Sept. 30, 1958 M. C. LOGAN 2,853,908

CRIMPING TOOL

Filed June 27, 1956

Fig. 1.

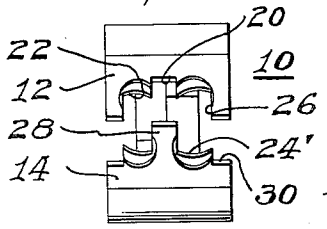


Fig. 2.

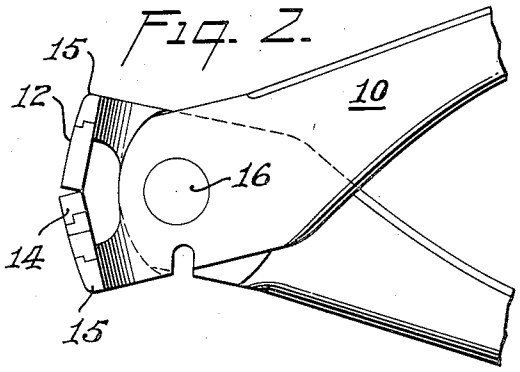


Fig. 3.

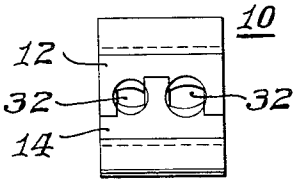


Fig. 4.

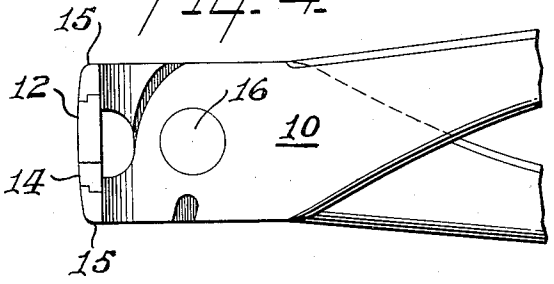


Fig. 5.

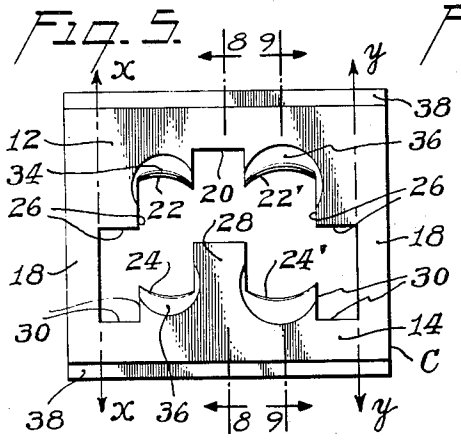


Fig. 6.

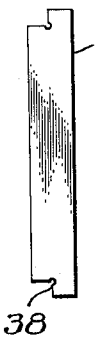


Fig. 7.

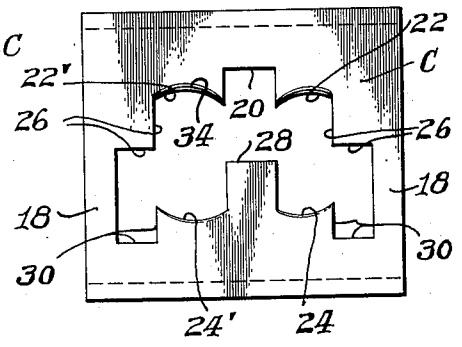


Fig. 8.

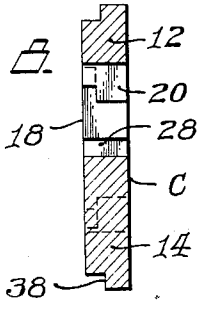
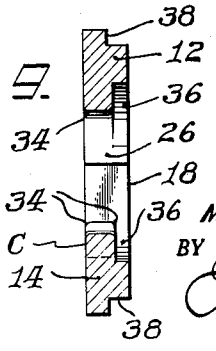


Fig. 9.



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CRIMPING TOOL

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Application June 27, 1956, Serial No. 594,185

8 Claims. (Cl. 81—15)

The invention relates to compression instrumentalities utilizable for crimping or otherwise securing electric terminal connectors and the like on bare end portions of insulated conductors or cables, and more particularly to a crimping tool of the pliers type having transverse jaws provided with integral complementary, plural die elements adapted to have parallel motion in an arcuate path in close proximity to the fulcrum of said tool.

More specifically, the invention resides in the crimping tool, complementary die elements therefor and the method of producing the same, the die elements being in the form of steel castings, having final configuration, which are precision cast in pairs as a unit with the die elements in spaced, matching relation and connected along their opposite end faces by marginal tie portions integral therewith.

It is known that hand tools of the type described are best adapted for "close-up" work, particularly in junction boxes and the like wherein a minimum of space is available for carrying out a crimping operation.

In the production of complementary plural die elements in matched pairs and having complex contours and radii, such die elements were produced heretofore by numerous machine operations, whereby the cost of producing such elements was prohibitive, at least for hand tools of the character herein described.

Known forms of terminal connectors which are provided with an insulating sleeve of molded nylon as in Frey Patent 2,769,965, for example, are crimped on a bare end portion of electric conductors and the like, through the insulating sleeve by means of a hand tool provided with complementary die elements of a configuration which may, for example, be substantially elliptical. However, such crimping operations resulted heretofore in the rupturing, cracking or partial splitting of the insulating sleeves by reasons of the fact that in conventional crimping tools for the purpose aforesaid, the complementary dies move in an arcuate path in a plane normal to the fulcrum of the tool, whereby the insulating sleeve is progressively stressed transversely of its axial center and spread toward its opposite side and often to the point of rupture, particularly when such sleeves have become dehydrated as a result of normal storage conditions. Moreover, such spreading of the insulating sleeve together with inequalities in the working surfaces of the complementary die elements, particularly in the marginal edges thereof, caused the insulating sleeve, in the deformation or crimping thereof, to become wedged in and between the die elements with the result that the deformed insulating sleeve had to be forcefully removed therefrom upon separation of the complementary die elements.

Accordingly, it is an object of the invention to provide interchangeable complementary die elements and a method of producing the same whereby such die elements may be accurately produced in large quantities at low cost.

A further object of the invention is to provide a pair of complementary die elements having final configuration which are cast as a unit of carbon steel and adapted to be separated without multilation as to size and configuration.

A further object of the invention is to provide complementary die elements for a crimping tool of the character described which will not rupture, crack or split an insulating sleeve or cause the same to be wedged therebetween when squeezed into crimped relation with an electric conductor.

Another object of the invention is to provide complementary die elements in a crimping tool of the character described in which the entire working surface, including the rounded marginal edges of each of the respective complementary plural die elements, are exact duplicates as to contour and radii throughout.

Another object of the invention is to provide a crimping tool of the character described in which complementary plural die elements are arranged and adapted for stressing a tubular fitting, lengthwise of its axial center, toward and away from the fulcrum of said tool while disposed at right angles thereto.

A further object of the invention is to provide a crimping tool of the character described in which novel complementary plural die elements, integral with the respective jaws thereof, are arranged and adapted to receive therebetween tubular fittings of different diameters in close proximity to and at right angles to the fulcrum of said tool.

Another object of the invention is to provide a precision-cast unit of steel in the form of complementary plural die elements having final configuration, whereby normal differences between separately cast die elements, due to shrinkage, misalignment, alloy variations and other factors, are obviated.

A further object of the invention is to provide a precision cast unit of steel in the form of complementary plural die elements spaced in opposed matching relation and having final configuration, whereby said die elements may be brought to matching size uniformly and at low cost by means of a broaching operation.

Another object of the invention is to provide complementary plural die elements of cast steel which are precision cast in multiple pairs with final configuration and adapted for a broaching operation and subsequent separation thereof without multilation as to size and configuration, whereby interchangeable die elements may be readily produced in large quantities at low cost.

A further object of the invention is to provide complementary plural die elements in a crimping tool of the character described wherein the respective die elements each presents aligned pressure surfaces adapted to have parallel motion in an arcuate path whereby to embrace the entire periphery of a cylindrical member when positioned square therewith.

Another object of the invention is to provide complementary plural die elements in a hand tool of the character described wherein the respective die elements each presents a pair of spaced pressure surfaces parallel with the fulcrum of said tool in all positions of angular movement to closed position each adapted to engage a cylindrical member square therewith.

With the above and other objects in view, the invention resides in the precision cast unit, complementary plural die elements, crimping tool, combinations and method of producing the same.

Various other objects, advantages and features of the invention will become apparent from the following detailed description when read in connection with the accompanying drawing, in which

Fig. 1 is a view in elevation of the nose-end of a hand

tool in open position illustrating the invention as applied thereto;

Fig. 2 is a side view in elevation of the same;

Fig. 3 is a view similar to Fig. 1, showing the hand tool in closed position;

Fig. 4 is a side view in elevation of the same;

Fig. 5 is a plan view in elevation of the front face of a metal casting showing a pair of complementary die elements, having final configuration, in integral, spaced, matching relation in accordance with the invention;

Fig. 6 is an end view in elevation of the same;

Fig. 7 is an elevational view similar to Fig. 5, showing the opposite face of the casting;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 5; and

Fig. 9 is a sectional view taken on the line 9—9 of Fig. 5.

Referring more particularly to the drawing, Figs. 1 and 2 and Figs. 3 and 4 illustrate a hand tool 10 of the character described, in open and closed position, respectively, with a pair of complementary die elements 12 and 14, produced in accordance with the invention, integral with the jaws 15 thereof in close proximity to and in parallelism with the axis of the fulcrum 16 of said tool.

In accordance with the invention and as best illustrated in Fig. 5, a pair of complementary die elements 12 and 14 having final configuration are produced by the well known "lost wax" method in the form of a single steel casting C with the respective die elements in spaced, matching relation and marginal die portions 18 integral with the opposite end faces of the respective die elements.

As shown in Figs. 5 through 9, the complementary die elements 12 and 14 are in the form of a male and female section, respectively, the female section indicated at 12 being provided with a rectangular open slot 20 in its working edge face intermediate the ends thereof, the slot 20 being flanked on each side by an arcuate pressure surface 22 and 22', each pressure surface having a different radius and extending in opposite directions from the slot 20. Each of the arcuate pressure surfaces 22 and 22' terminates at its outer end in an angular shoulder 26, with its defining surfaces parallel with the angular surfaces defining the open slot 20.

The male die element 14 is provided with a rectangular projection or tongue 28 intermediate its ends which is adapted to be freely received in the open slot 20 of the female die element 12 in dove-tail relation upon separation of the said die elements. The tongue 28 of the male die element 14 is similarly flanked on each side thereof by corresponding arcuate pressure surfaces 24 and 24', each having a different radius and matching, respectively, the radii of the arcuate pressure surfaces 22 and 22' of the female die section 12 in complementary relation. Similarly, each of the arcuate pressure surfaces 24 and 24' terminates at its outer end in an angular recess 30 with its defining surfaces in parallelism with the surfaces defining each of the angular shoulders 26 of the female die section 12, whereby when the respective die elements have been separated, as hereinafter described, the angular shoulders 26 of the female die elements will fit in the angular recesses 30 of the male die element 14 in substantially tongue-and-groove relation with the respective pairs of arcuate pressure surfaces forming a pair of substantially elliptical openings 32, of different size, between the complementary die elements, when in closed position, as shown in Fig. 3.

As shown in Fig. 5, the arcuate pressure surfaces 22, 22' and 24 and 24', are formed with rounded margins 34 which blend or merge into the rear face of the castings C, as in Fig. 7, and on the front side thereof, as in Fig. 5, into substantially semi-circular, depressed areas 36 which extend in the plane of the casting C toward the shouldered marginal edge portions 38 thereof and substantially beyond the opposite ends of each pair of the said arcuate

pressure surfaces to provide annular recesses adapted for receiving in abutment therewith an annular shoulder formed intermediate the ends of a known type of "pig-tail" connector whereby to properly locate the reduced diametral portion thereof relative to either pair of the arcuate pressure surfaces 22 and 22' or 24 and 24', as will be understood.

The shouldered margins 38 are formed in the respective die elements 12 and 14 during the casting thereof and subsequently machined by a straddle milling operation to obtain parallelism and an arcuate dimension between the shoulders 38 and the arcuate pressure surfaces of each die element, the sharp bottom corner, lengthwise of each shoulder 38, being preferably although not necessarily undercut, as in Fig. 6, to provide clearance for a purpose hereinafter described.

After a desired number of castings C, as illustrated in Fig. 5, have been produced by the "lost wax" method, as hereinafter specifically described, such castings are suitably broached to trim the surfaces defining the slot 20, elliptical pressure surfaces 22, 22', 24 and 24', tongue 28 and the angular shoulder defining surfaces 26 and 30 of any residual burrs or other inequalities to assure uniformity and the free interfitting engagement of any male die section 14 with any female die section 12.

Thereafter, one or more of the broached castings are suitably secured in a fixture, designed for the purpose, and straddle-milled along the broken lines *x*, *y*, indicated in Fig. 5, to cut away the marginal tie portion 18 and thus separate the respective die elements 12 and 14 without mutilation as to size or configuration, whereby any of the die elements 12 and 14 may be brought together in interfitting dove-tailed relation without the necessity of selectively matching such elements in pairs.

In accordance with the invention, the respective jaws 15 of the hand tool 10, are suitably slotted lengthwise of their free edge face for the reception of the shouldered margin 38 of a male and female die section 12 and 14 and the die elements permanently secured in place by means of a silver soldering or brazing operation while the jaws 15 are in closed position and the respective die elements 12 and 14 in interfitting relation, the die elements being immediately brought to a desired degree of hardness by quenching the nose-end of the tool 10 in a suitable oil bath or the like in known manner. Finally, the front and side edge faces of the respective die elements 12 and 14, including the jaws 15 of the tool 10, are suitably ground and polished to complete the hand tool illustrated.

Referring to Figs. 1 and 3, it will be noted that the inner edge face of each of the angular shoulders 26 at the respective ends of the female die section 12, and the opposite edge faces of the tongue 28 of the male die element 14, present oppositely disposed end walls adapted to contact the periphery of a ferrule of predetermined diameter, when positioned between either pair of the arcuate pressure surfaces 22 and 22' or 24 and 24', whereby to prevent spreading thereof transversely of its axial center when squeezed between the complementary die elements 12 and 14 as they are moved to closed position. Moreover, the respective die elements 12 and 14, in their movement to closed position, approach and squeeze the ferrule square therewith by reason of the fact that the said plural die elements 12 and 14 have parallel motion in all positions of angular movement, in contradistinction to conventional crimping tools wherein complementary pressure surfaces are disposed normal to the fulcrum of the tool and thus have scissors-like angular movement. Accordingly, it will be apparent that by means of the present invention, an insulating sleeve of molded nylon, as provided on the wire-barrel portion of known electric terminal connectors, for example, may be uniformly stressed during a crimping operation, toward the fulcrum 16 of the hand tool 10 and forwardly thereof, whereby wedging of the squeezed portion of the insulating sleeve

between either of the shouldered portions **26** and the tongue **28** is obviated and the subsequent removal thereof facilitated by reason of the parallel motion of the die elements to and from closed position in an arcuate path about the axis of turn of said tool.

For maximum economy in the production of the cast steel complementary die elements **12** and **14**, by the well known "lost wax" method, a predetermined number of master reproductions thereof are initially produced in wax or some suitable plastic material, including gates therefor. Subsequently, a suitable cylinder or shaft of wax or equivalent is mounted in a vertical position centrally of a suitable base board and the wax master elements connected to the wax shaft by means of the free ends of the gates, radially and lengthwise thereof, and a suitable sheet metal enclosure, open at both ends, placed on the base board with the wax shaft substantially in the center thereof. A suitable molding compound in the form of a slurry is then poured into the sheet metal enclosure to a depth covering the uppermost free end of the wax cylinder or shaft, and then permitted to dry. Thereafter, the base board is removed and the mold suitably baked while supported about and adjacent the peripheral edge portion of its end face, from which the base board was previously removed, to drain all of the wax or the like out of the mold, whereby to form cavities therein corresponding to the wax masters, including their respective gates and a sprue corresponding to the wax cylinder or shaft.

After the mold has been thus produced, molten medium carbon steel is poured into the mold through the sprue while the mold is suitably supported and rotated in an appropriate fixture to set up sufficient centrifugal force to assure completely filling the voids formed in the mold. After the mold has cooled sufficiently the sheet metal enclosure is removed from about the baked molding material to facilitate breaking-up of the same for the recovery of individual castings in a manner well known in the art, and the individual castings C trimmed and broached preparatory to a parting operation as hereinbefore described.

While a precision-cast, unitary steel member defining a pair of complementary die elements presenting spaced, matching pairs of substantially arcuate pressure surfaces, including tongue-and-groove elements, has been illustrated and described, it is to be expressly understood that complementary pressure surfaces of a configuration other than arcuate or elliptical may be similarly formed. Moreover, it is also to be understood that the invention is not limited in its application to hand tools, but may also be applied to power actuated mechanisms adapted for crimping and/or deforming heavy terminal connectors and the like. Therefore, the invention is not to be limited except as is necessitated by the prior art and the scope of the appended claims.

What is claimed is:

1. A hand tool of the pliers type, having a pair of complementary die elements integral with the jaws thereof in opposed matching relation, said die elements comprising steel castings having arcuate pressure surfaces and radii of predetermined final configuration in the opposed edge faces thereof and movable in parallelism to and from closed position in an arcuate path about the axis of turn of said tool.

2. A crimping tool of the pliers type, having a pair of complementary die elements integral with the jaws thereof in opposed matching relation, said die elements comprising steel castings having arcuate pressure surfaces and radii of predetermined final configuration including tongue and groove means in the opposed edge faces thereof and movable in parallelism to and from closed position in an arcuate path about the axis of turn of said tool and adapted to engage a ferrule square therewith.

3. A crimping tool of the pliers type, having a pair of complementary die elements integral with the jaws thereof in opposed matching relation, said die elements comprising steel castings having predetermined final configuration and movable in parallelism to and from closed position in an arcuate path about the axis of turn of said tool, said die elements each presenting a pair of arcuate pressure surfaces in spaced alignment differing in size and having rounded marginal edge portions including end walls closing the respective ends of said pressure surfaces as said die elements approach closed position whereby to prevent spreading of a ferrule when squeezed between either pair of said pressure surfaces square therewith to effect a crimping operation thereon.

4. A crimping tool of the pliers type having a pair of complementary die elements integral with the jaws thereof in opposed matching relation, said die elements comprising steel castings having predetermined final configuration and movable in parallelism to and from closed position in an arcuate path about the axis of turn of said tool, said die elements each presenting a pair of arcuate pressure surfaces in spaced alignment having different radii and rounded marginal edge portions, said arcuate pressure surfaces terminating at their respective opposite ends in coactable tongue-and-groove means adapted to close the inner and outer ends of said pairs of pressure surfaces as said die elements are moved toward closed position whereby to prevent lateral spreading of a ferrule when squeezed between either pair of said pressure surfaces square therewith to effect a crimping operation thereon.

5. A pliers of the transverse jaw type having a pair of complementary die elements integral with the jaws thereof and adapted to have parallel motion in an arcuate path about the axis of turn of said pliers, said die elements having a major edge face thereof in opposed facing relation each provided with complementary arcuate pressure surfaces having beveled margins in spaced alignment including a complementary tongue-and-groove means respectively therebetween and at the opposite ends thereof, said pressure surfaces being adapted to form substantially elliptical openings and said tongue-and-groove means being adapted to form end walls closing the respective opposite ends of said elliptical openings during movement of said die elements to closed position.

6. In combination with a hand tool of the pliers type having opposite, parallel jaw portions disposed transversely of the length of said tool including a stepped groove across the width of the edge face each of said jaw portions, of a pair of complementary die plates each defining a pair of arcuate crimping surfaces in spaced, relation in one major edge face thereof, and a complementary stepped groove across the opposite major edge face thereof, said die plates being each permanently secured in the stepped groove provided therefor in each of said jaw portions and adapted to have parallel motion to and from to closed position in an arcuate path about the axis of turn of said tool, said die plates including a complementary tongue and groove between the respective pairs of crimping surfaces and at the opposite ends thereof adapted to close the ends of said pressure surfaces during movement of said die plates to closed position.

7. In combination with a hand tool of the pliers type having opposite parallel jaw portions disposed transversely of the length of said tool including a stepped groove across the width of the edge face each of said jaw portions, of a pair of complementary die plates each defining a pair of arcuate crimping surfaces of different radii in spaced relation in one major edge face thereof and a complementary stepped groove across the opposite major edge face thereof, said die plates being each permanently secured in the stepped groove provided therefor in each of said jaw portions and adapted to have parallel motion to and from closed position in an arcuate path about the axis of turn of said tool, said die plates including a complementary tongue and groove between said work-

ing pairs of crimping surfaces and at the opposite end of each pair thereof adapted to close the ends of said crimping surfaces during movement of said die plates to closed position.

8. In combination with a hand tool of the pliers type having blank, spaced-apart parallel jaw portions each provided with a stepped groove across the width of each opposed edge face thereof, of a pair of complementary die plates having the same width as said jaw portions and comprising steel castings having final configuration and each defining a pair of arcuate crimping surfaces of different radii in spaced relation in one major edge face thereof, and a complementary stepped groove across the opposite major edge face thereof, said die plates being each permanently secured in the stepped groove provided therefor in each of said jaw portions and adapted to have parallel motion to and from closed position in an arcuate path about the axis of turn of said tool, said arcuate working surfaces having beveled marginal edges, and said die plates including a complementary tongue and groove between said pairs of arcuate crimping surfaces

and at the opposite end of each pair thereof to provide end walls for said crimping surfaces during movement of said die plates to closed position.

References Cited in the file of this patent

UNITED STATES PATENTS

158,810	Seiberling	Jan. 19, 1875
271,178	Wilser	Jan. 23, 1883
316,430	Derby	Apr. 21, 1885
611,574	Gay	Sept. 27, 1898
844,134	Jenkins	Feb. 12, 1907
1,611,968	Webster	Dec. 28, 1926
1,765,838	Kibby	June 24, 1930
1,858,418	Rowley	May 17, 1932
2,459,910	Alvin	Jan. 25, 1949
2,712,253	Kontra	July 5, 1955
2,744,428	Evans	May 8, 1956

FOREIGN PATENTS

697,362	Germany	Oct. 11, 1940