Nov. 17, 1953 Q. BERG 2,659,871

ELECTRICAL CONNECTOR STRIP HAVING LATERALLY DISPLACED STRIP FEEDING EDGES

Filed Oct. 3, 1949 2 Sheets-Sheet 1

Fig. 1.

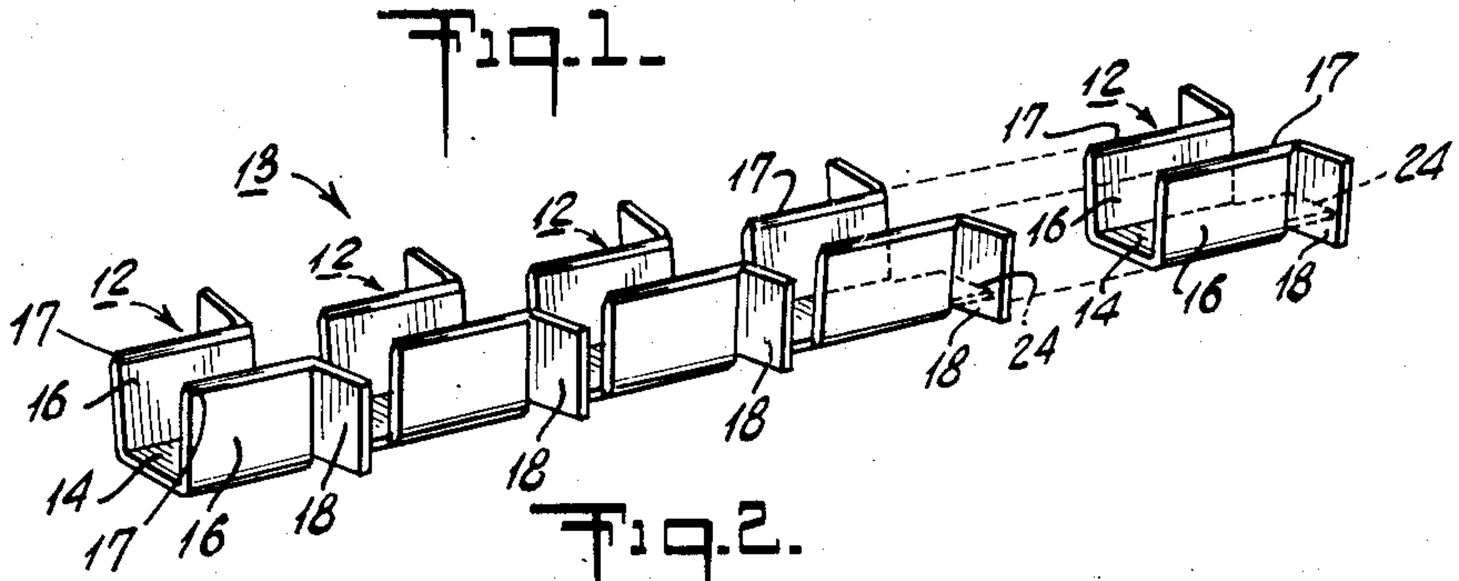

Fig. 2.

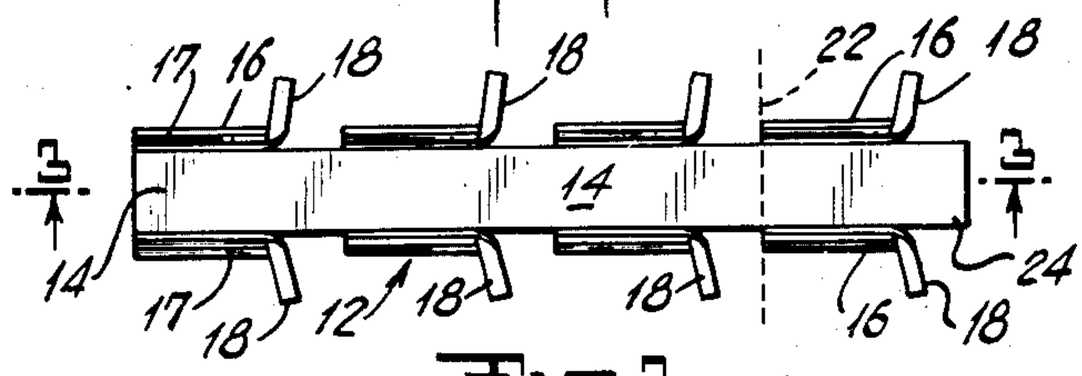

Fig. 3.

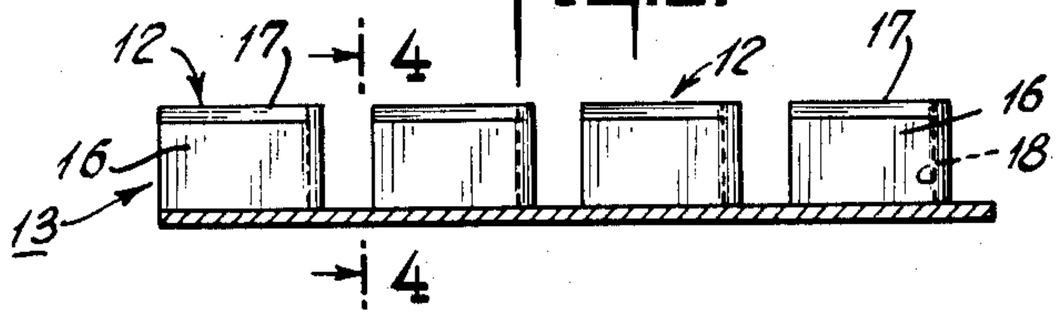

Fig. 4.

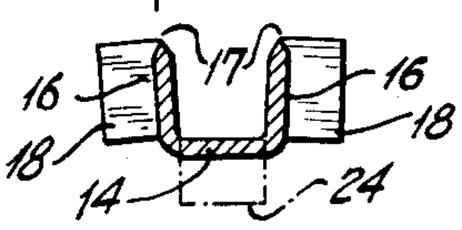

Fig. 5.

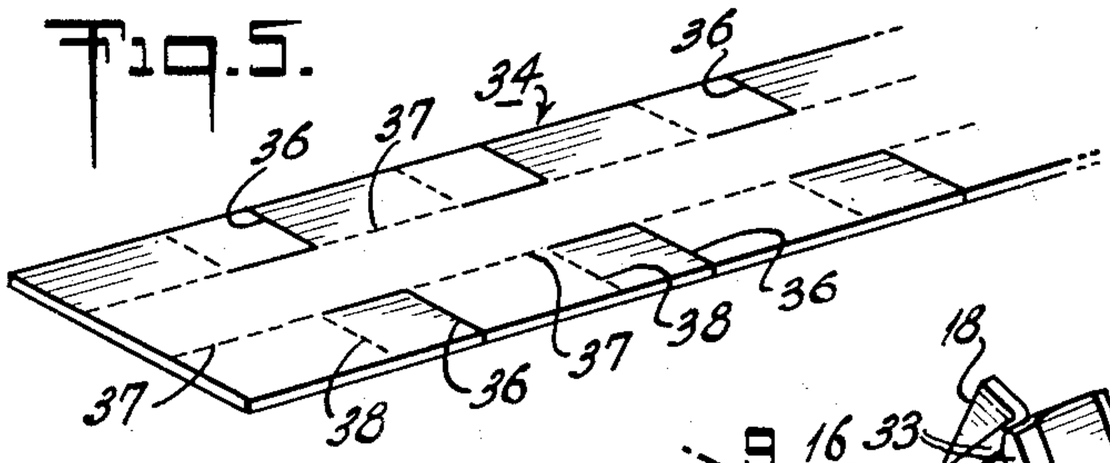

Fig. 6.

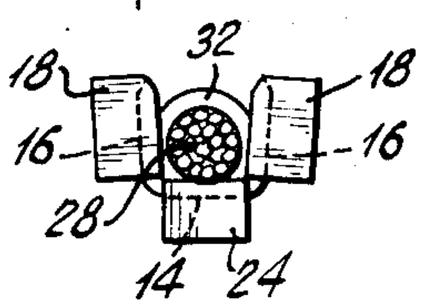

Fig. 8.

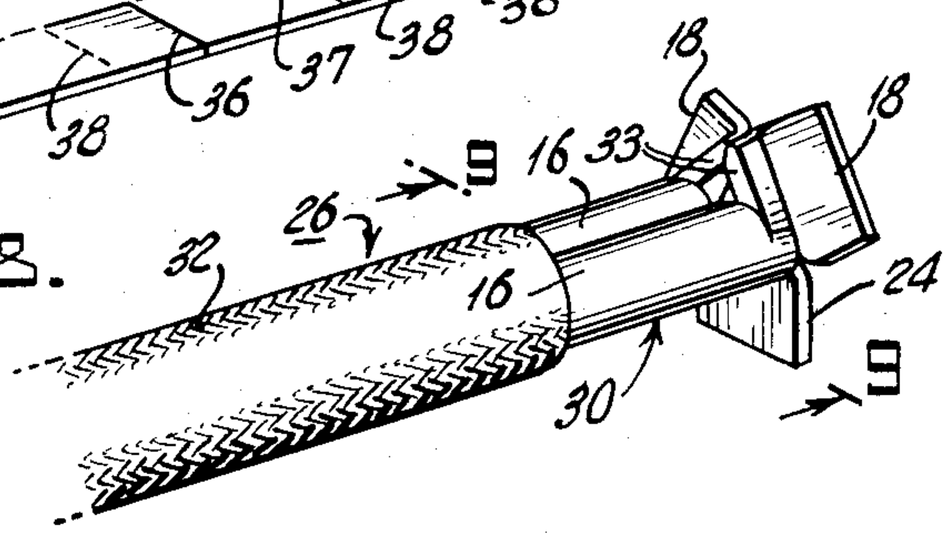

Fig. 7.

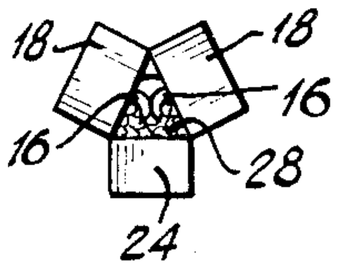

Fig. 9.

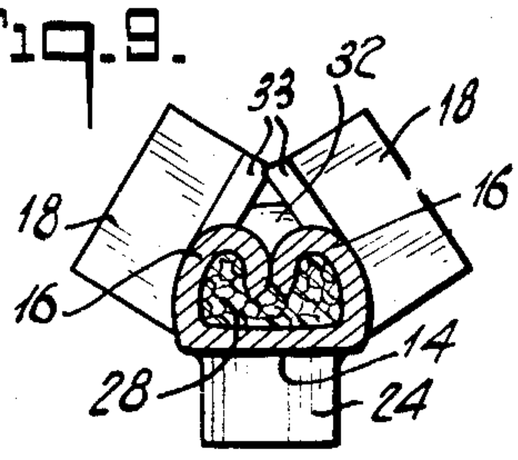

Fig. 10.

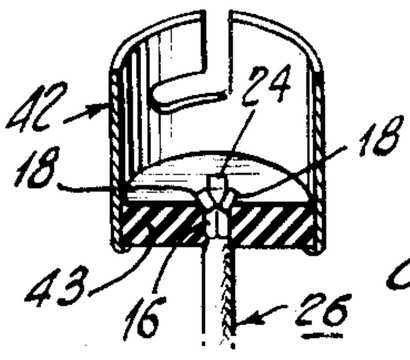

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Fig. 11.

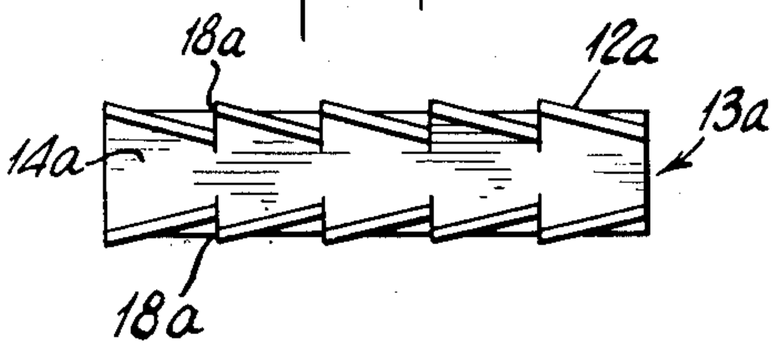


Fig. 12.

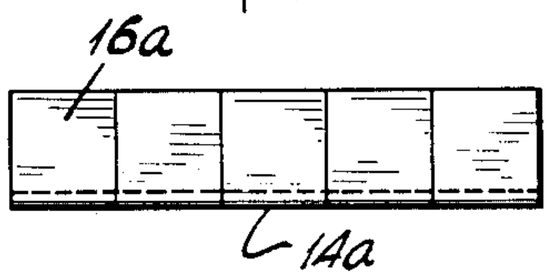


Fig. 13.

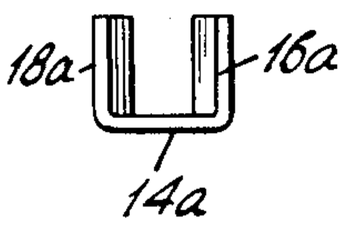


Fig. 14.

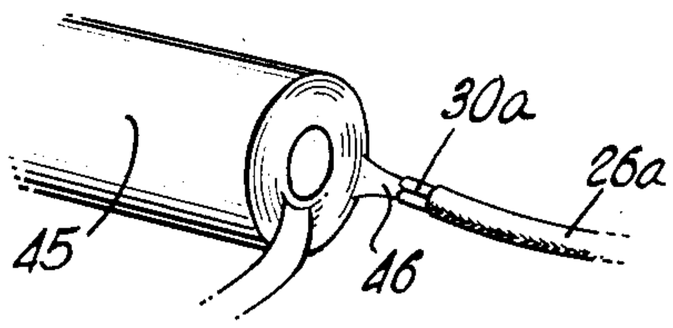


Fig. 15.

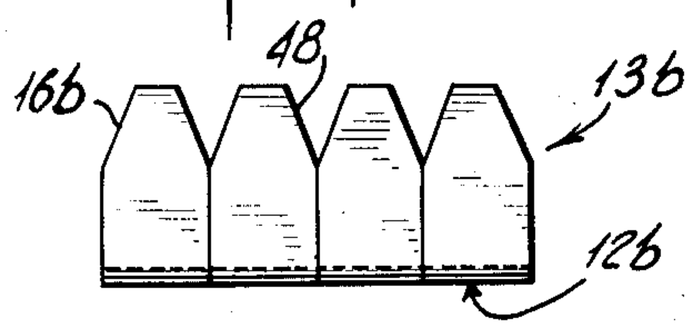


Fig. 16.

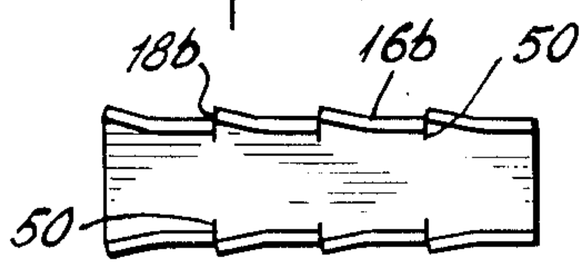


Fig. 17.

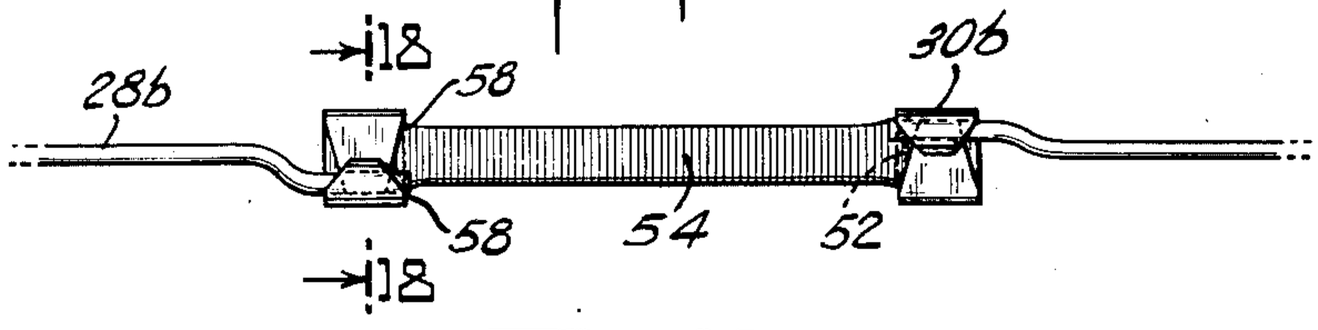
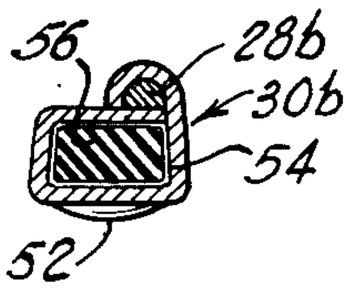


Fig. 18.



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UNITED STATES PATENT OFFICE

2,659,871

ELECTRICAL CONNECTOR STRIP HAVING LATERALLY DISPLACED STRIP FEEDING EDGES

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Application October 3, 1949, Serial No. 119,220

4 Claims. (Cl. 339—97)

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This invention relates to electrical connectors and the like, and to bonding blanks and multiple blank strips adapted for making electrical connections, leads, and other electrical circuit devices, and to methods of application.

In the manufacture and application of electrical connectors it has been customary to form a connector tongue, pin or receptacle, or the like by stamping and, adjacent to it and integral to a ferrule portion, closed into a cylinder, or in open channel form with upturned ears, which can be crimped down onto the wire as a gripping ferrule. These units follow one another in integral succession along the continuous strip, with the ferrule portion of each (or in some few designs the connector tongue, etc.) standing above the adjacent portions thus giving a projecting edge against which a pawl or other feeding device may engage for accurate feeding and positioning of the blanks in an applicator die.

Prior to this invention, there had also been used a connector strip in which the ferrule-forming ears succeeded each other directly along the sides of the strip. In such strip, gaps are punched out between the successive ears to give such feeding edges and to facilitate severance. Such a strip is disclosed in the copending application of Frank L. Pierce Serial No. 7,547 filed February 11, 1948.

The present invention provides for an economy of material and a simplification of the connector strip, without loss of utility. In its broader aspect the invention is applicable to various kinds of connectors, including particularly banding connectors for connecting wires to other conductors; and in one specific aspect it relates particularly to end contacts, e. g., for use in lamp sockets.

The present invention provides an improved blank and connector strip from which such lamp contact terminals can be made, to an improved contact terminal for lamp sockets and other uses, and to improved methods of construction and assembly.

In accordance with the invention, the terminals can be fabricated from a flat strip of sheet metal, all of which can be usefully incorporated into the assembled terminals, thereby eliminating waste material, simplifying the fabrication and assembly, and reducing the cost of the terminals. Moreover, provision is made so that the electric connection can be at least in part completed directly between the wire, around which the terminal is crimped, and an abutting contact surface, so that good electrical contact can be made.

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In the preferred embodiment of the invention a flat sheet of metal is formed, by bending and cutting, into a channel-like continuous strip of connectors adapted for use in automatic applicators in which they are assembled on a wire, etc. and crimped. The channel-like terminal strip is provided with a series of opposed regularly spaced transverse slits across the upwardly extending sides of the channel, at least a part of the sides adjacent the slits being bent outwardly to form projecting lateral edges. In the case of the end contact connector these bent out portions are slit from the base and constitute opposed fins spaced along the sides of the channel.

An individual terminal is assembled by severing the base of the strip between the opposed slits leaving a structure having a short U-shaped channel with the two opposed fins extending outwardly in opposite directions from adjacent ends of the two sides of the channel and a tongue which ordinarily at the instant of severing still projects beyond the fins in the plane of the channel base, but is bent downward into approximately co-planar relation with them, by the action of the applicator. Before or after the severing, the wire conductor is placed in the channel with one of its ends adjacent, or extending slightly beyond, the two fins; the terminal is then crimped to the wire by curling the sides of the channel inwardly over the wire and pressing their edges, which preferably are sharpened, end-wise down into or against the conductor. At the same time the forwardly-extending tongue may be bent down to form an additional fin in the same plane as the first-mentioned fins. By the crimping operation, the sides of the channel are bent inward bringing together the upper-inside corners of the lateral fins so that, from an end view, the assembled terminal has the appearance of a block Y, formed by the three fins, with the end of the wire conductor positioned at its center. If desired this conductor can project above the surfaces of the fins so as to make direct contact with a lamp base or other conductive member pressed against it. By utilizing such direct contact it is unnecessary to get contact between the connector and the conductor; it may be applied to an insulated wire without piercing the insulation.

The terminal is secured firmly to the wire conductor by the crimping operation, thus eliminating expensive soldering operations. The three fins provide a relatively large contact area, in a plane substantially perpendicular to the longitudinal axis of the terminal, against which a re-

movable pressure contact can be maintained, as by the center contact of an electric lamp.

Accordingly, it is a specific object of this invention to provide an improved terminal having particular utility as the center contact in an electric lamp socket, but which is also useful in other applications where electric contact is to be made by abutment of conducting surfaces. It is also an object to provide an improved terminal strip from which such terminals can be readily assembled. Still other aspects of the invention relate to methods of making such strips and terminals, and to apparatus and methods for reducing the cost, improving the quality of the electrical connection, and increasing the speed of fabrication and assembly.

These and other aspects, objects, and advantages of the invention will be in part pointed out in and in part apparent from the following description considered in conjunction with the accompanying drawings, in which similar parts bear similar reference numerals throughout the several views:

Figure 1 is a perspective view of a strip of terminals embodying the invention, and of a single terminal blank severed therefrom;

Figure 2 is a plan view of the connector strip shown in Figure 1;

Figure 3 is a sectional view taken along line 3—3 of Figure 2;

Figure 4 is a sectional view taken along line 4—4 of Figure 3;

Figure 5 is a diagrammatic showing of a flat strip of metal for fabricating the terminal strip of Figures 1, 2 and 3, with solid lines indicating places where slits are to be made and the broken lines indicating lines of bending.

Figure 6 is an end view of a wire conductor and a terminal assembled ready for crimping;

Figure 7 is an end view similar to Figure 6 showing the wire and terminal after crimping;

Figure 8 is an enlarged perspective view showing the assembled terminal;

Figure 9 is a sectional view taken along line 9—9 of Figure 8;

Figure 10 is a fragmentary sectional view in perspective of an electric lamp socket showing the terminal 12 forming the center contact for the lamp base;

Figures 11, 12 and 13 show respectively in plan, side elevation and end elevation another strip of banding connectors embodying my broader invention;

Figure 14 shows in perspective such a connector applied to a condenser for connecting a lead to a circuit wire;

Figures 15 and 16 show, in side elevation and plan, another embodiment of the invention;

Figure 17 is a top plan view of a resistor coil embodying the connectors of Figures 15 and 16; and

Figure 18 is a cross section taken on line 18—18 of Figure 17.

As shown in Figures 1 to 4, a group of terminals, generally indicated at 12, are arranged in the form of a continuous strip, generally indicated at 13, which comprises a base portion 14 having ears 16 extending upwardly at regularly spaced positions along opposite sides thereof. The ears 16 are arranged in pairs so that each of the ears on one side of the base 14 is positioned directly opposite an ear on the other side of the base. The upper edges of the bars 16 advantageously are swaged to form knife-like

edges, as at 17, for reasons that will become apparent later in the description.

A series of fins 18 are spaced along opposite sides of the strip, each fin 18 extending outwardly from and being supported by one of the ears 16, these fins also being positioned in pairs opposite one another along the terminal strip.

The ears 16 may be bent upwardly from the base portion 14 so that they are approximately perpendicular to the base, or they may form an angle somewhat less than 90°, as shown in Figure 4. The outwardly extending fins 18 also can be arranged perpendicularly to the plane of the ears 16, or they may form an angle slightly less than 90° therewith, as shown in Figure 2.

The assembly of a terminal 12, from the strip 13, with a wire, or an insulated conductor from which the insulation has been removed near its end, can be accomplished in a single operation by automatic machinery, but will be described as a series of separate steps in order to simplify the explanation.

A terminal 12 is severed from the strip 13, as by shearing along the line 22 of Figure 2. This terminal comprises the base 14, the two upright spaced opposed ears 16, the two outwardly-extending fins 18, and a forwardly-extending tongue 24 (see Figures 1 and 2) which is an extension of the base 14. The tongue 24 is then bent downwardly substantially perpendicularly to the base 14 so as to form an additional fin in approximately the same plane as the two side fins 18 (see Figure 4).

This terminal 12 is assembled with an insulated conductor, generally indicated at 26, (Figures 6 to 9) having an inner stranded wire conductor 28 and an outer insulating sheath 32 in the following manner: The wire 28 is exposed for a short distance near the end of the conductor by removing a portion of the insulation sheath 32, and this exposed portion of the wire 28 is placed in the channel formed by the base 14 and the ears 16 (see Figure 6) with the end of the wire 28 flush with or extending slightly beyond the fins 18 and 24.

The terminal 12 is crimped to the wire 28 by means of a suitable die (not shown), for example, generally similar to the one described in an application of James C. Macy, Serial No. 717,842, filed December 23, 1946, or in the application of Frank L. Pierce, Serial No. 10,951, filed February 26, 1948. By this means, the upper edges of the ears 16 are curved inwardly over the wire 28 and driven downwardly together between the strands of the wire, as shown in Figures 5, 7, 8 and 9, to form the wire-engaging ferrule 30. In some instances, the ears 16 may not penetrate the conductor, but be driven firmly downwardly on top of the wire or curled outwardly to press the face of its curl against the surface of the wire conductor.

During the initial crimping movement of the upper edges of the ears 16, the inner corners of the fins 18 are forced together, so that the three fins 18 and 24 appear as a block Y (see Figure 7). Further downward movement of the thin edges 17 of the ears 16 may shear or tear them from the adjacent fins 18 for a short distance near the upper edges of the ears 16, as at 33 in Figure 8 if the end of the die is sharp, or the die may be rounded at its end to form a groined arch in this area in accordance with the copending application Serial No. 10,951, filed February 26, 1948. For some applications it may be desirable to avoid this shearing action by

pre-cutting the sheet-metal stock, or by positioning the crimp further from the fins **18** so that the natural stretching of the metal will prevent any shearing action.

In the assembled terminal the three fins **18** and **24** form a relatively large surface against which a pressure electrical contact can be made. Moreover, the wire conductor itself can be allowed to extend at least flush with or slightly beyond the plane of the three fins so that electrical contact can be completed directly from the wire itself to the abutting contact member.

The small angle of fins **18** from the plane normal to the axis of the strip can be used to give this effect. If the wire is inserted through the channel between sides **16** until it abuts a stop beyond the ends of the fins **18**, it will thus project beyond the bases of said ears. When the ferrule is crimped onto the wire both it and the wire are extruded axially (due to radial compression) and this can be utilized to press the fins **18** against an abutment to bring them into co-planar relation. If it is desired to have the central conductor project to assure direct contact, the abutment may be recessed at the point where the wire projects at the completion of the crimping operation.

Although a convenient sequence of steps in the application of the connector to the wire is given above, it is not an essential. The connector can be crimped on to the wire before it is severed from the strip and the tongue **24** can be bent down before or after the crimping, to illustrate but a few of the possible variations.

As pointed out above, the terminals can be fabricated from flat sheets of metal without punching out or wasting any of the metal. For example, Figure 5 shows how the connectors of Figures 1–4 can be made from a stock metal strip **34** by shearing along the L-shaped lines **36** (indicated by solid lines) and bending the sides of the strip **34** upwardly along the broken lines **27**. The fins **18** are bent outwardly along the broken lines **38**.

Figure 10 shows the end of the terminal **12** mounted in an electric lamp socket **42** to form the center contact thereof. The crimped ferrule **16** is received in a hole in the insulating washer **43**; the exposed fins **18** and **24** engage the face of the washer in position to make contact with the center contact of the lamp, and the terminal **12** is assembled with the wire **32** connecting the lamp into its circuit (not shown).

From the foregoing it will be observed that the terminal embodying my invention is well adapted for the attainment of the ends and objects hereinbefore set forth and to be economically manufactured since waste material is eliminated and its fabrication is achieved by simple cutting and bending operations.

Although the terminal embodying the invention has been described as a center contact for an electric lamp, it should be understood that the invention is not necessarily limited to the use of the terminal in any particular combination; but that many possible embodiments may be made of the invention and many changes from the embodiment set forth, without departing from the scope of the invention.

Examples of such other embodiments are shown in Figures 11 to 18. That of Figures 11 to 14 consists of a simple strip metal bent to channel form with the sides slit at regular intervals and the resulting segments or side portions **16***a* twisted to a skewed position, shown

in Figure 11 so that the opposite edges **18***a* are exposed for engagement by a feeding pawl or other mechanism for precise feeding and positioning.

This strip **13***a* of Figures 11–13 is particularly adapted for application as banding ferrules. Thus in Figure 14 a condenser **45** has a lead **46** therefrom connected to a wire **26***a* by the crimped ferrule band **30***a*.

The example shown in Figures 15–18 can be fed either by a pawl, etc., engaging the notched edges **48** at the top of the opposite sides **16***b* or by a laterally engaging pawl or pawls, etc., engaging the projecting edges **18***b*. In this case these edges are bent out just far enough to provide such engagement. The opposite slits at these edges **18***b* are in this case carried part way across the base **14***b*, as shown at **50**, to facilitate the final severance of the individual connectors and to minimize any resulting burr. To the same end a recess in the crimping die may relieve the pressure on the severed part at the end of base **14***b*, as shown at **52** on Figure 18.

This is particularly important in the application shown, i. e., small resistors and coils for electronic circuits, wherein a burr might cause a rupture of the wire in the part of the coil which should make contact. Such a resistor as shown in Figures 17 and 18 consists of a fine wire **54** wound on a core **56** of insulating material tough enough (i. e. resistant and advantageously somewhat resilient to deformation by compression) to form a core against which the wire can be securely engaged by crimping of a ferrule **30***b*. The contact between the wire coil **54** and the banding ferrule occurs at the side edges **58**. On top, as shown in Figure 17, the edge recedes because of the tapered ends produced by the notching of the strip, while on the bottom the relieved area **52** avoids contact. The side edges are precisely located by the feed and thus the effective length of the coil is precisely predetermined.

As shown in Figure 18, the two ears **16***b* of the channel blank are bent over the top of the resistor to close the ferrule, the one ear being bent down flat and the other being curled down over the wire **28***b* and the pigtail connection and is compressed with inelastic cold forging of both the ear **16***b* and the wire **28***b* to give a tight rigidly held connection. The other ear lies substantially flat over the top of the coil, being pressed against it and locked by the other, curled end; and this pressure in turn maintains a perfect contact with the coil **54** and with the wire **28***b*.

Each of these examples, it will be observed, has a succession of connectors partially severed, by shearing or otherwise slitting, at opposite sides of a channel formed of a metal strip, but without removing metal of the strip to space said connectors. As shown each also has a portion of the side bent to expose an edge which can be engaged for feeding and/or positioning the connectors successively with the crimping die.

I claim:

1. An integrally-formed strip composed of a succession of integrally joined terminals for electrical conductors and the like, together comprising a channel-like strip having a continuous base portion, a plurality of substantially identical and contiguous side portions extending at an angle from each side of said base, and each of said side portions being severed from the corresponding side portion of the next terminal and having at least one of the severed edges displaced laterally

from the next to provide a strip feeding surface for said formed strip.

2. An electrical connector strip adapted to be parted into individual connectors for use on electrical conductors composed of a succession of integrally joined terminals together comprising a channel-like strip having a continuous base portion, a plurality of substantially identical and contiguous side portions extending upwardly from each side of said base and each of said side portions being severed from the corresponding side portion of the next terminal and having at least one of the severed edges of said side portions displaced outwardly from the next to provide a strip feeding surface for said formed strip.

3. An integrally formed connector strip composed of a succession of integrally joined connectors adapted to be cut into individual connectors for use on electrical conductors and the like together comprising a channel-like strip having a continuous base portion; a plurality of pairs of laterally opposed side portions integrally extending upwardly from said base; said side portions being substantially in edge to edge abutment along their upwardly directed edges; and

at least two of said upwardly directed edges of each pair of side portions being laterally displaced from the next adjacent upwardly extending edge portions.

4. A strip as defined in claim 2 wherein said entire side portions are disposed at an angle to the longitudinal axis of said strip.

QUENTIN BERG.

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