United States Patent

Hoffman et al.

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[45] **Dec. 19, 1972**

[54] **CRIMPING TOOL AND DIE ASSEMBLY**

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

[22] Filed: **May 21, 1970**

[21] Appl. No.: **39,410**

Related U.S. Application Data

[62] Division of Ser. No. 667,461, Sept. 13, 1967, Pat. No. 3,575,036.

[52] **U.S. Cl.**.....**72/402,** 72/410, 29/203 H, 81/309

[51] **Int. Cl.**.....**B21d 41/00**

[58] **Field of Search** ..81/421, 307, 309; 72/410, 409, 72/402; 29/200 H, 203 H, 203 HC, 203 HM, 203 HT, 280, 282

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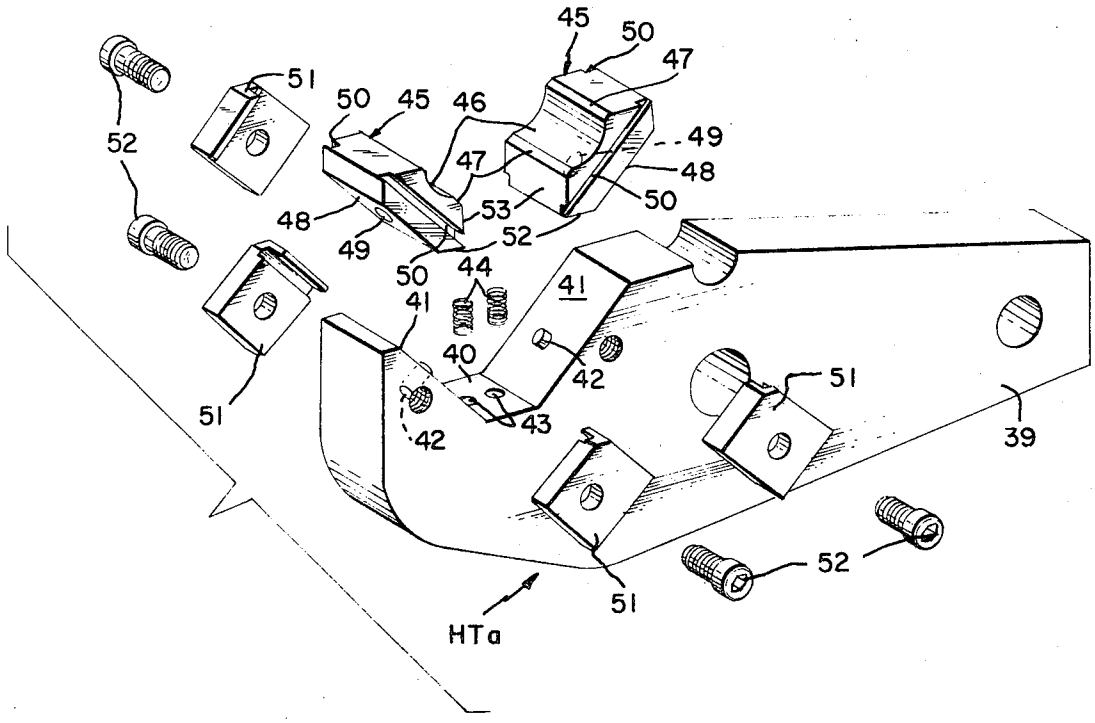
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Assistant Examiner—Michael J. Keenan
Attorney—William J. Keating, Ronald D. Grefe, Gerald K. Kita, Frederick W. Raring, Jay L. Seitchik and John P. Vandenburg

[57] **ABSTRACT**

A die assembly comprises opposed carrier members in which pairs of die members are pivotally mounted so that the pairs of die members are disposed opposite each other. Spring means maintain the pairs of die members in positions so that the crimping areas thereof are directed away from each other in a nonoperating position and the crimping areas are moved toward each other upon interengagement of the pairs of die members to define a crimping configuration to be applied to a ferrule when positioned within the crimping areas.

4 Claims, 10 Drawing Figures



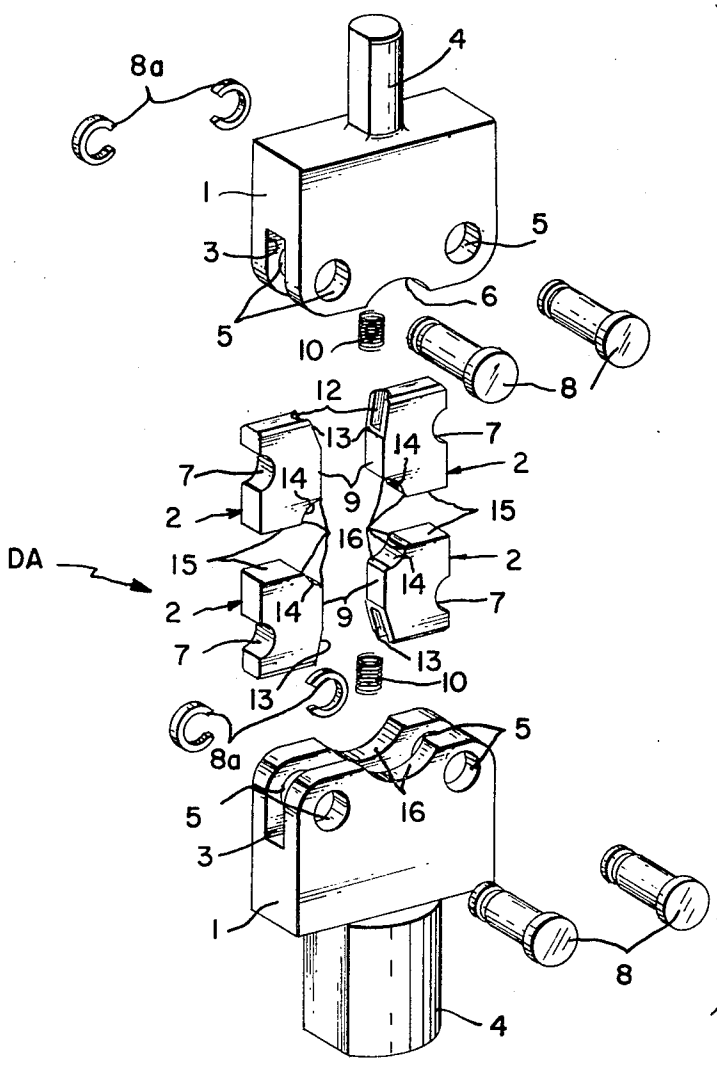


FIG 1

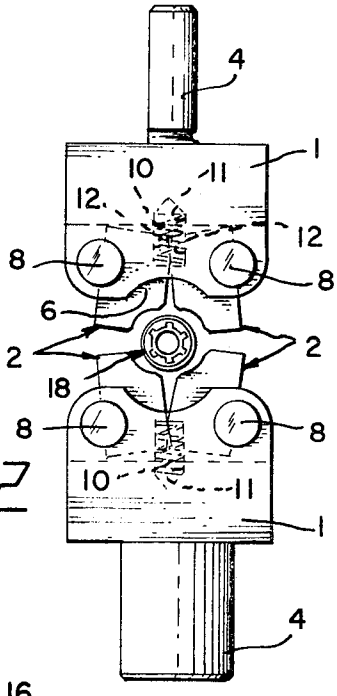


FIG 2

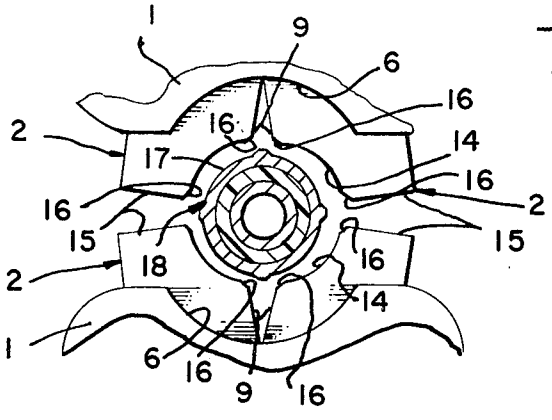


FIG 4

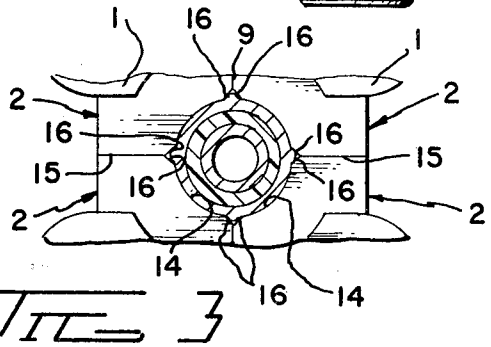


FIG 3

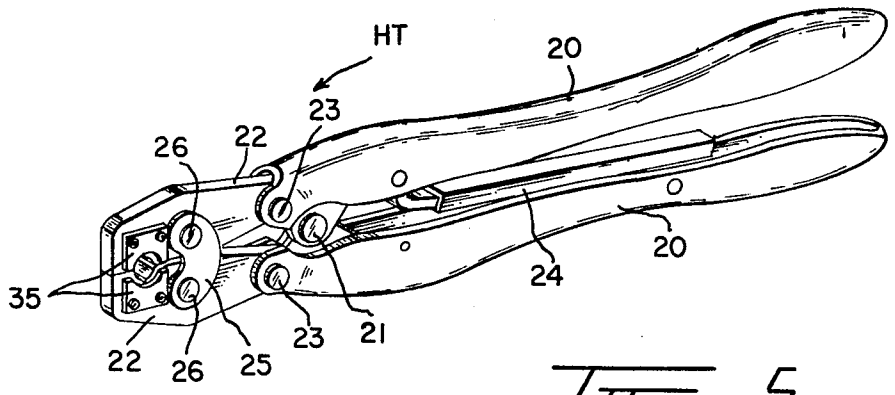

HT
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FIG 5

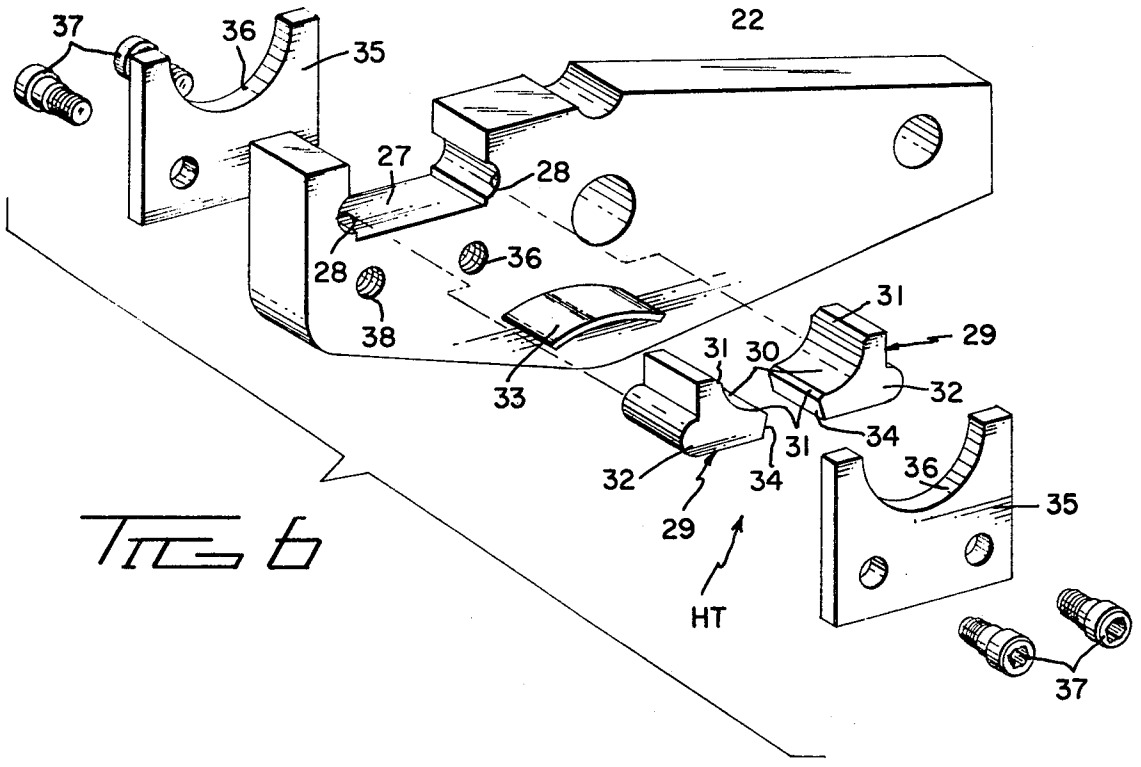

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HT
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FIG 6

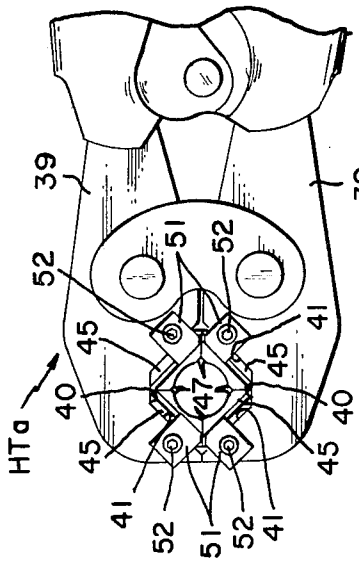

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41
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HTa
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FIG. 7

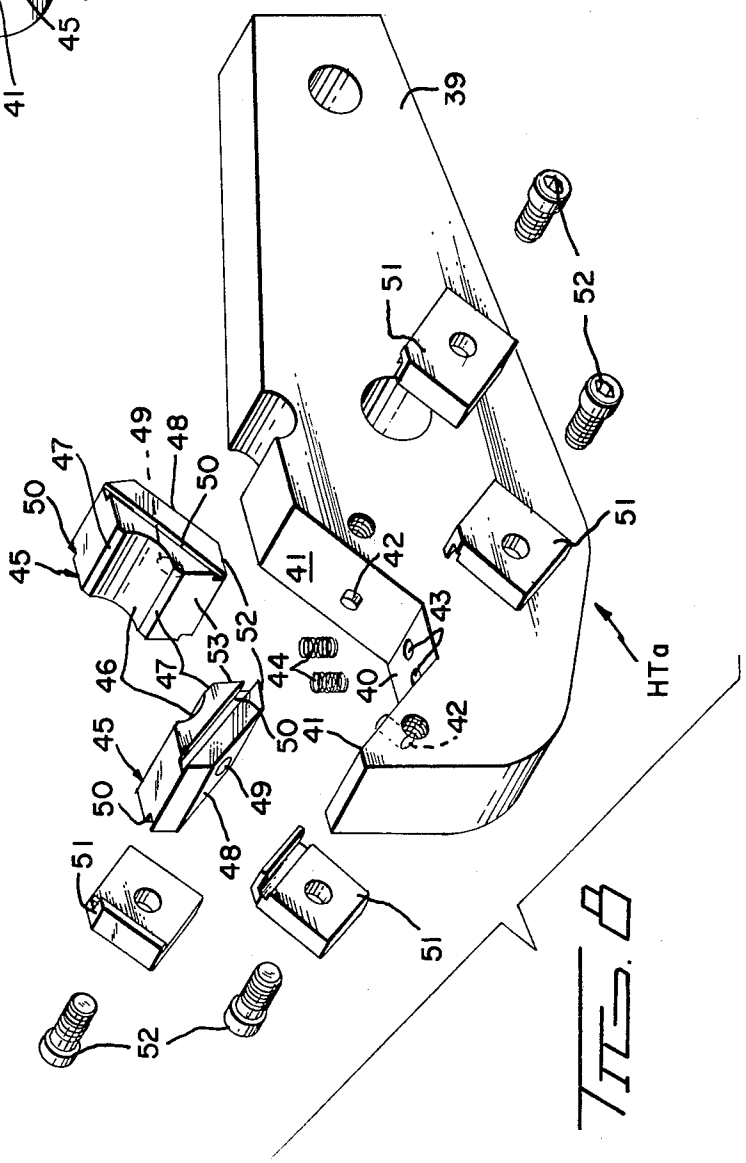

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HTa
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FIG. 8

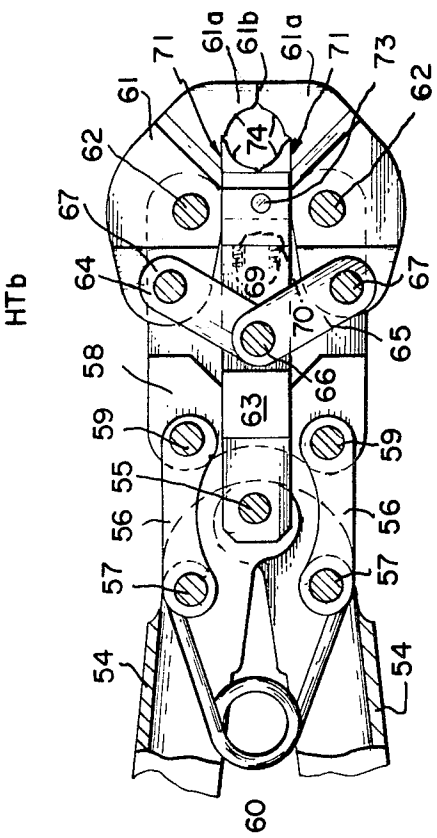

HTb
61a
61b
71
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FIG 9

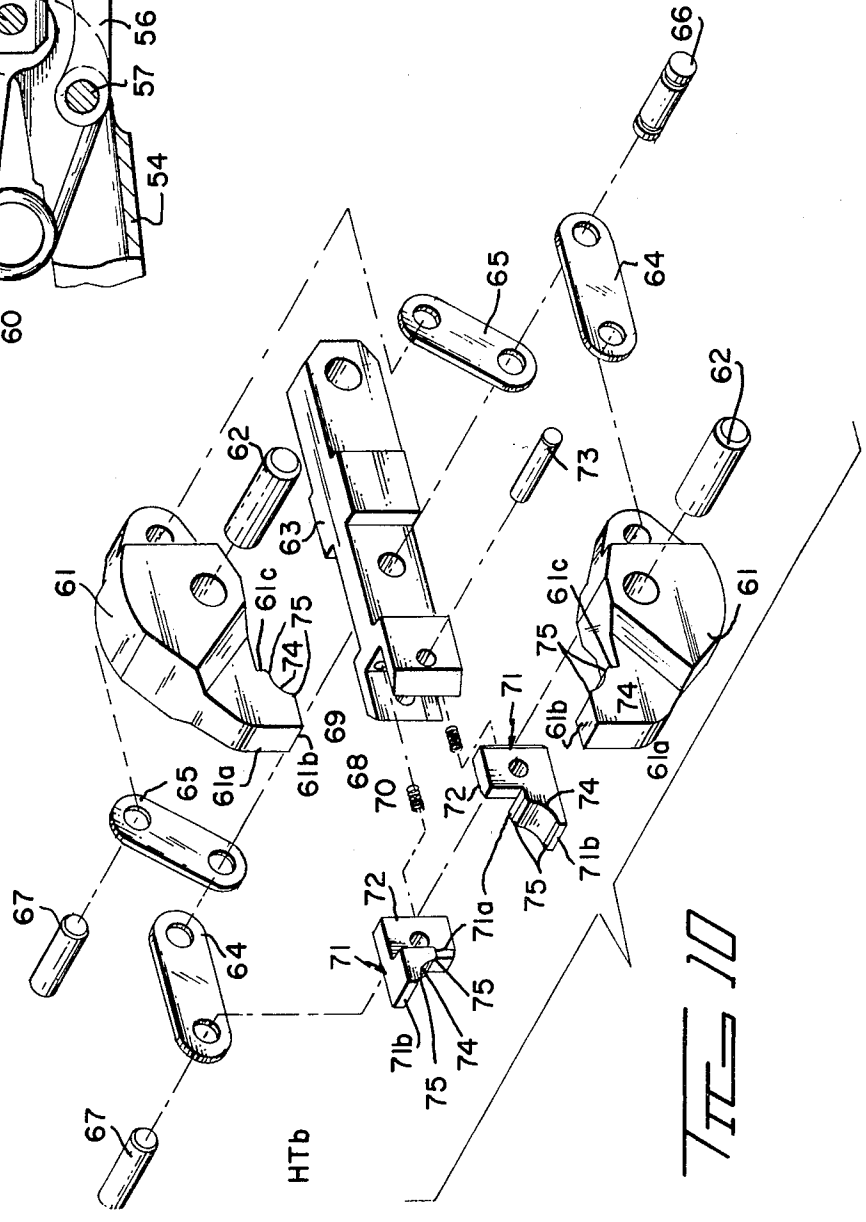

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61c
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61b
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71b
71a
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HTb

FIG 10

CRIMPING TOOL AND DIE ASSEMBLY

This application is a division of Ser. No. 667,461 filed Sept. 13, 1967, now U.S. Pat. No. 3,575,036.

This invention relates to tools and die assemblies and more particularly to crimping tools and die assemblies therefor.

Tools with die assemblies are known to crimp a ferrule into an O-configuration onto a tubular member, electrical conductor or similar tubular structure.

One such tool includes one die having a U-shaped opening provided with an outer wide section and an inner narrow section and in which a ferrule to be crimped is placed. Another die, known as the pusher die, moves into the opening of the one die to push the ferrule from the wide section into the narrow section causing the ferrule to be elongated and then formed into an O-configuration of less diameter than its original diameter.

Another known tool comprises jaw members that are pivotally mounted so as to be closed by a pusher member upon movement of the pusher member toward a working area of the jaw members which initially forms a ferrule member disposed in the working area into an elongated configuration and the pusher member then forms the ferrule member into an O-configuration of reduced diameter within the working area of the jaw members and pusher member.

These known tools have the following drawbacks:

There is a large travel of the pusher die upon its engagement with the elongated ferrule member and the movement of the pusher die to form the ferrule member into an O-configuration. The compression on the ferrule member takes place at two points which are the sharp edges of the pusher die thereby resulting in a less uniform crimp. The sharp edges of the pusher die break after repeated use which requires replacement thereof. In the case of the pivotally movable jaw members, the compression thereon tends to force these jaw members apart which provides a crimp that is less uniform than the die member having the U-shaped opening.

An object of the present invention is to provide crimping means that does not elongate a ferrule member during the crimping operation.

Another object of the invention is the provision of crimping means that equally distributes compressive forces onto a ferrule member.

A further object is to provide crimping means that does not have any sharp edges to break.

An additional object is the provision of crimping means that performs a more uniform crimp.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIG. 1 is a perspective and exploded view of a crimping die assembly;

FIG. 2 is a front elevational view of the crimping die assembly of FIG. 1 in an assembled condition prior to being moved into a crimping position;

FIG. 3 is a partial view of the crimping dies of the crimping die assembly of FIG. 2 illustrating the crimping position thereof on a ferrule member;

FIG. 4 is a view similar to FIG. 3 with the crimping dies of the crimping die assembly out of engagement with a completely crimped ferrule member;

FIG. 5 is a perspective view of an alternative embodiment of the present invention;

FIG. 6 is a perspective and exploded view of a jaw member and a crimping die assembly therefor of the hand tool illustrated in FIG. 5;

FIG. 7 is a partial side elevational view of another embodiment of the invention;

FIG. 8 is a perspective and exploded view of a jaw member and die assembly therefor of FIG. 7;

FIG. 9 is a partial side elevational view with parts in cross section of a further embodiment of the present invention; and

FIG. 10 is an exploded perspective view of the die assembly of FIG. 9.

Turning now to the drawings and more particularly FIGS. 1 through 4, a die assembly DA comprises die carriers 1 and crimping dies 2. Each of the die carriers 1 has a slot 3 disposed therein in which a pair of crimping dies 2 is disposed. A post 4 is located on die carriers 1 so as to be secured in a tool of the type disclosed in U.S. Pat. No. 3,212,316, which is assigned to the present assignee, for operation of the die assembly. Aligned holes 5 are located in die carriers 1 and arcuate areas 6 are disposed between holes 5.

A pair of crimping dies 2 is disposed in a respective slot 3 of die carriers 1 and each crimping die includes an arcuate depression 7 which is mateable with a pair of aligned holes 5 so that pins 8 are disposed in arcuate depressions 7 of a pair of dies within slot 3 of a die carrier to maintain the pair of dies in position therein since the inner ends of surfaces 9 are disposed in abutting relationship when the dies are in a normally inoperative position. Thus, a pair of crimping dies 2 are disposed within slot 3 between pins 8 about which they pivot. Pins 8 are held in position via C-shaped retainers 8*a*. A coil spring 10 is disposed within openings 11 at the inner ends of slots 3 and openings 12 located in beveled surfaces 13 of the crimping dies. Spring 10 therefore maintains each pair of crimping dies in a normally inoperative position with beveled surfaces 13 in engagement and surfaces 9 spaced from each other in a diverging manner as illustrated in FIGS. 2 and 4. Crimping areas 14 are located on the crimping dies between surfaces 9 and top surfaces 15. Each crimping area 14 is provided with beveled edges 16.

In operation, the die assembly DA is placed in the tool disclosed in U.S. Pat. No. 3,212,316 to actuate the die assembly to crimp metallic ferrule member 17 of coupling member 18 onto tubing member 19. A coupling member 18 is of the type disclosed in U.S. Pat. application, Ser. No. 517,747, filed Dec. 30, 1965, now U.S. Pat. No. 3,378,282 and assigned to the present assignee. With tubing member 19 disposed in coupling member 18, the assembly is placed within the crimping area of the die assembly which is defined by crimping areas 14 of crimping dies 2. The tool is actuated and the die carriers are moved toward each other or one die

carrier is held stationary while the other die carrier is moved toward the stationary die carrier, causing the crimping dies to engage the ferrule member which in turn causes surfaces 9 to move toward each other and crimping areas 14 to start engaging ferrule member 17. As the die carriers are moved toward each other, top surfaces 15 of opposing crimping dies 2 move into complete engagement with each other thereby causing opposing limiting surfaces 9 of the crimping dies to do the same which results in the dies being bottomed thereby limiting the movement of the dies towards each other, and ferrule member 17 undergoes a reduction in diameter while the crimping dies are being bottomed thereby crimping the coupling member onto the tubing member. Adjacent beveled edges 16 permit an outer area of ferrule member 17 to flow into the spaces created by these adjacent beveled edges while the inner surface of the ferrule member is maintained as a completed circular configuration thereby eliminating any leakage paths. Thus, the excess material of the ferrule member created as a result of the reduction of the diameter via the crimping dies is moved into the spaces of adjacent beveled edges 16 resulting in the formation of exterior ribs while the inner surface of the ferrule member retains its completely circular configuration.

The die assembly DA therefore effects an O-crimp onto a ferrule member without subjecting the ferrule member to any elongation prior to the ferrule member being formed into an O-configuration, the crimping dies apply uniform crimping pressure to the ferrule member and no sharp edges are present in the crimping dies that would be subject to wear and breakage.

FIGS. 5 and 6 illustrate an embodiment of the invention which is directed to a hand tool HT which comprises handles 20 pivotally connected together at one end by pivot pin 21 and to respective jaw members 22 via pivot pins 23. A ratchet assembly 24 is pivotally connected to handles 20 and operates in such a manner that, once the tool is operated, the handles cannot again be opened until the operation has been completed. This ratchet assembly is conventional and is completely described in U.S. Pat. No. 2,618,933, which is assigned to the present assignee.

Jaw members 22 are of the same configuration and are pivotally connected together by links 25 (only one being shown) and pins 26. Each jaw member includes a recess 27 having arcuate depressions 28 in inclined sidewalls thereof. Crimping dies 29 are provided with crimping areas 30 and beveled edges 31 similar to the crimping areas and beveled edges of crimping dies 2 of the die assembly DA of FIGS. 1 through 4. Arcuate projections 32 are located on crimping dies 29 and these projections mate with respective arcuate depressions 28 of recess 27. Arcuate depressions 28 and arcuate projections 32 define pivot points about which crimping dies 29 pivot. A leaf spring 33 is disposed between the bottom of recess 27 and crimping dies 29 to maintain inclined surfaces 34 in engagement when the tool is in its inoperative position. Retaining plates 35 having arcuate areas 36 are mounted on each side of jaw member 22 via screws 37 that mate with threaded openings 38 to maintain crimping dies 29 and leaf springs 33 in position within recesses 27. The operation of hand tool HT of FIGS. 5 and 6 is similar to the operation of die assembly DA of FIGS. 1 through 4 so that no further discussion is deemed to be necessary.

FIGS. 7 and 8 illustrate another embodiment of the invention which is a hand tool HTa and it is similar to the hand tool of FIGS. 5 and 6. Each of jaw members 39 is provided with a recess 40 having beveled sidewalls 41. Pin 42 extends outwardly from each sidewall and openings 43 are located in the bottom of recess 40 to receive coil springs 44 therein. Crimping dies 45 have crimping areas 46 and beveled edges 47 similar to crimping dies 2 and 29. Crimping dies 45 are provided with beveled surfaces 48 which slide along sidewalls 41 and they include oblong openings 49 which mate with pins 42 to limit movement of the crimping dies along walls 41. Grooves 50 are disposed in the sidewalls of the crimping dies and they have disposed therein the short legs of L-shaped retaining members 51 which are secured on jaw members 39 via screws 52. Grooves 50 of each crimping die are parallel to the beveled surface 48 thereof.

When crimping dies 45 are disposed in position along respective walls 41 and held in place therealong via pins 42, oblong openings 49 and retaining members 51, coil springs 44 engage inner flat surfaces 52 of the crimping dies thereby maintaining opposing flat surfaces 53 away from each other when the crimping dies are in an inoperative position. Walls 41 act as guide means along which crimping dies 45 move when they begin to engage the ferrule member, otherwise the operation is the same as that of the embodiments of FIGS. 1 through 6.

FIGS. 9 and 10 illustrate another hand tool HTb which is a further embodiment of the present invention. This tool is similar to the tools disclosed in Ser. No. 517,747, now U.S. Pat. No. 3,378,282. Tool HTb includes handles 54 pivotally connected together by pin 55. Links 56 have one end pivotally connected to handles 54 via pins 57 and to plates 58 (only one being shown) via pins 59. A spring 60 has its ends connected around pins 57 and it maintains handles 54 in an open position. Jaw members 61 are pivotally connected between plates 58 by means of pins 62. A pusher member 63 has one end connected to pin 55 and it is slidably movable between jaw members 61 to operate same via a linkage means including links 64 and 65 having one of their ends pivotally connected to pusher member 63 by pin 66 and the other ends of the links are pivotally connected to respective jaw members 61 via pins 67.

Pusher member 63 is provided with a slot 68 having holes 69 in the bottom thereof in which coil springs 70 are disposed. Crimping dies 71 have overlapping sections 72 that are disposed within slot 68 of pusher member 63 and they are pivotally held in position in slot 68 via pin 73 with springs 70 engaging respective sections 72 thereby maintaining crimping areas 74 of the crimping dies directed away from each other when the tool is in its normally inoperative position. Jaw members 61 are also provided with crimping dies 61*a* which are also provided with crimping areas 74 and crimping areas 74 of crimping dies 61*a* and 71 are provided with beveled edges 75. Thus, crimping areas 74 and beveled edges 75 of crimping dies 61*a* and 71 are similar to the crimping areas and beveled edges of the crimping dies of the embodiments described hereinbefore.

Prior to operation, spring 60 maintains handles 54 away from each other so that pusher member 63 is in its

inoperative position wherein crimping dies **71** under the influence of springs **70** are disposed at an angle with respect to each other so that crimping areas **74** thereof are directed away from each other. This is true with respect to crimping areas **74** of crimping dies **61***a* because spring **60** in maintaining handles **54** away from each other maintains pusher member **63** in an inoperative position and pusher member **63** via links **64** and **65** cause jaw members **61** to be out of engagement with each other at the outer ends thereof.

To crimp ferrule member **17** onto coupling member **18**, the ferrule member is placed within the crimping area of tool HTb and handles **54** are moved toward each other which causes pusher member **63** to move outwardly thereby causing jaw members **61** to be pivoted toward each other via links **64** and **65**. As crimping dies **61***a* move into engagement with each other, they engage crimping dies **71** causing them to move into engagement with each other, and, at the end of the crimping action, crimping dies **61***a* are in engagement with each other at surfaces **61***b* thereof and crimping dies **71** are in engagement with each other at surfaces **71***a* thereof. Also surfaces **71***b* of crimping dies **71** are in engagement with surfaces **61***c* of crimping dies **61***a*.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. In a crimping tool:

a. die members each having a concave arcuate crimping surface, each of said surfaces having beveled portions on either end thereof, and further having a flat base surface opposite said crimping surface, and further having grooves on either side of each die member, said grooves being parallel to said surfaces;

b. jaw members having recesses with beveled sidewalls adapted for carrying said die members;

c. operating means operatively connected to said jaw members for moving said jaw members and said die members thereon toward each other whereby said crimping surfaces define a crimping area and said beveled portions define inwardly facing angular grooves,

d. spring means provided for said die members to maintain the die members in a normally inoperative position away from said crimping area;

e. L-shaped retaining members positioned on said jaw members so that one portion thereof engages said grooves on said die members thereby guiding said die members toward and away from each other; and

f. limiting means for limiting movement of said die members said limiting means including

pins positioned on said beveled sidewalls, and

oblong openings in said base surface of said die members to receive said pins.

2. A crimping tool for crimping metal ferrules and the like, comprising:

a. two pair of die members, each die member having an arcuate crimping surface, said surfaces being beveled at each end thereof, said die members further having arcuate projections on a surface generally opposite said crimping surface;

b. two jaw members, each provided with a recess having inclined walls in which one pair of said die members are disposed so that said crimping surfaces thereon generally face each other;

c. pivot means to permit pivotal movement of said die members relative to each other, said means including arcuate depressions in each of said inclined walls adapted to receive said arcuate projections on said die members

d. operating means operatively connected to said jaw members to move same and said die members thereon toward each other whereby said crimping surfaces form a crimping area and said beveled ends cooperate to form inwardly facing angular grooves for receiving metal flowage from said ferrules as such are being crimped by said die members, and to move said jaw members and said die members thereon away from each other; and

e. leaf springs in engagement with inner surfaces of said die members thereby maintaining said crimping surfaces directed away from each other at an inoperative position thereof.

3. A tool for crimping ferrules and the like, which comprises:

a. a pair of jaw members pivotally linked to each other, each member having an angular recess thereon;

b. two pair of die members, each pair mounted in one of said recesses in said jaw members, said die members each having a concave arcuate crimping surface, said surfaces beveled at each end thereof;

c. operating means operatively connected to said jaw members for moving said members and said die members mounted thereon toward each other whereby said crimping surfaces form a crimping area and said beveled ends cooperate to form inwardly facing angular grooves for receiving metal-flowage from said ferrules as such are being crimped;

d. spring means provided on said members to maintain said die members in a normally inoperative position with said crimping surfaces disposed away from each other;

e. grooves positioned on each of said die members; and

f. retaining members positioned on said jaw members, each of said retaining members having an inwardly projecting leg thereon for sliding engagement in said grooves on said die members thereby guiding said die members toward and away from each other.

4. A crimping tool for use in crimping metal ferrules, which comprises:

a. a pair of elongated handles each having a free end and a connecting end, said connecting ends being pivotally connected together;

b. a pair of spaced apart plates extending from said elongated handles, each plate being connected at one end thereto to one of said handles near said connecting ends;

c. a pusher member slidably mounted between said spaced apart plates and connected at one end to said connecting ends of said handles and having an outwardly facing slot at another end;

d. a pair of die members each having a concave arcuate crimping surface with beveled ends thereon, said die members being pivotally mounted in said slot in said pusher member so that said crimping surfaces thereon are generally continuous and face outwardly from said pusher member;

e. a pair of coil springs each positioned between said pusher member and one of said die members so that said crimping surfaces on said die members are biased away from each other;

f. a pair of jaw members each pivotally connected intermediate the ends thereof to another end of one of said spaced apart plates, each jaw member having at one end and facing the other, a concave arcuate crimping surface so that when said jaw members are brought together, said crimping surfaces become generally continuous with each other and generally face inwardly toward said crimping surfaces on said first pair of die members;

g. linking means for linking said pusher member to both of said jaw members so that as said pusher member slides towards said handles, said jaw members are pivoted away one from the other and as said pusher member slides away from said handles, said jaw members are pivoted toward each other to form a crimping area in cooperation with said die members on said pusher member.

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