

March 16, 1971

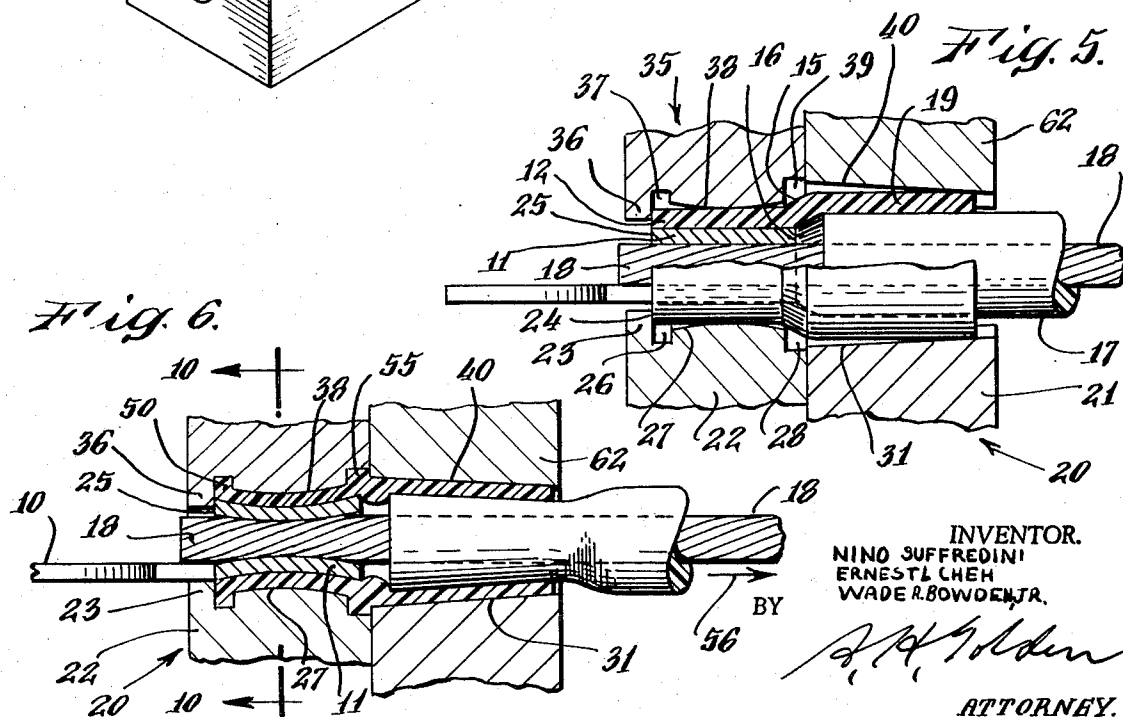
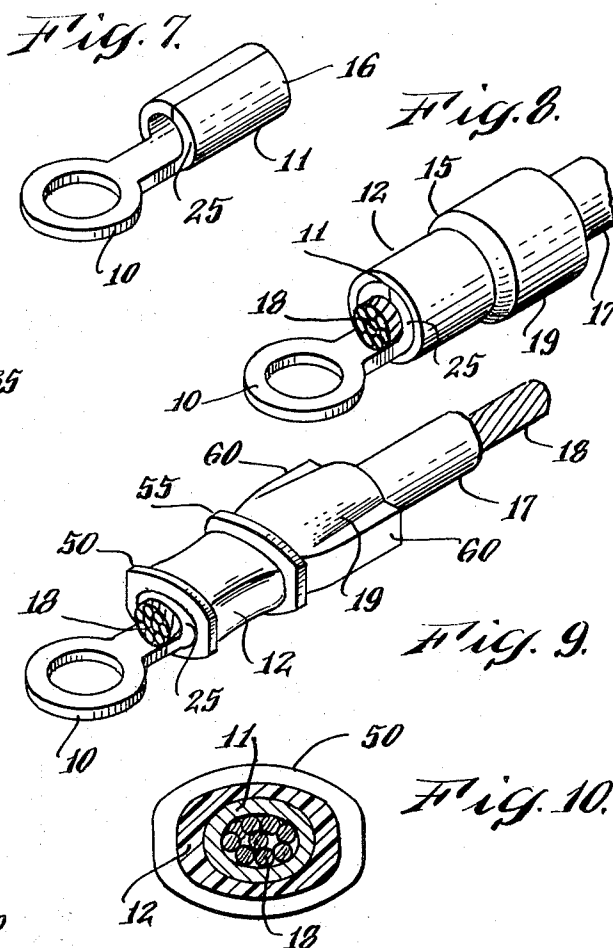
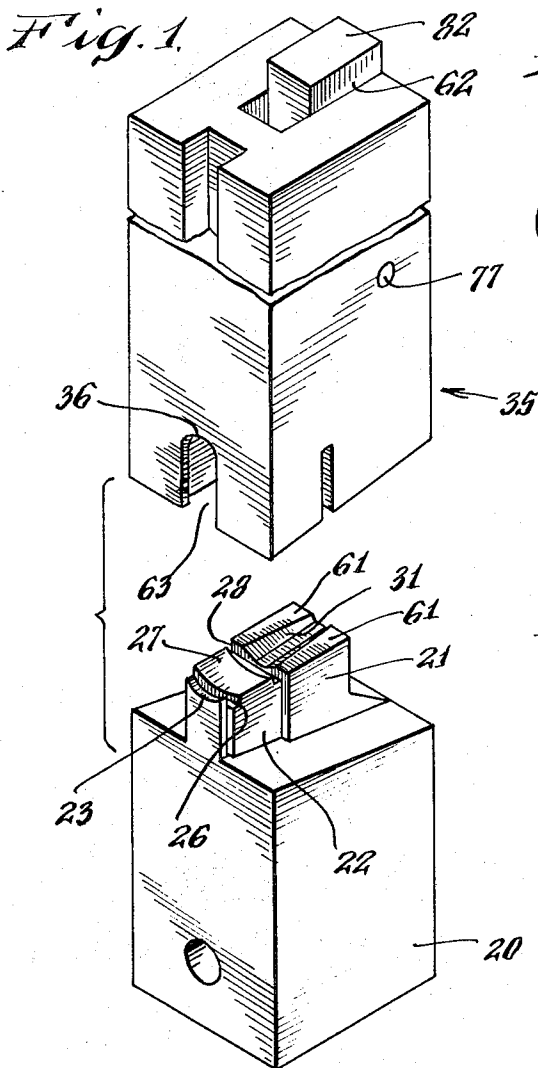
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Fig. 2.

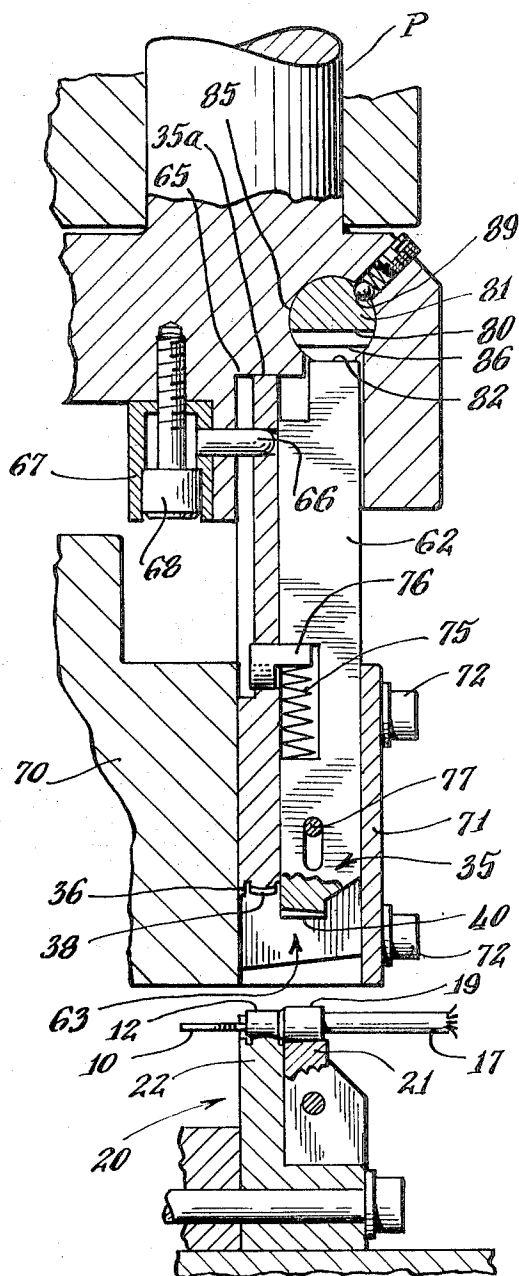


Fig. 3.

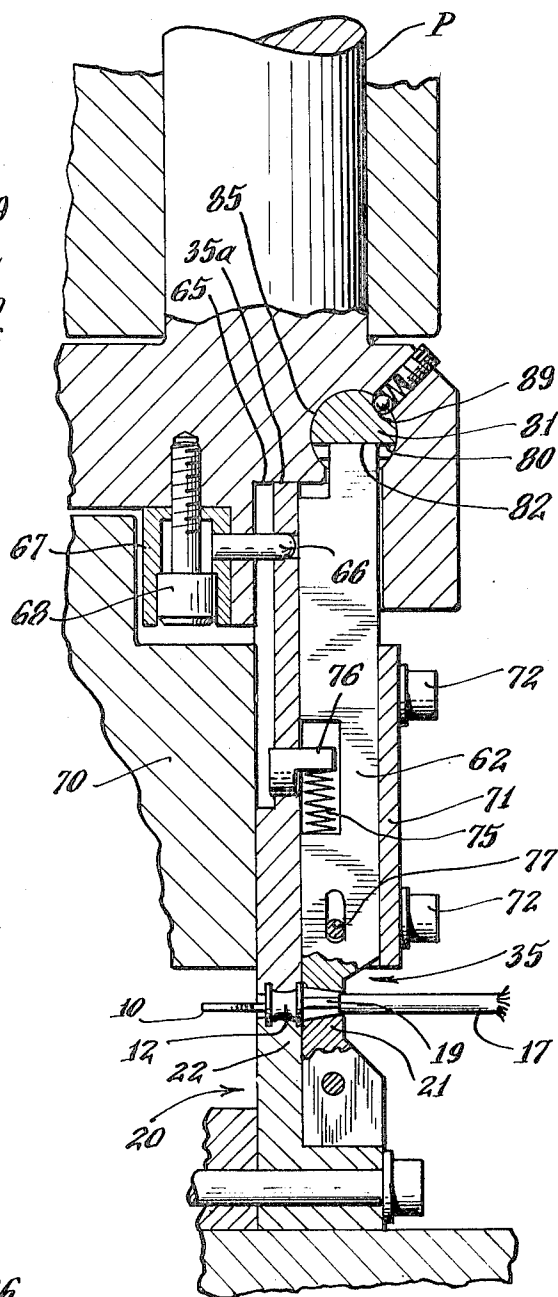


Fig. 4.

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11 Claims

ABSTRACT OF THE DISCLOSURE

A two part die crimps a wire conductor to a connector barrel. The barrel is covered by a plastic insulating sleeve that forms a shroud for a short length of the conductor extending out of the barrel. One part of die crimps the barrel to the conductor and is formed with a channel into which the plastic of the sleeve flows during crimping to form a ridge that limits the extrusion of the sleeve so as to preserve its insulating value. The other part of the die presses the shroud portion of the sleeve against the conductor. A stop determines the degree of movement between the two parts of the die and therefore the pressure against the shroud portion of the sleeve.

This invention relates to a die, and more particularly a die which one of the two coacting halves is itself formed of two relatively movable parts. The die of our invention is particularly adapted for coaction with a work piece in which two or more parts are formed of different materials, or which have different constructions.

Actually, the die of our invention is adapted for crimping a connector barrel to a conductor wire, after the conductor wire has been placed into the barrel. The barrel is of the type that is formed integrally with a connector terminal and takes the shape of a sleeve. Prior to the crimping operation the barrel is insulated by placing on it a plastic sleeve that extends beyond the barrel at one end of the barrel so that it may constitute a shroud for covering a part of the conductor wire extending outwardly from the barrel. Since the conductor wire covered by the shroud is formed of a flexing wire covered by plastic material, while the connector barrel is a metal sleeve, the die must necessarily coact with the plastic shroud in a manner different from its coaction with the plastic covered metal barrel. This is particularly true because frequently a particular form of shroud is required, and many times the shroud is flared prior to the crimping operation. Also, the shroud may be required to grip the conductor wire in different relationships because of varying conditions, even though the same connector is used, all as is well known to those skilled in the art.

As a feature of our invention we contribute a moving die portion having two relatively movable parts, with one part adapted to contact what we have indicated is the shroud portion of the plastic sleeve, the other part of the die being adapted to contact the plastic covered metal barrel of the connector. As a particular feature of the invention, we arrange to press the shroud contacting part of the die downwardly toward the connector, relatively to that part of the die acting as the crimping die for the connector barrel, preferably using a spring for this purpose. Therefore, it is obvious that the spring projected part of the die will be the first to contact the work piece, in this case the shroud portion of the plastic sleeve extending beyond the barrel. This contact will naturally react against the spring, so that the die will first be effective against the work piece only to the extent that the spring will hold the die against the work piece. The other part of the die is movable naturally with the press plunger on which it is mounted and will act solidly against the plastic sleeve

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covered portion of the metal barrel for the crimping operation.

By providing a stop for the spring projected die part, so that that die part can only move against the spring pressure a limited distance, we can, in effect, make the spring projected part of the die integral with the crimping die after some relative movement between the two. Through the adjustment of the stop mechanism thus making the two parts of the die integral, the degree of action of the spring projected part of the die against the shroud may readily be varied and controlled.

This part of our invention contributes a further feature of exceeding importance. Thus, it will be appreciated that as the shroud is acted upon by the spring projected part of the die, the spring operating against this movable part will be stressed. Therefore, upon completion of the crimping operation, the spring will be effective to press the spring projected part of the die relatively to the other part and to eject the work piece from the moving die so as to leave the connector resting on the fixed half of the die. This ejection of the work piece, in this case the crimped connector barrel, is of exceeding value and importance, as those skilled in the art will appreciate.

When the barrel crimping part of the two piece die portion acts against the plastic sleeve, and through the plastic sleeve against the metal barrel, it is obvious that there will be a tendency for a flow of the plastic material axially of the barrel and beyond the ends of the barrel, particularly beyond that end of the barrel facing the connector terminal and from which the inserted end of the wire extends. Naturally, flow of the plastic material endwise of the barrel can greatly decrease the thickness of the plastic at any particular point, and greatly lower the insulating quality of the plastic sleeve if not entirely destroy it. We have contributed a die concept under which the plastic material is itself utilized to prevent plastic flow. This use of the plastic material for preventing flow thereof is exceedingly important because it is impossible to manufacture the die so that it will confine the plastic against flow.

Thus, because of the relatively small size of the barrel sleeve and the very thin section of the plastic sleeve, it is not possible to utilize a die that will crimp and yet will effectively, as by a flange, confine the plastic sleeve relatively to the metal sleeve. Thus, when placing a wire into the barrel, it is the custom of the art to move the wire in the barrel to a point where its end extends beyond the barrel. In this way, the operator can determine readily that the wire has been fully inserted. Also, the end extending beyond the barrel remains uncrimped after the crimping operation. It is therefore somewhat larger than the crimped barrel, and obviously, any attempt to pull the wire outwardly of the barrel would require a compression of the uncrimped wire. Naturally, there are many advantages to this manner of bringing about the crimping. However, this protruding end of the wire limits the downward movement of the die, and therefore prevents the utilization of a flange effective for confining the plastic material against flow.

As a particular feature of this part of our invention concept, we utilize initial plastic flow of the plastic sleeve for creating a barrier against continued plastic flow. Thus, the die of our invention is formed with a pocket or channel located preferably at the part coinciding with the end of the plastic sleeve facing the terminal. When the die is applied to the plastic sleeve, the plastic material will flow into this pocket or channel, and will form a plastic shoulder which prevents any further flow of the plastic material so that the plastic material moves with the metal of the barrel and forces the metal barrel into crimping relation to the wire inserted in the barrel.

While we particularly utilize this channel at that end of the connector barrel facing the terminal, we also prefer to utilize the same shoulder forming construction at the other end of the connector barrel where the plastic sleeve extends beyond the barrel to form the shroud to which we have earlier referred.

We have thus outlined rather broadly the more important features of our invention in order that the detailed description thereof that follows may be better understood, and in order that our contribution to the art may be better appreciated. There are, of course, additional features of our invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which our disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of our invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of our invention, in order to prevent the appropriation of our invention by those skilled in the art.

Referring now to the drawings;

FIG. 1 is an isometric view showing the lower and upper halves of a die constructed in accordance with the invention to be described in this application;

FIG. 2 is a vertical section illustrating the die parts of FIG. 1 as they are related to one another in an actual crimping machine. In this figure a connector is illustrated in position on the lower half of the die with the upper half of the die about to descend into contact with the connector for effecting the crimping operation as well as the desired deformation of the shroud covering the conductor wire;

FIG. 3 is a view of the parts of FIG. 2 after the upper portion of the die has contacted the connector and has completed the crimping operation;

FIG. 4 illustrates in elevation and partial section the adjustable stop for one of the parts of the upper half of the crimping die for determining the relationship between the crimping operation on the barrel of the connector, and the deformation of the shroud covering the wire just outside the connector barrel;

FIG. 5 illustrates in partial section the position of the upper half of the die of FIG. 1 just as it is about to deform the shroud and also crimp the barrel of the connector against a wire conductor;

FIG. 6 illustrates the parts of FIG. 5 just after the crimping operation has been completed and shows the barrel crimped against the conducting wire, and the shroud portion of the plastic sleeve suitably deformed as required relatively to the wire conductor;

FIG. 7 illustrates one form of connector that may be utilized with the die of our invention;

FIG. 8 illustrates the connector of FIG. 7 after the barrel portion of the connector has been covered by a plastic sleeve and a wire conductor inserted into the barrel in advance of the crimping operation;

FIG. 9 illustrates the connector of FIG. 8 after the crimping operation has been completed and the shroud portion of the plastic sleeve has been deformed;

FIG. 10 is a section through the crimped connector barrel taken along line 10—10 of FIG. 6.

Referring now more particularly to the drawings, FIG. 7 shows in isometric one form of a connector that is adapted to be acted upon by the die of our invention. The part designated by reference numeral 10 of FIG. 7 is termed a terminal portion. Reference numeral 11 indicates the barrel portion of the connector, it being understood that the connector is actually formed of one piece of metal that is stamped and bent, all as is standard in the art. In FIG. 8, the barrel portion 11 is shown covered by a plastic sleeve 12, this sleeve being well illustrated also in FIG. 5, in which its relation to the connector and the wire to be crimped to the con-

ductor is also well illustrated. It will be noted that the plastic sleeve 12 is outwardly flared as best shown at 15 in FIG. 5 and FIG. 8. This flaring takes place just beyond the end 16 of the connector barrel 11, and its purpose is to accommodate the insulation 17 of a wire conductor 18. That portion of the plastic sleeve 12 covering the insulation 17 is termed a shroud, and is designated by the reference numeral 19 in both FIGS. 5 and 8.

For bringing about the crimping operation, it is customary to remove the insulation 17 from the end of the conductor wire 18 so that only the bare wire 18 will lie within the barrel 11 as is also well illustrated in FIGS. 5 and 8. It will be noted that the end of the connector wire 18 protrudes beyond the terminal facing end of the barrel 11. This relation of the wire 18 to the barrel 11 is important because, once the crimping operation is completed, an uncrimped and enlarged wire portion will be outside of the barrel and will effectively prevent the pulling of the wire 18 through the barrel 11, since such pulling would require the compression of the wire 18 in order to make it to conform to the inner diameter of the barrel 11. As was earlier emphasized, this end of the wire 18 also presents a problem because it limits die movement.

A simple viewing of the wire conductor 18 and its relation to the various parts illustrated in FIG. 5, will amply illustrate that if crimping pressure is applied to the sleeve 12 and against the barrel 11, the plastic material of the sleeve will flow axially of the barrel, since substantial pressures are required for crimping. Therefore, it follows that parts of the plastic sleeve 12 would be so extruded that little or no insulation would remain to protect some parts of the barrel 11. We have conceived the idea of preventing extrusion or axial flow of the plastic sleeve 12 relatively to barrel 11 through utilizing a flanged die to cover the end of the plastic sleeve 12. Unfortunately such relationship of a die to the plastic sleeve is partially prevented by the presence of the projecting end of the conductor wire 18. In other words, because the wire 18 projects beyond the barrel 11 as shown in FIGS. 5, 8 and 9 toward the terminal portion 10 of the connector, it is not possible for a die flange to cover that end of the plastic sleeve 12 that terminates at the connector barrel, since such a flange would obviously form an obstacle to the downward die movement of the crimping operation.

All this will appear more clearly after a further description of our invention is presented. In any event, because we have found that it is impossible to eliminate extrusion or axial flow of the plastic sleeve 12 relatively to the barrel 11 through the use of containing or limiting die surfaces, we have conceived, as is set forth earlier in this application, the feature of controlling the extrusion or flow of the plastic sleeve by forming a self-limiting ridge integral with the plastic sleeve during the first portion of the die closing operation, so that in effect, the plastic sleeve itself prevents the extrusion thereof and the possible baring of the barrel 11 so as to destroy the insulating value of the sleeve 12.

We believe that the form of the die of our invention is well illustrated in FIGS. 1, 5, and 6 to which reference is now made. In these figures it will be noted that the lower or fixed half of our die designated by reference numeral 20 is formed with an upstanding shroud crimping portion 21 and a barrel crimping portion 22. The barrel crimping portion is formed with a flange 23 that is adapted, as best illustrated in FIG. 5, to lie against the forward end surface 24 of the plastic sleeve 12. This end surface 24 lies in the same plane and is coincident with the end surface 25 of the barrel 11 of the connector. The flange 23 forms with the remainder of the die portion 22 a channel 26, this channel 26 lying between the flange 23 and the crimping surface 27 of the die portion 22. A somewhat similar channel 28 is formed between the other end of the crimping surface 27 of the lower die portion 22, and the shroud crimping surface 31 of the shroud crimping die portion 21.

The upper or movable half of the die coacting with the

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lower fixed half 20 is designated by reference numeral 35 in FIG. 1 and also in FIG. 5. The upper die portion is formed complementary with the lower die portion except that the shroud crimping part thereof is slidable relatively to the barrel crimping part as was earlier outlined, and as will be described presently. The barrel crimping part of the upper die is formed with a flange 36 that is similar to the flange 23, and there is a channel 37 between the flange 36 and the crimping surface 38 of the upper die. A further channel 39 is formed complementary to the channel 28 between the crimping surface 38, for the barrel, and the crimping surface 40 for the shroud 19.

Let us now examine FIG. 6 in order to determine just what happens when the two die halves of FIG. 5 approach one another to complete the crimping operation. The flange 36 of the upper die portion will approach the connector wire 18 as it, together with the flange 23 of the lower die slide along the end surface 25 of the barrel 11. While the upper and lower flanges 36, 23 will act somewhat to contain the plastic sleeve 12 so as to prevent extrusion thereof axially, it is obvious that the relationship of the parts will be ineffective to prevent considerable extrusion of the plastic material as the two die halves approach one another. At this point it will be noted that the protruding end of the conductor 18 will prevent the use of a fully effective flange 36, and that there is a space through which plastic can flow.

It will be noted that the channel 26 and the channel 37 are complementary, and form a peripheral chamber, in effect, into which the plastic from the sleeve 11 may flow axially as the die parts move relatively to one another from the position of FIG. 5 to the position of FIG. 6. This flow is such that a shoulder portion 50 is formed at the end of the plastic sleeve 12. This shoulder, once formed, will obviously first limit and then prevent plastic flow. Therefore, it may be said, that the channel portions 26, 37, permit the formation of a self-limiting shoulder through a controlled flow of the plastic material of the sleeve 12. Of course, the two channels 28 and 39 will also form a shoulder lying between the barrel covering portion of the sleeve 12 and the portion 19 of the sleeve 12 that is the shroud for the wire conductor insulating portion 17.

It will be noted that the shroud of the sleeve 12 is adapted to be tapered as illustrated in FIG. 6 by the surfaces 31 and 40 of the shroud forming die parts. In this manner, the shroud is deformed so as to grip effectively the insulation 17 of the wire conductor 18. A further effect of the tapering of the die portions 31 and 40 is to assist in preventing flow of the plastic material axially. Thus, in FIG. 6, it can readily be ascertained that the tapers 31 and 40 will assist the shoulder 55 formed at the right hand end of the barrel 11 on the sleeve 12, in preventing excessive axial flow by extrusion of the plastic sleeve 12 during the crimping operation.

It will be noted in FIG. 6 that the end of the conductor 18 facing the terminal 10 has not been deformed by the crimping operation, and that it is somewhat larger than the inside diameter of the deformed crimped barrel 11. As was earlier emphasized, this relatively larger portion of the connector wire 18 will be very effective in preventing outward pull of the connector wire 18 from the connector barrel in the direction of the arrow 56 in FIG. 6.

In FIG. 9, the shoulders 50 and 55 formed by the extrusion of the plastic sleeve 12 are well illustrated. Also well illustrated is the deformed shroud portion 19. At this point it will be well to indicate that the two wing-like portions 60 of the shroud portion 19 are formed by the relatively flat surfaces 61 of the lower portion of the die seen in FIG. 1, and similar surfaces on the upper portion of the die. Sectional FIG. 10 illustrates well the shoulder 50 as well as the crimped barrel 11 and its relation to the conductor wire 18.

While the lower die portions 22 and 21 are fixed rela-

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tively to one another, these being the die portions on which the connector barrel 11 together with the plastic sleeve 12 rests for the die closing operation, the upper die portion coacting with portions 21 and 22 is formed of two relatively moving parts as was earlier outlined. This, as was also emphasized, is necessary in order to vary the relationship between the barrel crimping operation and the shroud crimping operation, it being obvious that frequently it may as an example be desirable to have a relatively loose fitting shroud accompanied by an extremely effective barrel crimping operation, and other variations.

Referring now more particularly to the FIGS. 2 and 3, it will be seen that the upper crimping surface 40 for the forming of the tapered shroud 19 is integral with die part 62. This part 62 is slidable relatively to the upper die portion 35 to which reference has already been had. The flange 36 and the upper crimping surface 38 are integral with this die portion 35 as is apparent. It will of course be further appreciated that the die portion 35 (FIG. 1) is formed with a suitable opening 63 for accommodating the upstanding die portions 21 and 22 integral with the lower die body 20, so that the upper and lower dies may be brought into suitable closing and mating relationship.

The die 35 may be fixed in any desired manner to a vertically reciprocating piston of a standard press. Also, it may be guided in any suitable manner for vertical movement in a predetermined path so that it will coast effectively with the lower half of the die 20 that is fixed to the machine in which the vertically moving piston is mounted. The vertically moving piston of our invention is designated generally by the letter P, and it will be noted in FIGS. 2 and 3 that the upper surface 35a of the die 35 bears against a surface 65 of the piston P so that the piston P may exert downward pressure on the die part 35 as is required. A locating pin 66 is secured in proper position by a sleeve 67, in turn fixed by a screw 68 to piston P, for locating the die 35 relatively to the piston P. The die 35 may be suitably guided in its movement with the piston by a guide body 70 and a plate 71 secured to the guide body as by screws 72. As was indicated, the manner of mounting of the die 35 and its actuation by a piston P may be in any manner standard in the art. For this reason, this portion of the invention is shown and described only generally.

The movable die portion 62 carrying the shroud crimping die part 40 is projected downwardly relatively to the die part 35 by a spring 75 reacting against a lug 76 fixed to the die part 35. A pin 77 fixed to the die part 35 also guides portion 62. Let us now consider what happens when the piston P moves downwardly from its position of FIG. 2 to its position of FIG. 3 carrying the upper die 35 toward the lower die 20 and its upstanding die portions 21 and 22 on which now rests a connector of the type seen in FIG. 8 whose barrel 11 is covered by a plastic sleeve, a conductor 18 being in the barrel. The shroud forming surface 40 will first contact shroud forming portion 19 of the sleeve 12, but very little effective pressure will be applied, all pressure being exerted only through spring 75. After the portion 38 of the upper die 35 contacts the plastic sleeve 12 and acts through that plastic sleeve 12 against die surface 27 to crimp the barrel 11 against the wire 18, contact will be made between a surface 80 of an adjusting bar 81 (shown in detail in FIG. 4) and a surface 82 of the movable die portion 62. This contact is well illustrated in FIG. 3.

It is obvious that by varying the distance between the upper surface 82 of the movable die portion 62 and the surface 80, the point where pressure is applied to the moving die portion 62 by the piston P may be varied. In this way, it is possible to vary the relationship between the crimping of the shroud portion 19 of sleeve 12 relatively to conductor 17, 18, and the crimping of the barrel 11 to the wire 18. For this purpose we utilize bar 81 shown best in FIG. 4. This bar merely slides in an opening 85

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in the piston P, and in effect, is integral with piston P. In addition to a stop surface 80, it is equipped with stop surfaces 86, and 87, and may have any number of stop surfaces required in order to vary the relationship between the crimping of the shroud and the barrel. For indexing the slide 81, the slide has a series of depressions 88 and cooperating with these depressions is a spring pressed ball 89 carried by piston P. Obviously, the spring pressed ball 89 holds the slide 81 yieldingly in any of its positions to which it is moved manually.

While the relatively moving die parts are required in order to vary the crimping relationship has already been emphasized, there is a corollary contribution made by this sliding relationship. Thus, when the piston P moves upwardly from its position of FIG. 3 back to its position of FIG. 2, so that the crimped connector may be indexed toward a further position in the machine for severing, as is understood by those skilled in the art, the spring 75 will act to hold the connector in its position against the lower die. In effect, the spring 75 will bring about an ejection of the connector from the upper die so as to leave the crimped connector in a position on the lower die surfaces 27 and 31 for transfer laterally.

We do believe that those skilled in the art will now appreciate the rather considerable contributions of our invention. It is obvious that by a very simple arrangement of die portions, we are able to determine the relationship between the crimping of the shroud and the crimping of the barrel relatively to the wire conductor 17, 18. We are also able to prevent the flow of the plastic material of the plastic sleeve 12 through extrusion under pressure of the two die portions by utilizing the plastic of the sleeve itself as an obstruction to this flow. This method for preventing such flow of plastic under pressure is in itself of extreme value.

We now claim:

1. In a crimping die for a metal connector of the type having a terminal and a crimp barrel with a plastic sleeve on said barrel, one end of the sleeve being coextensive with that end of the crimp barrel facing the connector terminal, the other end of the sleeve extending beyond the sleeve and forming a shroud for a wire extending into said barrel with the inserted end of said wire just beyond the terminal facing end of the crimp barrel, a containing flange at one end of said die fitted against the terminal facing end of the plastic sleeve together with a crimping surface on said die inwardly of said end adapted to be applied against the plastic sleeve and therethrough to crimp the barrel covered by said plastic sleeve, and a channel in said die between said crimping surface and said flange for receiving plastic flowing axially toward said flange during the crimping action so that a ridge is formed on said plastic sleeve at said terminal facing end.

2. A crimping die assembly for a metal connector of the type having a terminal and a crimp barrel, a plastic sleeve on said barrel, one end of the sleeve extending beyond the barrel and forming a shroud for a conductor wire extending into said barrel, comprising a barrel crimping die part to be applied to that portion of the sleeve covering said crimp barrel for crimping the wire to the barrel through the intermediary of the sleeve, a shroud crimping die part for crimping the plastic sleeve relatively to a portion of the conductor wire outside the barrel, and means mounting said shroud crimping die part for movement relatively to said barrel crimping die part upon application of end pressure to said shroud crimping die part.

3. In the combination of claim 2, the feature of a spring pressing said shroud crimping die part endwise relatively

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to said barrel crimping die part and toward the plastic sleeve shroud, with said spring accepting pressure when said shroud crimping die part strikes the plastic sleeve, whereby said spring resists movement of said shroud crimping die part relatively to said barrel crimping die part.

4. In the combination of claim 2, the feature of means for limiting the movement of said shroud crimping part relatively to said barrel crimping part whereby to adjust the shroud crimping action of said shroud crimping part.

5. In the combination of claim 3, a press piston in which said die assembly is mounted with said barrel crimping part moving integrally with said piston, and an adjustable stop on said piston for limiting the movement of said shroud crimping part relatively to said barrel crimping part whereby to adjust the shroud crimping action of said shroud crimping part.

6. A crimping die or the like for a plastic covered metal sleeve or the like, comprising a crimping surface and a surface formed to prevent flow of the plastic of said plastic covering the metal sleeve endwise of said metal sleeve during application of crimping pressure by said die to said plastic and therethrough against said metal sleeve.

7. In the combination of claim 6, the feature that said surface of said die is formed as a channel or depression into which plastic flows as pressure is applied to said plastic by said crimping surface, whereby the plastic in said channel forms a limiting shoulder limiting the flow of plastic under pressure and locks the plastic against movement relatively to said die during application of crimping pressure by said die to said plastic.

8. In the combination of claim 7, the feature that at least one end of the die is formed with a flange defining one side of said channel, said flange fitting against the end of the metal sleeve as said die crimps said metal sleeve by application of pressure to the plastic covering said sleeve.

9. In the combination of claim 8, the feature that said metal sleeve is a crimp barrel of a connector and that it is covered by a plastic sleeve, one end of the plastic sleeve being coextensive with that end of the crimp barrel facing the connector terminal, the other end of the sleeve extending beyond the barrel and forming a shroud for a wire extending into said barrel with the inserted end of said wire just beyond the terminal facing end of the crimp barrel.

10. In the combination of claim 3, the feature that said shroud crimping die part through the intermediary of said spring applies angular pressure to prevent movement of said plastic sleeve in one direction relatively to said barrel, and a flange on the barrel crimping die part fitting against the end of the plastic sleeve to hold the plastic sleeve against movement in an opposed direction on said barrel.

11. In the combination of claim 10, the feature that said flange defines one side of a channel in said die into which plastic flows as pressure is applied to said plastic, whereby the plastic in said channel becomes a limiting shoulder limiting the flow of plastic under pressure and locks the plastic against movement relatively to said die during application of pressure by said die to said plastic sleeve.

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