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**CRIMPING TOOL**

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The present invention relates to crimping tools, and more specifically relates to a hand tool for crimping, particularly for necking or reducing the diameter of metal ferrules or the like.

There are known and available a number of crimping tools for reducing the diameter of, or necking, metal ferrules. For the most part, such tools are cumbersome and complex, relying largely upon cam or vise type operating linkages, and usually employing large castings for strength and mechanical advantage. Effectively, many of these prior art tools are useful only as bench installations. The crimping tool of the present invention, on the other hand, is small and compact, easily portable as any conventional hand tool, and readily and economically fabricated from simple metal stampings. Further, the present crimping tool is constructed basically upon a scissors type of linkage. Although scissors type crimping tools are also broadly known, they usually suffer from the defect that inherently in their operation they tend to pinch a portion of the ferrule being crimped, and thereby form a ridge on the ferrule running axially thereof.

It is accordingly one object of the present invention to provide a hand crimping tool for reducing the size of or necking metal ferrules, or the like.

Another object of the present invention is to provide such a crimping tool based upon a scissors type linkage.

Another object of the present invention is to provide such a crimping tool which will not pinch the ferrule in operation.

Still another object of the present invention is to provide such a crimping tool which may be readily fabricated from metal stampings.

Other objects and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description of one exemplary embodiment of the present invention, had in conjunction with the accompanying drawings, in which like numerals refer to like or corresponding parts, and wherein:

Fig. 1 is a plan view of the crimping tool of the present invention, wherein the tool is shown open and in condition to receive between its jaws a ferrule to be crimped;

Fig. 2 is a side or edge view of the tool of Fig. 1;

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a cross-sectional view taken along the line 4—4 of Fig. 1;

Figs. 5 and 6 are enlarged plan views of the jaw portion of the tool, showing the operation of the tool in successive stages of closing;

Fig. 7 is a view similar to Figs. 5 and 6, showing the tool completely closed;

Fig. 8 is a cross-sectional view taken along the line 8—8 of Fig. 7, with the addition of a ferrule shown crimped on a tube by the jaws of the tool; and

Fig. 9 is a plan view of a ferrule crimped on a tube, as effected by the tool.

Referring particularly to Fig. 1, the crimping tool of

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the present invention comprises a pair of handles 10, 11, which terminate in outwardly divergent, angularly projecting crank arms 12, 13. Each handle on its inner edge is provided with a lug, lug 14 for handle 10, and lug 15 for handle 11. Lugs 14, 15 function to provide a pivotal connection between the handles 10 and 11, by receiving therethrough a suitable rivet eyelet, or the like 16. A pair of jaws 20, 21 are pivotally connected at 18 and 19 respectively to crank arms 12, 13, cross each other at 22, and are pivotally connected together at 17 remote from pivots 18 and 19. The crimping bite of the tool is provided by recesses 24, 25 in the jaws.

Each handle, and its associated crank arm and lug, is shown as formed from the lamination of two superposed stampings, 11a and 11b in the case of handle 11, and 10a and 10b in the case of handle 10. These stampings are spaced from each other by the interposition of a spacer stamping 11c for handle 11, and 10c for handle 10, the spacers being located only in the handle portions per se. The laminations and spacer for each handle are all secured together by suitable rivets or the like. It is apparent that more than two spaced laminations for each handle may be used, if desired. Because of the spaced lamination structure, the lug 14 of handle 10 is interleaved with the lug 15 of handle 11 when the handles are pivotally assembled by rivet 16.

Rivets, or the like, 18, 19 pivotally connect jaws 20, 21 to the ends of crank arms 12, 13. As will be described more fully subsequently, the jaws 20, 21 are angularly shaped to cross each other at 22 and to be pivotally connected together by a rivet 17, or the like, at their ends remote from the crank arms 12, 13. The actual crimping surfaces, or bite of the tool, are located between cross over area 22 and pivot 17, and are defined by the opposed recesses 24, 25. Recesses 24 and 25 are herein termed oblate semicircles. By this term it is meant that the base of each recess is semicircular, and that from the ends of the semicircle the recess extends along straight lines corresponding to tangents at the semicircle ends.

When the crank arms are formed of two spaced superposed stampings, as shown, each of the jaws 20, 21 is preferably constructed of three spaced laminations of metal stampings, as indicated at 21a, 21b, and 21c for jaw 21, and at 20a, 20b, and 20c for jaw 20, shown in Figs. 2, 3, and 4. Spacers are also used over a portion of the area of the jaws to separate the laminations thereof: spacer 21d between laminations 21a and 21b, spacer 21e between laminations 21b and 21c, spacer 20d between laminations 20a and 20b, and spacer 20e between laminations 20b and 20c. The jaw spacers extend over only a portion of the area of the jaws, as indicated in Fig. 5, in order that the jaw laminations may be interleaved at 22 and at the pivotal connection 17.

Thus, it will be appreciated that the three laminations of jaw 21 are symmetrically interleaved with the two laminations of crank arm 12, and the three laminations of jaw 20 are similarly symmetrically interleaved with the two laminations of crank arm 13. Since the laminations 11a and 11b of handle 11 are respectively located in planes one lamination thickness lower than the corresponding laminations 10a and 10b of handle 10, the same will be true of the laminations of jaw 20 with respect to the corresponding laminations of jaw 21. Consequently, the jaw laminations readily interleave as they cross one another in the area 22. The nose ends of the jaws at 17 likewise have their laminations interleaved where they come together and are pivotally joined at 17. In addition, in the transition from cross over area 22 to nose pivot 17, the laminations of one jaw are intertwined with respect to the laminations of the other jaw. In other words, at cross over area 22, laminations 21a, 21b, and 21c of jaw 21 are each respectively in a plane