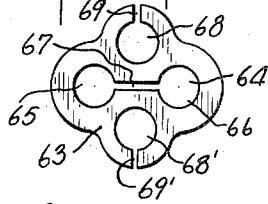


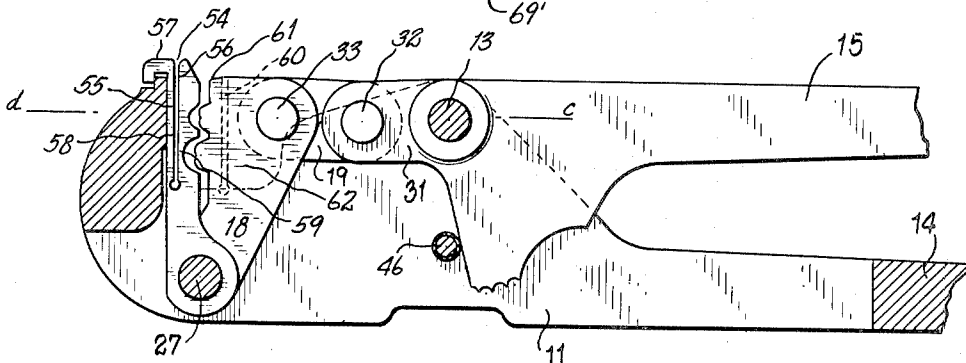
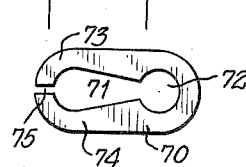
Fig. 4.



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2,743,634

FLEXIBLE TOGGLE LINK ACTUATED CRIMPING TOOL

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6 Claims. (Cl. 81—15)

The invention relates to a crimping tool of the pliers type particularly, but not exclusively, designed for use in deforming a small malleable metal sleeve into a crimping engagement with wires within the sleeve for making a durable joint therebetween in forming electric fittings.

The present disclosure relates to an improvement and further development in the power-multiplying toggle features of such tools as disclosed in the co-pending application of Martin D. Bergan, filed herewith, entitled "Crimping Tool, Serial No. 249,309, filed October 2, 1951, now Patent No. 2,696,747. The same reference characters are used in both applications to identify corresponding parts.

In the Bergan patent there is disclosed a squeeze clamp for deforming the sleeve, a shiftable jaw of which clamp is powered from an actuating handle operating through a toggle having equal length arms to attain such mechanical advantage as is inherent in such mechanism, as the toggle reaches its theoretical maximum output. The Bergan application device works satisfactorily provided the available manual force operating the handles is sufficient, when multiplied through the toggle as shown, to overcome the resistance interposed by the sleeve to the squeezing action of the jaws thereon, and provided the resultant output force is sufficient and operates continuously up to the point where the shiftable jaw is able to reach its pre-set point of nearest approach to the fixed jaw as featured in said Bergan application. It is not unusual in this art for the sleeve to resist the closing movement of the jaws during the initial closing movement and thus before the toggle can deliver its maximum output force.

The primary object of the invention is to provide a form of crimping tool featuring a toggle form of mechanical advantage which will make the desired crimp in the sleeve under all normal conditions and thus under conditions where the output force is not sufficient to overcome the resistance interposed by the sleeve during the initial period of the crimping act.

Broadly, this objective is attained by interposing a non-loaded and relatively rigid spring in the chain of power transmitting parts between the actuating handle and the relatively fixed jaw or its backing and which spring will operate when loaded by reason of the resistance to the closing of the jaw to increase automatically the mechanical advantage of the toggle and thus change the toggle ratio sufficiently to utilize the available power to overcome the resistance interposed by the sleeve and thus cause the jaws to effect the desired crimp.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of one form of crimping tool embodying the invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

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In the accompanying drawings,

Fig. 1 is a view taken along the medial central plane of a preferred embodiment of the invention showing the position of the parts at an intermediate state of the crimping operation, slightly closed from their fully open position shown at the time the crimping jaws are beginning to meet an opposition to closing under the force output of the toggle and in its position as shown with the slot of the spring link open and thus with the link having its normal maximum length and unloaded;

Fig. 2 is a similar view with the jaws still in their arrested position with the toggle considered as a whole advanced slightly from its position shown in Fig. 1 towards its final position, with the slot of the link closed and with the link, loaded and in position to be advanced slightly therefrom to its final position of nearest approach to the fixed jaw;

Fig. 3 is a plan view looking down on the left end of Fig. 1;

Fig. 4 is a view of the slotted link shown in the preceding figures in its normal unloaded condition as in Fig. 1;

Figs. 5 and 6 are views of modified forms of the link shown in Fig. 4; and

Fig. 7 is a view similar to Figs. 1 and 2 of a modified form of tool with the toggle in its dead center position, with a solid form of link, and showing in full lines a slotted form of the die forming the fixed jaw, and showing in dotted lines a slotted form of shiftable die jaw.

In the drawings there is shown a crimping tool 10 of the pliers type used to crimp a metal sleeve S onto wire conductors C therein. The tool includes a long main body, frame or relatively stationary member 11 and a long lever 12 pivotally connected to the member 11 at pivot pin 13 and with member and lever provided with extensions forming, respectively, a lower handle 14 and an upper handle 15 normally disposed in parallel relation as shown in Fig. 7. An upturned solid end 16 of member 11 forms a rugged seat or backing for receiving in abutting relation thereto a replaceable die element 17 forming the relatively fixed jaw of a squeeze clamp.

A rockable link 18 pivoted to the member 11 forms a coacting die and the relatively shiftable jaw of the clamp. The shiftable jaw 18 is connected to lever 12 by a pair of short connecting links 19 which form with a short end of the lever a toggle connection providing a mechanical advantage to the system. The portion of the member 11 between the end 16 and the handle 14 is slotted as shown in Fig. 3 and provides a pair of cheek plates 20 and 21 between which cheek plates the jaw 18 and the links 19 are contained.

The upturned end 16 is provided on its inner side with an upstanding flat face 22 against which abuts the die element 17. An anchoring pin 27 secures die 17 in place and forms a fulcrum about which rocks the shiftable jaw 18.

While it is usual to provide the jaws of a crimping tool with a plurality of matching nests and coacting indentors, only one is shown in the accompanying drawing as being sufficient to disclose any one of a plurality of crimping steps. For this purpose the fixed jaw is provided with a depression or nest 29 and the shiftable jaw is provided with an indenter 30 between which the assembly of sleeve and conductors to be crimped is inserted.

The lever 12 is fulcrumed intermediate its ends and quite close to the links 19 and has a long arm which forms the upper handle 15, and a very short toggle element forming arm 31 which projects from the pin 13 towards the shiftable jaw. The links 19 are in pairs on opposite sides of the arm 31 and the jaw 18. One end

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of the pair of links is pivoted to the short arm 31 by a dowel pin 32 and the other end of the links is pivoted to the shiftable jaw 18 by a pivot pin 33.

The shiftable jaw 18 has two limiting positions (neither of which is shown), one a fully open position at the beginning of its operative stroke and a position of nearest approach to but spaced slightly from the fixed jaw and spaced an exact factory-pre-set distance from the fixed jaw when the toggle has reached its dead center position.

The pins 33, 32 and 23 are shown in their positions of being in substantially a dead center alignment on the line *d-c* as shown in Fig. 7 at the time when the jaws are in a desired preferred spaced-apart relation controlled by the length of the connecting links.

Up to this point the disclosure is exactly as described for the showing in the above-identified Bergan application, with its fixed length of links.

The particular feature of novelty in this disclosure as illustrated in Figs. 1-4 is that each of the links 19 is provided with a slot 50 extending transversely of the link adjacent its mid-length, and each outlined by a pair of parallel spaced-apart walls 51, 52 extending inwardly from its top edge 53. The pair of links so slotted operate to form collectively a spring steel plate normally rigid and thus each resistant to collapsing in its own plane under relatively high load, but capable of collapsing each in its flatwise dimension under extremely high load to a new and fixed length slightly shorter than the normal length, and thus capable of modifying the toggle ratio to obtain with the less length of connecting link a more powerful toggle action than would be possible if the links were not so shortened under excessive load.

In other words, the distance measured between the axis of the pins 32 and 33 is slightly shorter in Fig. 2 than in Fig. 1 by an amount approximately one-half of the width of the slot 50.

In operation and assuming a stock assembly of a sleeve S with wire conductors C therein is located in the nest 29 and at which time the sleeve is of tubular and usually cylindrical form, the device is ready for operation. Bringing the handles together causes the indenter 30 in succession; first to engage and then to push in the adjacent side of the sleeve and thus to deform the same, as in usual in the crimping art. During this initial squeezing operation the links 19 function as do solid links, and this condition of the links continues so long as the power output of the toggle mechanism is sufficient to overcome any resistance which may be interposed by the sleeve in its resistance to becoming further deformed.

In further explanation let it be assumed that at some point in the advance of the shiftable jaw 18, say, at the point shown in Fig. 1, the power output of the toggle 31-19 is not sufficient to overcome the resistance of the sleeve S at this instant, but is sufficient to overcome the resistance of the links to become deformed. At this point the short arm 31 of the lever 12, and with it the pin 32, continues to move clockwise, that is, upwardly in the showing of Fig. 1, while the shiftable jaw and with it the pin 33 is held from further advance by the partly crimped sleeve S. Eventually, with the continued and very much restrained action of the lever the walls 51, 52 angle inwardly and close the outer end of the slot until the walls contact at their outer edges to form an inter-bearing point 50a, and thus the link along its upper portion becomes in effect a solid that is, a non-yielding, non-collapsible link of slightly shorter all-over length than originally. With the links 19 thus shortened, even though slightly, the power effect of the toggle is improved and in the case illustrated the toggle can then move into or at least practically into its dead center position and thus into a position capable of delivering to the shiftable jaw its maximum possible power output.

The final crimping action is had by a slight further advance of the actuating handle 15 beyond the position of the parts as shown in Fig. 2 and until the desired pre-

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set degree of crimping deformation of the sleeve S has been attained, as more fully defined in the companion Bergan application.

For a more detailed explanation of the toggle action of the illustrated device, it is recalled that in the case of a toggle joint of equal length arms the multiplier used to determine the resulting maximum force is the coefficient of the angle at any instant of time multiplied by the in-put power acting on the lever. Let us assume in the case illustrated that the in-put at the handles is fifty pounds and with the toggle at, say, twenty degrees as in Fig. 1, a resultant force of, perhaps, 1000 pounds is being delivered to the shiftable jaw 18. Let it be assumed, however, that this 1000 pounds is not sufficient to further deform the sleeve, and which further deformation we will say requires a squeeze force of 1200 pounds. This situation often occurs in crimping operations and the operator is quite apt to assume that the crimp has been completed when he can close the handles no further.

Let it be further assumed in the instant case that the spring links 19 are designed so that they will deflect towards their condition as shown in Fig. 2 at a force of about 800 pounds. As the width of the slot at its outer end progressively decreases under the 1000 pounds load, there is a resultant decrease in the center-to-center distance between the axes of the pins 32, 33, and the original toggle link of equal length arms becomes a toggle line of unequal length of arms, and in this way the handle 15 can be forced down towards the handle 14 an additional number of degrees, say, five or more degrees as exemplified in Fig. 2. The pin 32 forming the knee of the toggle can be moved nearer to the dead center line *c-d* than before and the angle of twenty degrees in Fig. 1 decreases to, say, fifteen degrees in Fig. 2. Of course, as the toggle begins to straighten out by reason of its momentarily overcoming the initial resistance interposed by the sleeve, enormously powerful squeeze forces approaching a ton or more are developed as the final squeeze force. In this way a crimping tool having a specific and limited input force can by the use of spring links in its chain of toggle parts as herein disclosed overcome a specific resistance to the closing movement of its squeeze jaws in a way not possible with conventional forms of such tools wherein the toggle parts have arms of fixed lengths, as in the aforesaid Bergan patent.

Releasing the lever pressure permits the inherent resiliency of the links 19 to restore themselves to their original normal distended position as shown in Figs. 1 and 4, and the continued lifting of the handle 15 breaks the toggle joint, separates the shiftable jaw from the fixed jaw, and thus the crimped fitting can be removed from the tool. With the tool restored to its fully open position it is again ready to receive a new stock assembly.

As the intent in all the cases illustrated is to give the toggle a little more freedom of movement close to its dead center line position than is possible with conventional forms of rigid arm toggles, it is possible to obtain this result otherwise than by following the preferred scheme of slotting the toggle link. For instance, and referring to the modified form of the invention shown in Fig. 7, it will be seen that substantially the same effect as was produced by a slotted link in the toggle may be obtained by similarly slotting either the fixed or the shiftable die, or both, in planes spaced from and parallel to the general direction of the work-engaging face of the die so slotted.

For this purpose the die 17 shown at the left of Fig. 7 is provided with a narrow slot 54 extending transversely through the die from edge to edge. The slot is outlined by parallel, closely related, transversely-extending walls 55, 56 extending inwardly from the upper edge 57 for the full length of the associated work face with its series of nests. The die 17 thus forms a pair of rigid, upstanding spring plates 58, 59, with the plate 59 capable of bending at its root end resiliently towards the fixed

plate 58, in the event the output from the toggle as it approaches its dead center position is not sufficient prior to the bending of the plate to overcome the resistance offered by a sleeve for the moment located between the work faces of the jaws of the clamp. Even the slight give provided by the slot in closing at its upper end exactly as described for the slot 50 permits the knee 32 of the toggle to approach the dead center line *c-d* a little more than would be possible if the slot 54 were not present, and thus the toggle is capable of exerting a more powerful thrust on the shiftable jaw than would be the case if the die 17 were solid as in the Figs. 1-3 showing.

Also, in Fig. 7 the shiftable jaw 18 is provided with a slot 60 shown in dotted lines formed identically as is the slot 54 and similarly forming a shiftable indenter plate 61 and a rigid backing plate 62 forming the balance of the shiftable jaw. This form with its slotted shiftable jaw operates in identically the same way as does the slotted fixed jaw and is correspondingly operative in closing to permit the solid link toggle to approach its dead-center position when the indenter plate 61 of the jaw is momentarily stopped from further advance by a sleeve between the jaws.

Ordinarily, only one of the jaws, either the fixed jaw 17 or the shiftable jaw 18, is slotted as shown in Fig. 7, but it is suggested that both may be slotted in those cases where a material advance of the work faces towards each other is desired after the sleeve therebetween begins to demonstrate its resistance to further crimping, and it is suggested that the slot 60 may be wider than the slot 54 and in this way effect a progressive give to the resistances interposed by the sleeve to the squeezing effect thereon.

Figs. 4 and 5 are forms of links different from the preferred and simplest form shown in Figs. 1-3, and which have been substituted therefor in the tool illustrated in Figs. 1 and 2 in different physical embodiments of the invention.

Fig. 5 shows a four-eyed link 63 of four-leaf clover form provided with four pivot holes 64, any opposing two of which may receive the pins 32 and 33. Two of the holes 65, 66 are connected by a kerf 67. At opposite edges of the link 63 kerfs 69 and 69' lead, respectively, to the other two holes 68 and 68'.

Fig. 6 shows an elongated form of link 70 provided with an opening 71 therethrough of key-hole form having a circular recess 72 at one end and with the other end of bifurcated form with the two sides 73, 74 separated by a narrow cut 75.

In so far as the present disclosure is concerned, it may be assumed that the links of Figs. 5 and 6 operate as do the links of the form shown in Fig. 4.

While the invention has been described in connection with a manually operated type of pliers tool, it is obviously within the scope of the disclosure to operate the toggle by mechanical power and, of course, in this case the dies need to be carried on pivotally related jaws, but the shiftable die may approach the fixed die along a straight line in a compressive machine.

In both forms of the invention the part 16 may be considered as a frame, the lever 12 may be considered as a source of power, and the elements between the source and the frame, to-wit, the toggle 31-19, the shiftable die 18 and the fixed die 17, may be considered as a chain of squeeze pressure transmitting elements, one of which, either the links 19, the die 18 or the die 17, is slotted across the line of squeeze force to provide the U-spring herein featured.

I claim:

1. A crimping tool including a body portion provided at one end with a fixed jaw and its other end forming a handle, a coacting shiftable jaw pivoted to the body portion, a lever pivoted to the body portion and comprising a short arm and a long arm forming a handle, 75

a link pivoted at one end to the short arm and at its other end to the shiftable jaw to move the same to and from the fixed jaw, said short arm and the link coacting to form a toggle operative to move the shiftable jaw to a position of nearest approach close to but spaced slightly from the fixed jaw as the toggle reaches a dead-center position, said link being slotted in the part thereof between the shiftable jaw and the short arm, forming a normally unloaded U-shaped spring operable when deformed under load by the further advance of the short arm in turning slightly towards its dead center position after the shiftable jaw has been restrained from movement towards the fixed jaw by reason of the resistance interposed thereto by an object located between the jaws to permit the toggle as it approaches its final position to exert a squeeze effect capable of moving the shiftable jaw to its position of nearest approach against the resistance interposed by the object.

2. A crimping tool including a fixed die element and a shiftable die element, a toggle for actuating the shiftable die element, said toggle including a work arm and a normally rigid link pivoted at one end to the shiftable die element and at its other end pivoted to the arm, said link in the part thereof between its pivotal connections with the die element and arm being slotted to form a spring link capable of shortening the normal distance between its pivotal connections when the shiftable die element is restrained from further movement and the toggle continues to move towards its dead center position.

3. A toggle including a flat steel link, pivots at its opposite ends connecting the link to the adjacent elements of the toggle, said link capable of transmitting squeeze pressures therethrough in the plane of the link, and said link in the portion thereof between its pivots being slotted inwardly from one edge to form a narrow slot normally open at its outer end and capable of closing at its outer end when forces capable of doing so cause the pivots to approach each other.

4. A toggle one of whose component elements is normally rigid and is slotted to provide a normally open slot extending across the line of force in said element and said slot being collapsible towards a closed position under forces acting through the element capable of deforming the same to effect such closing of the slot.

5. A mechanical movement including a shiftable work element, a toggle for actuating said element, said toggle including a work arm and a link of spring steel pivoted at one end to the work element and at its other end pivoted to the work arm, said link in the part thereof between its pivotal connection with the work element and the arm being slotted inwardly from one of its edges to form the link as a U-spring.

6. In a crimping tool including two jaws operative to squeeze an article therebetween, a chain of connected parts including a toggle for moving the jaws towards each other, one of the parts being slotted to form of it a U-spring with the slot normally open, said toggle operative in a timed relation to the closing of the jaws to close the slot and thus make the slotted part rigid by reason of the resistance imposed by the article to a further closing of the jaws when the toggle is in position close to but spaced from its fully distended portion, and said toggle operative in moving more fully into its fully distended position to transmit power to the jaws to more fully close the same.

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