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PRINTED CIRCUIT CONNECTOR

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5 Claims. (Cl. 339-176)

This invention relates to a wire connection terminal and plug contact element for printed circuit boards and like electrical devices. Such terminals and contacts are useful in applications where a projecting contact on one member, such as a plug, is to be electrically connected to a flat conducting member or surface area, that is, one that is not provided with a socket or hole matching or fitting the projecting contact. Terminals for wires leading to the contacts are also provided.

In such types of connections, which may be considered butt-joints, pressure must be applied between the contacting surfaces sufficient to maintain good electrical transfer between the joined parts. In a multiple-wire plug connector, this pressure, or a uniformly good pressure, is often difficult to obtain as between all of the wires or circuits in the plug and their respective butt-connected conducting members in the cooperating joined part. With no limitations as to space, size, or number of parts involved, theoretically there are no difficulties. However, in plug elements having a multiplicity of connections to be made, or otherwise where size and space are at a premium and where cost is a factor, the design of an efficient, practical and economical butt-joint connection element is far from easy or obvious.

The principal object of this invention therefore, is to provide a simple plug element contact that will insure good endwise or butt-joint contact pressure with a flat surface when brought adjacent thereto, such an element being capable of manufacture in small sizes, for use in limited space, and being relatively economical and easy to fabricate and assemble. Another object is to provide a wire connection terminal combined with a contact of the type described.

The objects of this invention are accomplished by providing, as a unitary structure, an elongated ribbon-like piece or element of highly flexible and resilient conducting material, one end of which is provided with formations that are folded or crimped against the bared end of a wire to connect the piece mechanically and electrically thereto. According to the invention, the ribbon-like piece is first extended in an elongated spring section beyond the end of the connected wire and then provided with a second reversely bent spring section followed by a third opposite reversely bent spring section lying closely along side the first and second sections, ending in a contact tip extending beyond the outer end of the bend between the first and second sections. It is this contact end that is to be brought against a flat conducting area or surface to provide the resilient butt-joint connection, and the two opposite reversely bent sections form with the first section a double spring loop that gives a comparatively long stroke, soft-action operation to the contact end of the element. For mounting the resilient element in an insulating support or plug body, stop projections and locking ears are also provided, these in themselves constituting no part of the invention but, by their positions, holding the combination wire terminal and contact element in a plug body for contact with a printed circuit board when the plug is mounted thereon.

Other objects, advantages, and further details of that which is believed to be novel and included in this invention will be clear from the following description and claims, taken with the accompanying drawing in which is

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illustrated an example of a printed circuit board connection plug embodying the present invention and incorporating the reversely bent or double loop contact element and wire terminal above generally described.

In the drawings:

FIG. 1 is a top plan view of an exemplary multiple-contact plug attached to a segment of a printed circuit board and carrying a combined connection terminal and contact element according to the invention;

FIG. 2 is a transverse vertical sectional view through the plug of FIG. 1, substantially on the line and in the direction of the arrows 2-2 thereof, showing the combined terminal and contact element in side view; and

FIG. 3 is a perspective view of the combined connection terminal and contact element of this invention shown removed from the plug with which it is used.

For indicating a typical setting in which the invention is used, a printed circuit board 6 is shown, this board carrying on one face one or more substantially flush conducting lines or circuits 8, each ending in a contact area 10. In the circuit board shown, eleven such lines are used and the corresponding contact areas are arranged at equally spaced points around a circle, the conducting lines extending radially outwardly from the circle of contact areas. Other numbers and arrangements of conducting circuits and contact areas may be used as desired. A plug-locking hole 12 may be cut, pierced or otherwise formed through the board and a positioning recess or hole 14 also provided in the board in areas clear of the conducting and contact areas 8 and 10 for purposes that will later appear.

The contact plug of this invention is shown as an insulating body 16 of cylindrical or other shape having a projecting boss or ear 18 on one face, which is to be received within the recess or hole 14 on the board, for properly locating and positioning the plug on the board. The body 16 also has a cavity 20 therein and a central hole 22 in the cavity for slidably and rotatably carrying a locking plunger 24, used in removably connecting the plug to the circuit board. The plunger 24 has on its lower end a cross head 26 of such a size and shape as to pass readily through the plug locking hole 12 in the board when in one position, but when turned 90°, locking the plug against withdrawal from the board. A compression spring 28, extending and acting between the bottom of the cavity 20 in the body and a shoulder on the plunger 24, biases the plunger and its cross-head always toward their raised or outer positions so that after the cross-head has been passed through the locking hole 12 in the board, rotated 90° and released, the plug body will be firmly held against the plug board by pressure of the spring.

The plug body serves as a support for the wire terminals and contacts that are to cooperate with the contact areas 10 on the board and for this purpose the body is provided with a number of through passageways 30 corresponding in number and location with the contact areas on the board to be engaged and connected by the plug. Each passageway preferably has a pair of opposite side pockets or recesses 32 therein near one end, the other end of each passageway being enlarged by a step or ledge 34 facing in the opposite direction. The opposed side pockets 32 and the step 34 are provided for holding the combined connection terminal and contact element of this invention in the plug without the necessity for extraneous bolts, rivets or other separate attaching elements.

As seen in the drawing, the terminal and contact element of this invention is intended to be secured to the bared end of a wire W. The combined terminal and contact element is indicated generally by the number 36 and although but one is shown in the connection plug of the drawing it will be understood that any number may be used in accordance with the particular connection require-

ments of each installation. This element is made of an elongated thin strip or ribbon-like piece of highly flexible and resilient conducting material such as Phosphor bronze or the like and one end is firmly connected mechanically and electrically to the bared end of the wire as by side spurs 38 and/or ears 40 which are folded inwardly or crimped against the wire end and the insulation thereon in a manner readily understood. The element 36 thus becomes a connection terminal for the wire.

The elongated element 36 is extended flatwise beyond the end of the wire connection as shown by the straight spring section 42, this section lying along one side of the passageway 30 when assembled in the plug and extending preferably the full depth of the plug. Hook-like projections 44, bent back from either side edge of the straight section 42, will engage under the ledge 34 and prevent withdrawal of the terminal and contact element accidentally after it has once been inserted. Opposite straight side extensions 46 on the element 36 will engage and seat in the opposite side pockets 32 when the element is inserted to prevent the element from being pushed into the plug too far during assembly. By the hooks 44 and extensions 46 or something similar, the element is held firmly in place in the plug without the need for screws, rivets or the like.

The resilient nature of the element and the formation of the rest of its length also assist in holding the element firmly in place in the plug and at the same time provide the desirable action found in the contact portion of this invention. At the end of the straight section 42 the element is bent back on itself as at 48 in a semi-circle just within the face of the plug, producing a reversely directed, substantially straight spring section 50 adjacent and generally parallel to the first straight section 42. The element is then reversely bent back toward its original direction in a semi-circle as at 52 and a third substantially straight spring section 54 is thereby provided generally parallel to but longer than section 50. This last section extends beyond the bend 48 slightly and is provided with a final bent or semi-circular curved contact tip 56 dimensioned and positioned, when assembled, to project somewhat beyond the lower face of the plug body. The end or final edge 58 of the piece forming the terminal and contact element 36 is preferably extended sufficiently back toward bend 48 and section 50, so that it lies against the straight spring section 50 just above the end of curvature of the first bend 48. This is done so that there will be no tendency for the curved contact tip 56 to ride over the bend 48 and the soft spring action will be improved.

It will be seen that in side view the element 36 is in the shape of a broad, flattened "S," being composed of a double loop. When this element is forced into a passageway 30 in the plug the resilient nature of the material in this element and the formations of the bends 48 and 52 between the spring sections 42, 50 and 54 will allow this element to be compressed and the hooks 44 to ride over and engage under the ledge 34. The curved contact tip 56 as explained above, then will project and be exposed beyond the bottom face of the plug and be in position directly over a contact area 10 on the circuit board when the plug is properly engaged with the circuit board. Although the boss 18 and the resiliently pressed locking plunger 24 are shown for locating and securing the plug to the board, other structures for positioning and securing the plug with respect to the board may be used according to this invention. The principal function of this positioning and securing means is to hold the plug so that the contact tip on the combined connection terminal and contact element will be properly positioned and pressed firmly against a contact area 10 on the board 6. The pressure against the exposed contact tip will cause the element to flex at the bends 48 and 52 and also slightly swing and bow the spring sections 42, 50 and 54. This flexing, swinging and bowing action will allow a

comparatively long stroke of the curved contact tip 56 with relation to the plug body, a soft-action operation that is particularly suitable for the type of connection being made. The terminal end or edge 58 will bear against the section 50 of the element and the section 54 of the element will bear against a side wall of the through passageway 30 and give a smooth sliding action to the contact tip 56 during its contacting stroke.

Obviously, when the plug is released from the circuit board and withdrawn, the various sections of the element will flex, swing and bow back again until the contact tip 56 is again fully projected from the face of the plug.

As should be evident from the foregoing description, certain aspects or details of this invention are not limited to the particular ones set forth herein, and it is contemplated that various and other modifications and applications of the invention will occur to those skilled in the art. Therefore, it is intended that the appended claims shall cover such modifications and applications as do not depart from the true spirit and scope of the invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A combined wire terminal and contact element for a connection plug, comprising
 - an elongated thin strip of resilient electrically conducting material,
 - integral formations on said strip near one end thereof adapted for connecting the end of a wire thereto,
 - a first spring section on said strip extending away from said wire connecting formations,
 - a first reverse bend at the end of said first section leading to
 - a second spring section extending alongside said first section,
 - a second reverse bend at the end of said second section leading to
 - a third spring section extending alongside said second section to a point beyond said first reverse bend,
 - a contact tip at the said point on said third section and
 - integral means on said strip adapted for holding said strip in a connection plug with said contact tip exposed.
2. A terminal and contact element according to claim 1,
 - said contact tip comprising another reverse bend at the end of said third section,
 - the end of said strip lying against said second section near said first reverse bend.
3. A combined wire terminal and contact element for a connection plug, comprising
 - an elongated ribbon-like piece of flexible resilient electrically conducting material formed along its length into
 - means near one end for connecting the end of a wire thereto,
 - a substantially straight first section on said piece extending lengthwise beyond said wire connecting means,
 - a first semi-circular bend at the end of said first section,
 - a substantially straight second section following said first bend, extending lengthwise alongside and generally parallel to said first section,
 - a second semi-circular bend at the end of said second section,
 - a substantially straight third section following said second bend, extending lengthwise alongside and generally parallel to said second section but projecting beyond the extent of said first bend, and
 - a last semi-circular bend at the projecting end of said third section, said last bend serving as a contact tip for the element.

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4. A terminal and contact element according to claim 3, said last bend being directed back toward said first bend and said second section, the end of said piece lying against said second section.

5. A terminal and contact element according to claim 3, said piece including integral projections thereon adapted to engage against cooperating shoulders in a connection plug and

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thereby hold said piece in the plug with said contact tip bend exposed.

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