April 13, 1965 D. A. VAN OORT 3,177,695

CRIMPING TOOL FOR ELECTRICAL AND OTHER CONNECTORS

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Fig. 1.

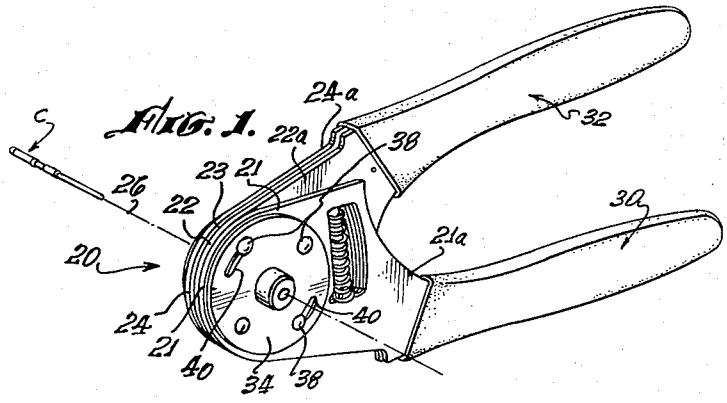

Fig. 2.

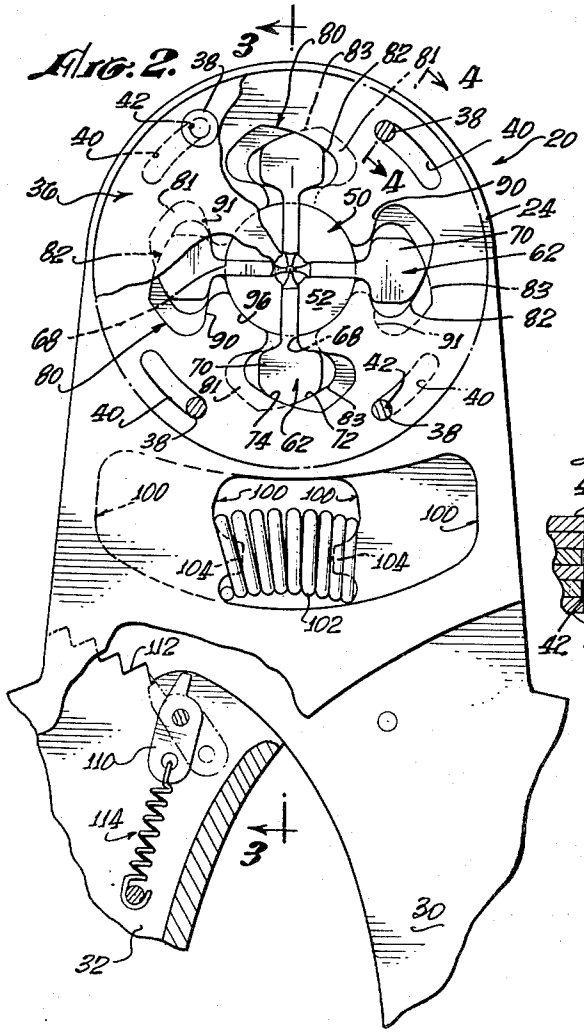

Fig. 3.

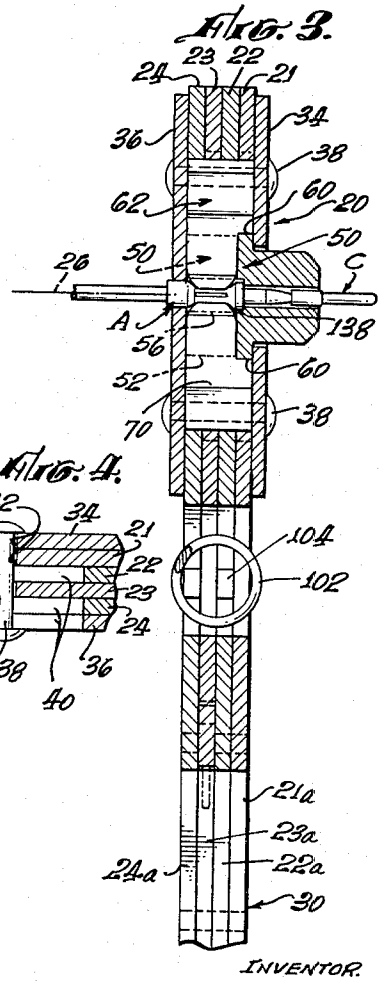

Fig. 4.

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Fig. 5.

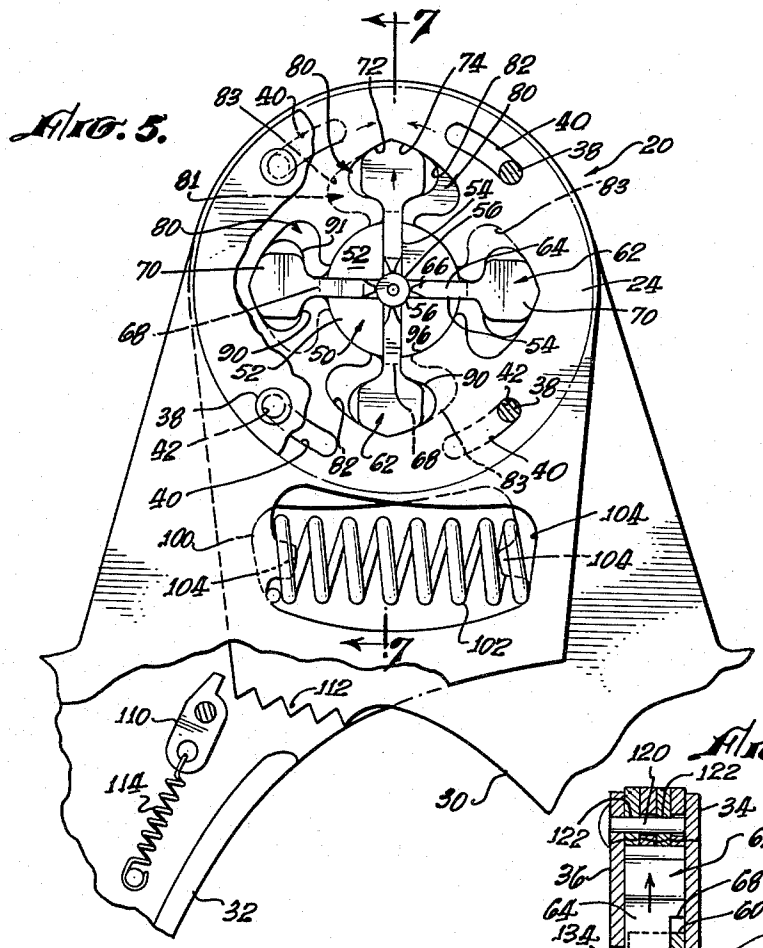

Fig. 7.

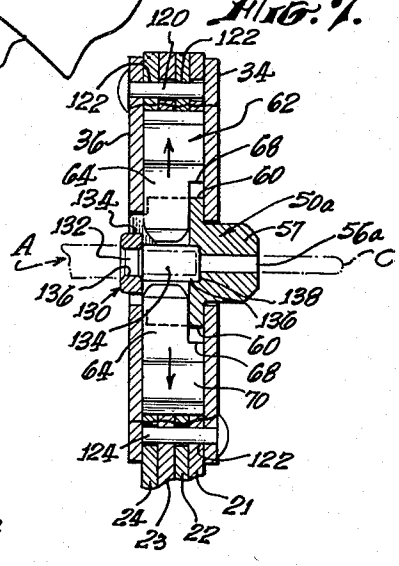

Fig. 6.

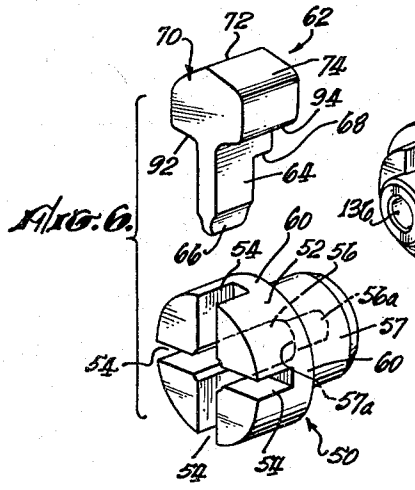

Fig. 8.

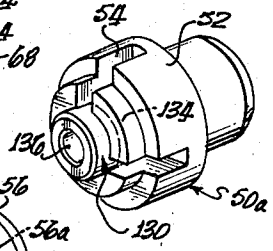

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FIG. 9.

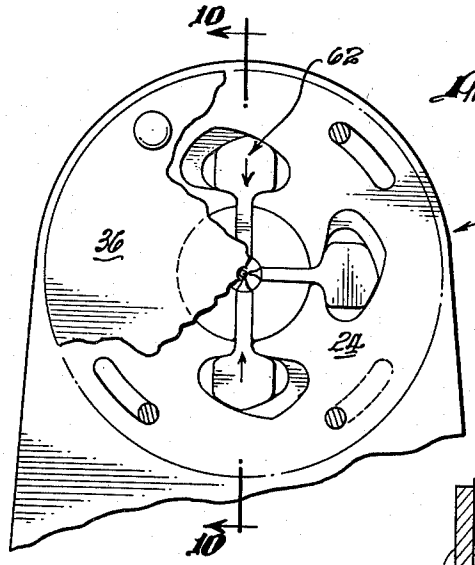


FIG. 10.

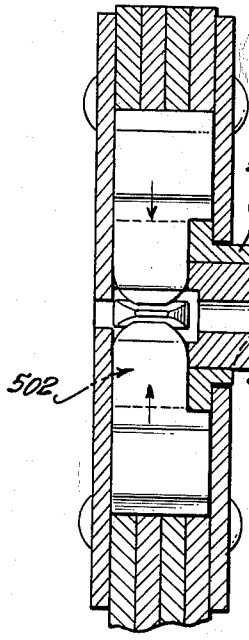


FIG. 11.

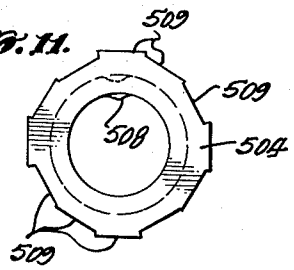


FIG. 12.

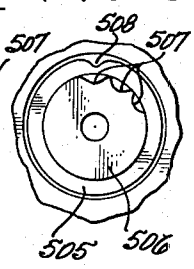
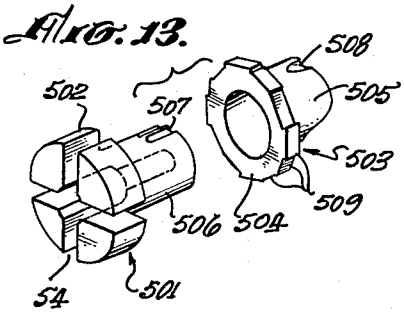


FIG. 13.



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3,177,695

CRIMPING TOOL FOR ELECTRICAL AND OTHER CONNECTORS

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15 Claims. (Cl. 72—402)

The present invention has to do with certain improvements in crimping tools of the type commonly in use for crimping a tubular "crimp pot" or connector onto a wire or other electrical conductor. Although the improved tool of the invention may be used for crimping such a tubular member on and about various other inserted elements and the invention is thus not limited to the crimping of electrical connectors, the following specific description will deal with such connectors and the application to other connections will be obvious.

Crimping tools of the type here concerned are commonly made for hand operation like that of a pair of pliers with pivoted handles and a crimping head which operates by virtue of relative rotation of the two handle-swung heads. Crimping dies mounted for radial movement in the head are operated by camming action of the relatively rotatable heads. The illustrative embodiment of the invention will be described as having handles for manual operation, but, as will be apparent, the relative rotation of the crimping heads may be otherwise caused.

There are several characteristic features of the present inventive improvements, among which the following may be preliminarily noted.

The relatively rotatable heads are pivoted on a central die carrier in which the several dies, here shown illustratively as four in number, are carried and guided for radial movements, or, more generally speaking, for inward and outward movements having a radial component. The heads, which are rotated in opposite directions, have camming faces which adjacently operate on each die in opposite directions of movement, so that the tendency of a single camming action to swing the die in the direction of that cam movement is opposed by the camming action of an immediately adjacent oppositely moving cam.

Further each head is preferably made up of at least two pairs of oppositely moving adjacent cams, arranged so that any tendency of a single pair to twist a die about a radial axis is opposed and obliterated. Variations of that presently preferred arrangement are spoken of below.

The preferred feature is accomplished by making up the heads in the form of inter-leaved laminations each carrying their camming faces. And it is another feature of the present invention that the heads, whether or not interleaved, are duplicates of each other. That, and other features of the present invention, lead to low cost of tool production.

The above characteristics, and others, will appear from the following detailed descriptions of presently preferred and illustrative embodiments of the invention, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective showing the external appearance of the improved tool in a form for hand operation;

FIG. 2 is an enlarged elevation, of the side of the tool opposite to that seen in FIG. 1, with an external cover plate partially broken away and showing the parts in operated crimping position;

FIG. 3 is a section on line 3—3 of FIG. 2;

FIG. 4 is a detail section on line 4—4 of FIG. 2;

FIG. 5 is a view similar to and in the same aspect as FIG. 2 but showing the parts open in their position to take the connector to be crimped;

FIG. 6 is a perspective showing the die carrier in the form shown in FIGS. 1 to 5, and also showing one of the dies;

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FIG. 7 is a section on line 7—7 of FIG. 5, with parts broken away to show modified means of holding the laminations and cover plates together, and showing certain other modification of the die carrier;

FIG. 8 is a perspective showing the modified die carrier shown in FIG. 7;

FIG. 9 is a side elevation of the modified form shown in section in FIG. 10;

FIG. 10 is a section on line 10—10 of FIG. 9;

FIG. 11 is an end view of the settable member associated with the die carrier of FIG. 10, for the purpose of adjustably setting the depth of crimp to suit connectors of different diameters, etc.;

FIG. 12 is an end elevation taken as indicated by line 12—12 on FIG. 10; and

FIG. 13 is a perspective showing the die carrier and settable member of FIG. 10.

Referring first now to FIGS. 1 to 7. The crimping head 20 is there shown as composed of four head laminations 21, 22, 23 and 24, interleaved as shown in FIGS. 1, 3, 4 and 7. These four head laminations are pivoted together in the manner described below, on the pivot axis designated 26 in FIGS. 1 and 3. Two of the head laminations, for instance 21 and 23 are connected to rotate or swing together by being, in this hand operated tool, extended as shown at 21*a*, 23*a* into handle 30, while the other two laminations 22 and 24 are extended as shown at 22*a* and 24*a* into handle 32. Two circular cover plates 34 and 36 lie outside head laminations 21 and 24 respectively and, in the form of FIGS. 1–5, are held in place by rivets 38 which pass through holes 42 and arcuate slots 40 in the cover plates and head laminations, the slots allowing the relative rotation of the head laminations and the cover plates. For example cover plate 34 may rotate with head laminations 21 and 23 in which case that cover plate and those laminations have holes 42 through which rivets 38 pass. Then the other, relatively rotatable cover plate 36 and laminations 22 and 24 have the arcuate slots 40.

Central die carrier 50 has a generally cylindric body 52 (see FIG. 6) of an axial length substantially equal to the assembled thickness of the four head laminations (see FIG. 3), and, as shown in those figures, that cylindric body carries a series, here shown as four, of radial slots 54 extending from its periphery to a central axial bore 56. Slots 54 do not extend axially throughout the axial length of body 52. As shown best in FIG. 6, they extend from the left hand face of body 52 to a line short of the right hand face of that body so that outer cylindric surfaces are left at the slot ends as shown at 60 in FIGS. 3, 6 and 7.

Four crimping dies 62 are carried and radially guided in slots 54. One such die is shown in FIG. 6. It has a shank 64 of cross sectional dimensions substantially the same as that of a slot 54, to fit the slot for radial sliding. The die's inner end 66 is formed as a foot for crimping the sleeve of the connector pot when forced inwardly. Foot 66 may be made up of one, two or more crimping feet, spaced in the direction of the length of 66, if desired. Shank 64 has an inwardly facing shoulder 68 that sets on the body surface 60, that shoulder limiting the inward movement of the die to the desired crimp depth. FIG. 5 shows the dies in their outer or open positions with their shoulders 68 spaced outwardly from the periphery of the carrier body and with their crimping feet 66 as far out as to clear the carrier bore 56, or at least clear the inserted connector. Bore 56 must be larger than the un-crimped connector to allow for its possible expansion in external diameter when crimped. FIG. 2 shows the dies at the ends of their inward crimping strokes with their shoulders 68 seated on the periphery of carrier body 52. Each die has a camming head 70, the

axial length of that head, and also that of shank 64 outward of shoulder 68, being substantially the same as the axial length of carrier body 52 and again substantially the same as the assembled thickness of the four head laminations 21 etc. Die head 70 is also preferably considerably thicker in the aspects of FIGS. 2 and 5 than die shank 64, as is apparent in those figures and FIG. 6, and its radially outer end carries two opposite camming faces 72 and 74 there shown preferably as lying at angles of about 60° to the radial length of the die at about 30° from a circle centered on the carrier opening and passing through the outer tip of the die head.

In any given crimper of the type here described, the crimp depth in a tubular connector of a given external diameter, or accommodation to connectors of different diameters or wall thickness, adjustment of the inner positions of the dies may be made either by changing the location of the crimping foot relative to the camming faces 72, 74, or by changing the radial displacement of seating surface 60 relative to the central axis. Relative to the latter see FIG. 13, described below. In general, the distance relation between shoulder 68 and camming faces 72, 74 in any given assembly should be constant.

The four head laminations have central openings surrounding die carrier body 52, that body centering the several laminations for relative rotation about the axis 26 of the carrier. As seen in FIGS. 2 and 5, head lamination 24, for example, has four openings 80 accommodating die heads 70 and each having at its outer periphery a camming face 82. As can be seen by comparison of FIGS. 5 and 2, when head lamination 24 rotates relative to the die heads in counter-clockwise direction from the open position of FIG. 5 to the closed crimping position of FIG. 2, the cam faces 82 act on the die head faces 74 to force the dies inwardly.

The immediately adjacent head lamination 23 has the same opening formations as 80 but those openings 81 in that next lamination 23 are relatively circumferentially reversed, so that their outer peripheral cam faces 83, on relative clock-wise rotation from FIG. 5 to FIG. 2, act on die head faces 72, in a circumferential direction opposite to that of the cam faces in lamination 24, also to force the dies inwardly.

The next head lamination 22, has its openings and cam faces oriented in the same direction as those in lamination 24; and head lamination 21 has its openings and cam faces oriented in the same direction as those in lamination 23. It will thus be seen that there are two pairs of head laminations, each pair composed of two adjacent laminations with cam actions on the die heads in opposite circumferential directions. While a single adjacent pair with oppositely acting cams has no tendency to force the dies in either direction in the plane of FIGS. 2 and 5; the provision of two such oppositely acting pairs also eliminates any tendency to twist the dies about a radial axis. The dies are consequently free of any force tending to bind them in the carrier slots 54, in which they then slide freely.

From what has been said it will be obvious that the several head laminations are exact duplicates, with one pair simply reversed right for left in the aspect of FIGS. 2 and 5. It will also be apparent that the arrangement of the pairs might be such that 24 and 21 could be similarly oriented, with 23 and 22 similarly oriented opposite to the orientations of 24 and 21.

It will also be apparent that a complete set of laminations might be made up of three with two exterior laminations oriented in the same direction and a central one oriented oppositely. That can be visualized in the described preferred arrangement by, for instance, merely omitting, say, lamination 21; with 24 and 22 similarly oriented and connected to one handle, and 23 oppositely oriented and connected to the other handle. But the described arrangement with 24 and 22 similarly oriented and connected to one handle, as 32, and 23 and 21 similarly oriented and connected to the other handle 30, makes the whole of the two head lamination and handle assemblies substantial if not exact duplicates. The duplications of the laminations, and of their assemblies, are features that lower cost of production.

On opening movement from the position of FIG. 2 to that of FIG. 5, oppositely acting cam faces, such as 90 on lamination 24, and 91 on lamination 23, acting on the inner faces 92 and 94 of the die heads, move the dies out.

The circular central opening in each of the head laminations—the opening that rotatively rides on carrier body 52 and centers the head laminations on that body—is formed by concentric surfaces 96 at the inner ends of the lamination portions lying between the die accommodating openings 80, 81 etc.

In this hand operated form of the crimper, each lamination has an opening 100, the several openings lining up in the open position of FIG. 5 and moving to the relative positions of FIG. 2 in the closed crimping position. A compression spring 102 in that opening, held in lateral position by the projections 104 on each lamination at one end of its opening 100 tends to force the two handle operated assemblies open.

The two handle assemblies are completely identic, except for one minor feature—the ratchet and pawl element shown in FIGS. 2 and 5. By duplicating that element, the two assemblies could be completely identic. In the open position of FIG. 5, pawl 110 on one handle assembly has been passed by ratchet teeth 112 on the other handle assembly and is thrown to the position shown in that figure by its spring 114. On closing to the position of FIG. 2 (where the closing action is limited by die shoulders 68 setting down on the die carrier) pawl 110 drags over ratchet teeth 112 in the relative position shown in broken lines in FIG. 2. At close approximation to that closed position pawl 110, cleared by teeth 112, is then snapped over to the full line position of FIG. 2, allowing the crimper to be opened to the position of FIG. 5 with the pawl dragging over teeth 112, inclined oppositely to the dotted line position of FIG. 2. The pawl-ratchet element thus prevents the crimper from being operated in either direction until the movement in the opposite direction is completed. Spring 102, as here shown, limits the opening movement, but that limit may be set by any suitable stops, such for instance as the lengths of slots 40.

FIGS. 7 and 8 show two modifications that are applicable to the form of FIGS. 1–6. One modification has to do with the riveting that holds the cover plates and head laminations together laterally. In crimping tools used by ordinary assembly personnel it is of some importance to prevent accidental or unauthorized tampering that may change the depth of crimp. Thus it is, for such tools, important to make the assembly at least difficult to disassemble.

In FIG. 7 one set of assembly pins 120 is shown as force driven into tightly fitting holes 122 in cover plate 36 and head laminations 24 and 22, which all rotate together, the other laminations 23 and 21 having the slots previously spoken of. Pin 120 does not extend through cover plate 34; and it may or may not have a head outside plate 36 as shown. Another set of similar holes in cover plate 34 and laminations 21 and 23, forcedly take pins 124 which do not extend through cover plate 36, laminations 22 and 24 having the slots that allow relative rotation of the sets of head laminations. Even if the pins 120 and 124 have heads such as shown they are difficult to remove.

In the form of the die carrier shown in FIG. 6 the major bore 56 through body 52 of the die carrier is of a diameter somewhat larger than the diameter of the part of the connector inserted into that bore, as illustrated in FIG. 7. Extension 56*a* of that bore through the locater 57 may be smaller than 56 and provide a shoulder 57*a* against which a shoulder on the connector

A, C (FIG. 7) may be stopped to thus locate the connector axially. Any other longitudinal stop arrangement may be used to suit connectors or crimp pots of various designs.

In the form of FIG. 6 the right hand end of a connector to be crimped is centrally located by the bore **56***a* in locator **57**. To similarly centrally locate the left hand end of a connector which has, as at **132** (FIG. 7), a part of diameter larger than that of the original uncrimped part **134**, an adapter ferrule **130** may be attached to the die carrier, as shown in FIGS. 7 and 8. As there shown, for example, the ferrule **130** is fitted into a shouldered counterbore **134** in the die carrier, and has a concentric bore **136** into which the enlarged connector part **132** fits closely. That enlarged part may be, for instance, an insulating sleeve surrounding the metal connector or an insulation support sleeve. But, whatever its nature, the ferrule accurately centers the left-hand end of the connector. Ferrule **130** may be force-fitted into counter-bore **134** and thus, in effect become a permanent part of the die carrier. Ferrule **130** and the locator bore **56***a* thus not only accurately center the length of the connector in the die carrier, but they also provide a means of immeditaely recognizing a bent or otherwise damaged connector due to the fact that it will not easily fit into either or both bores **56***a* and **136**.

FIGS. 9 to 13 show another variation, designed particularly for use in the field by reliable personnel. The general assembly shown in these figures is the same as in the other figures, but provision is made for the operator changing the depth of crimp to suit crimp pots of differeing sizes, configurations or wall thicknesses.

As best shown in FIG. 13, the die carrier **501** is made up in two parts **502** and **503**, relatively rotatable. Part **502** carries the slots **54** of FIG. 6, but the unslotted portion of body **50** of FIG. 6 is formed by a flange **504** on part **503** which has a tubular hub **505** which slides over hub **506** of part **502**. Hub **506** carries a set of indentations **507** into which outer hub **505** may be indented, as at **508**, to set part **503** in any desired orientation about part **502**. Flange **504** carries peripheral sets of seating surfaces **509**, the three surfaces of each of the sets, here four in number, being of different radial distances from the carrier center. Those surfaces **509** are settable by registration of **508** with the indentations **507** to be aligned with the shoulders **68** of the several dies.

I claim:

1. In a device adapted for crimping a tubular connector, a crimping head embodying the combination of
a central die carrier of generally cylindric form with a concentric central bore and a plurality of angularly spaced die-guiding passages extending in directions having radial components from its cylindric exterior to the central bore,
a radially movable crimping die slidable in each said passage and having an outer camming head external of the die carrier,
a plurality of substantially axially adjacent cam-carrying plate-like members each rotatably mounted on the die carrier to rotate about its axis,
said plurality including at least two said members carrying cam faces which respectively are of sufficient width in an axial direction to have inward camming action on each of the several die heads upon relative rotation of said cam-carrying members in opposite directions,
each said camming head being of sufficient width in an axial direction to be engaged by the cam faces on each of said members,
and means for simultaneously rotating said cam-carrying members in opposite directions.

2. The combination defined in claim 1 and in which
each said rotatable member also carries cam faces which respectively have outward camming action on each of the several die heads upon relative rotations opposite to said previously specified relative rotations.

3. The combination defined in claim 2 and in which
the number of said plate-like members is at least three with one said member lying between two opposite members, and in which the said camming action of said one member is effected by rotation of said one member in one direction,
and the camming actions of said other two members are effected by relative rotation in the opposite direction.

4. The combination defined in claim 1 and in which
the number of said plate-like members is at least three with one said member lying between two opposite members, and in which the said camming action of said one member is effected by rotation of said one member in one direction,
and the camming actions of said other two members are effected by relative rotation in the opposite direction.

5. The combination defined in claim 2 and in which
said plurality of cam-carrying members is composed of at least two pairs of such members,
the respective members of each pair having camming action on the several die heads upon relative rotation in opposite directions,
and means for rotating one member of each pair oppositely to relative rotation of the other member of each pair.

6. The combination defined in claim 5 and also including
two cover plates lying against the outermost of said members,
a pin passing transversely through fitting holes in one cover plate and in one member of each pair and through arcuate slots in the other member of each pair,
and a similar pin passing transversely through fitting holes in the other cover plate and in the other member of each pair and through arcuate slots in the said one member of each pair.

7. The combination defined in claim 1 and in which
said plurality of cam-carrying members is composed of at least two pairs of such members,
the respective members of each pair having camming action on the everal die heads upon relative rotation in opposite directions,
and means for rotating one member of each pair oppositely to relative rotation of the other member of each pair.

8. The combination defined in claim 7 and also including
two cover plates lying against the outermost of said members,
a pin passing thransversely through fitting holes in one cover plate and in one member of each pair and through arcuate slots in the other member of each pair,
and a similar pin passing transversely through fitting holes in the other cover plate and in the other member of each pair and through arcuate slots in the said one member of each pair.

9. The combination defined in claim 1 and also including
two cover plates lying against the outermost of said members,
a pin passing transversely through fitting holes in one cover plate and in one of said members and through arcuate slots in the other of said members,
and a similar pin passing transversely through fitting holes in the other cover plate and through fitting holes in the other of said members and through arcuate slots in the said one member.

10. The combination defined in claim 1 and in which
said plurality of cam-carrying members is composed of at least two pairs of such members,

the respective members of each pair having camming action on the several die heads upon relative rotation in opposite directions,

and means for rotating one member of each pair oppositely to relative rotation of the other member of each pair.

11. The combination defined in claim 2 and in which each die camming head has a set of two outwardly facing and a set of two inwardly facing camming faces, the camming faces of each set lying in planes at opposite acute angles to a circumferential direction about the carrier center,

and in which the several co-operating camming faces on said members lie in planes at similar acute angles to the circumferential direction.

12. The combination defined in claim 1 and in which each die camming head has two outwardly facing camming faces lying in planes at opposite acute angles to a circumferential direction about the carrier center,

and in which the several co-operating camming faces on said members lie in planes at similar acute angles to the circumferential direction.

13. The combination defined in claim 1 and in which an axial portion of the die carrier is not passaged,

and each radially movable die carries a radially inwardly facing shoulder adapted to seat inwardly on a not passaged part of said carrier to limit inward die movement.

14. The combination defined in claim 13 and in which said not passaged part of said carrier is carried on a part rotatively adjustable relative to the cylindric slotted body of the carrier and about its axis,

said not passaged part having outwardly facing seating surfaces for each of the several die shoulders, said seating surfaces being at different radial distances from said axis.

15. In a device adapted for crimping a tubular connector, a crimping head embodying the combination of

a central die carrier of generally cylindric form with a concentric central bore and a plurality of angularly spaced die-guiding passages extending in directions having radial components from its cylindric exterior to the central bore,

a radially movable crimping die slidable in each said passage and having an outer camming head external of the die carrier,

rotatable camming means mounted to rotate on the die carrier about its axis and adapted by camming action to move said dies inwardly upon rotation,

each said radially movable die carrying a radially inwardly facing shoulder,

and a generally circular part rotatively adjustable about the axis of the die carrier and having on its periphery outwardly facing seating surfaces at different radial distances from said axis for selective engagement by the shoulder on each of the several dies.

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