Oct. 11, 1960 E. A. BENNETT 2,956,260

MULTI-CONTACT CONNECTOR

Filed Sept. 3, 1957

Fig. 1.

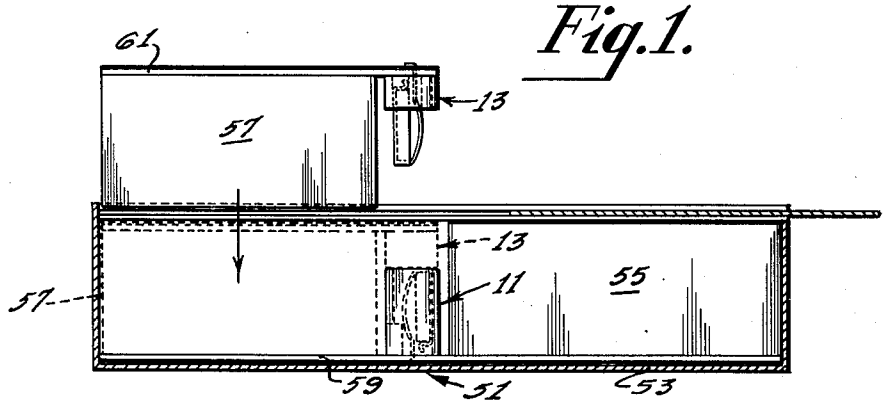


Fig. 2.

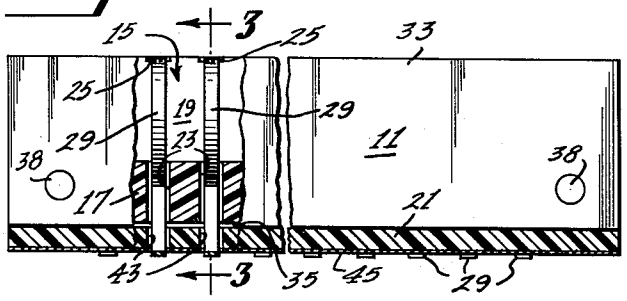


Fig. 3.

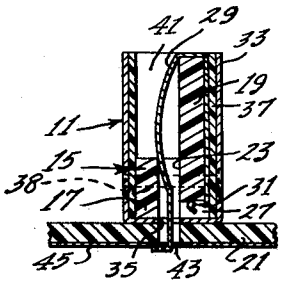


Fig. 4.

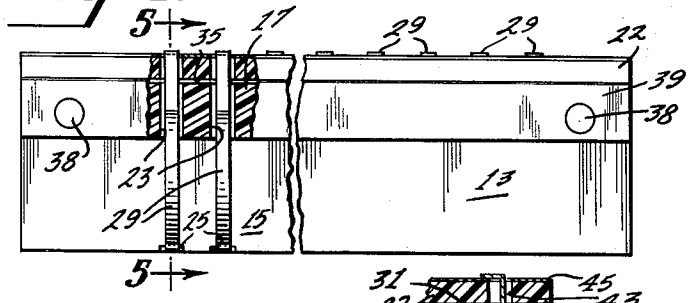


Fig. 5.

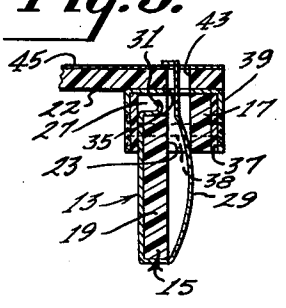
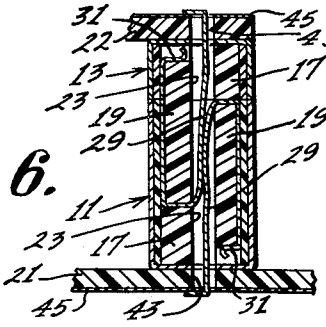


Fig. 6.



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MULTI-CONTACT CONNECTOR

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10 Claims. (Cl. 339—176)

This invention relates to a multi-contact connector, and more particularly to a multi-contact connector adapted for use with printed circuits in miniature circuit assemblies.

An object of this invention is to provide an improved miniature multi-contact connector adapted for use with printed circuits.

Another object of this invention is to provide an improved multi-contact connector having mating members including identical structural parts for economy of manufacture.

A further object of this invention is to provide an improved miniature multi-contact connector in which good electrical connection between contacts is reliably maintained.

A still further object of this invention is to provide an improved miniature multi-contact connector containing a large number of well insulated contacts in a relatively small space.

A connector, in which the above objects are realized, comprises two mating members including identical parts of insulating material. Each of the parts comprises a strip having a substantially rectangular base and a substantially rectangular contact supporting rib which is an extension of one side of the base. The base and rib define a substantially L-shaped cross section. Spring metal contacts are supported on the parts in transverse planes and are exposed on the inner faces of the ribs. The exposed portions of the contacts are supported for engagement with similarly supported contacts on the mating connector member. Portions of the contacts in each part extend through the base thereof for connection to a printed circuit board or other member on which the connector members are mounted.

A metallic shell completely encloses the part for one connector member with the exception of the face opposite from the base. A metallic shell encloses the base of the part for the other connector portion. In the one connector member, a recess is formed by the shell and the contact supporting rib for receiving the contact supporting rib of the other connector member. When the two connector members are assembled, the two shells completely enclose the assembly.

The novel features of the invention, as well as additional objects and advantages thereof, will be understood more fully from the following description when read in connection with the accompanying drawing, in which:

Figure 1 is an end view of an assembly including a connector in accordance with the present invention and including other circuit portions shown as modules and printed circuit boards;

Figure 2 is a side view, partially broken away, of a first connector member;

Figure 3 is a sectional view taken along the line 3—3 of Figure 2 in the direction of the appended arrows;

Figure 4 is a side view, partially broken away, of a second connector member;

Figure 5 is a sectional view taken along the line 5—5 of Figure 4 in the direction of the appended arrows; and

Figure 6 is a sectional view of the first and second connector members in mating relationship.

Referring in detail to the accompanying drawing, an illustrative embodiment of a connector assembly comprises a first or socket connector member **11**, shown in Figures 2 and 3, and a second or plug connector member **13** shown in Figures 4 and 5.

Each connector member includes a molded part **15**, a plurality of contacts **29** supported on said part, an enclosing shell **33** or **39** and insulating lining strip **37**. The parts **15** are identical for each connector member and may be cast from an insulating material such as mica filled phenolic. The parts are cast in elongated strips having a substantially rectangular base **17** and a rib **19** which defines a contact supporting portion. The base **17** is adapted to lie adjacent to a printed circuit board **21** or **22** upon which the connector members are mounted in a manner to be described. The contact supporting rib **19** is an extension of one face of the base **17** and lies in a plane perpendicular to the printed circuit board. The base **17** and contact supporting rib **19** define a substantially L-shaped cross section for the form **15**. The faces of the base **17** and rib **19**, which are common, will be referred to as the rear or outer faces. The opposite face of the rib will be referred to as the front or inner face. The faces of the part **15** opposite from the face adapted to lie adjacent to a printed circuit board **21** will be referred to as upper faces.

A row of holes **23** is provided in the part **15**, the holes extending through the base **17** substantially in the plane of the inner face of the rib **19**. The part is further provided with grooves **25** which lie in the rear face of the form and extend over the upper edge of the rib. The grooves and the holes lie in transverse planes of the part **15**, which may be spaced on one tenth inch centers, for example, along the length of the part. Each locating plane defines the position of one groove **25** and one hole **23**. A corner groove **27** is provided in the base, adjacent to the rear face of the part **15** and extends the length of the part.

The part **15** supports a plurality of flat spring metal contact strips **29** which may be made from a metal such as beryllium copper, suitably plated. As viewed from one end of a connector member, these contacts are generally in the shape of a U. The terminal end of a contact **29** extends through a hole **23**, in the base **17** of the part, and protrudes from the base for connection to a printed circuit board. The contact extends, from the upper face of the base, adjacent to the front face of the rib **19**. This portion of the contact, which is adapted to engage a similar contact on a mating connector member, is bowed away from the inner face to provide contact pressure when the connector members are engaged. The contact is then formed over the rib **19** and lies in a groove **25** in the upper and rear faces of the rib and the part **15**. The end of the contact, opposite from the terminal end, is formed to provide a clip **31** which engages the groove **27**. By means of the clip **31**, the contact is held relatively rigid on the form **15** without other supporting means.

Each connector part **15**, with its associated contacts **29**, is partially enclosed by a shell, which is made of brass for example. In the case of the first or socket connector member **11** (Figures 2 and 3), a shell **33** is rectangular and has one open face. The base of the shell **33**, which is opposite from the open face, is provided with a longitudinal slot **35**. The part **15** of the first connector member is positioned in the shell **33** so that the terminal ends of the contacts **29** extend through the slot **35** and protrude from the base of the shell. The shell is sufficiently deep so that the part **15** is entirely enclosed within the

shell, the open face of the shell lying in the plane of the upper edge of the rib **19**. Strips of insulating material **37**, which may be made of a glass base phenolic, are placed along the two opposite sides of the shell **33** to insulate the shell from the part **15** and its associated contacts. The assembly of the part **15**, the shell **33**, and the insulating strips **37** is held together by suitably placed rivets **38**, for example.

In the case of the second or socket connector member **13** (Figures 4 and 5), a similar shell **39** is provided. The shell **39**, however, is not as deep as the shell **33** and encloses only the base **17** of its associated part **15**, hence exposing the rib **19** and portions of the contacts **29**.

In each of the connector members, the contact clips **31** are confined within the longitudinal groove **27** by the respective shells and insulating strips. The portions of the contacts adjacent to the clips **31** are confined within the grooves **27** by the respective shells and insulating strips. This confinement of the contacts, in addition to the confinement provided by the holes **23**, provides for a relatively rigid securing of the contacts to the parts **15** as well as accurate longitudinal placement of the contacts with respect to the parts **15**.

Referring now particularly to Figure 6, it will be seen that a recess **41** is formed in the first connector member **11**, into which the rib **19** of the second connector member **13** is received. When the first and second connector members are engaged as shown, the bowed portions of the contacts **29** engaged each other in reliable electrical and mechanical contact. It will further be noted that, when the connector members are engaged, the shells **33** and **39** provide a complete shield for the connector assembly. Hence, electrical shielding for the connector is provided if the shields **33** and **39** are metallic.

Each of the connector members **11** and **13** is secured to a printed circuit board **21** or **22** by means of the terminal ends of the contacts **29**, which extend through holes **43** provided in the printed circuit boards. The printed circuit boards are single sided boards and the connector members are mounted on the faces of the boards opposite from the faces provided with the printed conductors **45**. The terminal ends of the contacts may be bent over to lie against the printed conductors on the board and the contacts may then be soldered to the board by any of the well known techniques. Each of the connector members is then rigidly joined to a printed circuit board.

Referring now particularly to Figure 1, an end view of a circuit structure **51**, including the above described connector members, is shown. A housing **53** for the circuit structure is shown partially broken away. The illustrated circuit structure includes the complete circuitry for a transmitter and receiver. The outside end dimensions of the housing, as illustrated in Figure 1, are approximately 2¾ inches by ⅝ inch. The length dimension, which is not shown, is approximately 3¾ inches.

The circuit structure includes individual circuits which are shown as enclosed modules **55** and **57**. The module **55** extends the length of the unit and is mounted on a printed circuit board **59**. A first connector member **11**, as described above, is mounted on the circuit board **59** adjacent to the module **55**. The module **57** is mounted on a printed circuit board **61**. A second connector member **13**, as described above, is mounted on a printed circuit board **61** adjacent to the module **57**. The module **55** is shown, in full lines, in position to be inserted into the circuit structure. The module **57** is shown, in dotted lines, in its assembled position. In this position the connector members are engaged as shown in Figure 6.

As to the dimensions of the connector members themselves, in the illustrated circuit structure, the overall heighth of each connector member is approximately three eighths inch and the overall thickness is approximately three sixteenths inch. The above dimensions are indicated to emphasize the small size of the connector members. The length of the connector members is slightly less than the length of the circuit structure. Thirty-four individual contacts are provided in each connector member.

There has been described a connector assembly including mating connector members of extremely small size and providing reliable electrical contact. The parts **15** of the two connector members are of identical structure providing for economy of manufacture. Similarly, the contacts **29** of both connector members are identical. The connector members comprise a novel structure which includes enclosing shells to provide complete electrical shielding of the assembly when the connector members are engaged with each other.

What is claimed is:

1. A connector member for cooperation with a mating connector member provided with a contact, said first-named connector member comprising a contact supporting part of insulating material, said part having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having an outer face and an inner face and said base portion being formed with a hole, a spring metal contact supported over said outer and inner faces of said rib portion and extending through said hole in said base portion to provide a terminal for said contact, an open faced shell at least partially enclosing said part and confining said contact at said outer face of said rib portion, and means insulating said shell from said contact, the portion of said contact lying adjacent to said inner face of said rib portion being adapted for engagement with said contact of said mating connector member.

2. A multi-contact connector member comprising an elongated contact supporting part of insulating material, said part having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having an outer face and an inner face and said base portion being formed with a hole, a plurality of spring metal contacts supported in spaced relation over said outer and inner faces of said rib portion and extending through said hole in said base portion to provide terminals for said contacts, an open faced shell enclosing said part and confining said contacts at said outer face of said rib portion, means insulating said shell from said contacts, said shell and the inner face of said rib portion defining a recess dimensioned to receive a mating connector member, and the portions of said contacts lying adjacent to said inner face of said rib portion being adapted for engagement with respective contacts of said mating connector member.

3. A multi-contact connector member comprising an elongated contact supporting part of insulating material, said part having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having an outer face and an inner face and said base portion being formed with a hole, a plurality of spring metal contacts supported over said outer and inner faces of said rib portion and extending through said hole in said base portion for connection to a supporting member, said rib portion having means for positioning said contacts in spaced relation, an open faced shell enclosing said part and confining said contacts at the outer face of said rib portion, means insulating said shell from said contacts, said shell and said inner face of said rib portion defining a socket recess dimensioned to receive a contact supporting portion of a mating connector member, and the portions of said contacts lying adjacent to said inner face of said rib portion being adapted for engagement with respective contacts of said mating connector member.

4. A connector member comprising a contact supporting part of insulating material, said part having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having an outer face and an inner face and said base portion being formed with a hole, a spring metal contact supported in spaced relation over said outer and inner faces of said rib portion and

extending through said hole in said base portion to define a terminal for said contact, an open faced shell enclosing said base portion and confining said contact at the outer face of said rib portion, and means insulating said shell from said contact, said rib portion protruding above the open face of said shell, said protruding rib portion being dimentioned to be inserted in a mating connector member also having a contact, and the portions of said contact lying adjacent to the inner face of said rib portion being adapted for engagement with the contact of said mating connector member.

5. A multi-contact connector comprising a pair of mating connector members, each said member including identical contact supporting parts of insulating material, each of said parts having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having an outer face and an inner face and said base portion being formed with a plurality of holes, and each said member also including a plurality of spring metal contacts supported in spaced relation therealong over said outer and inner faces of said rib portion thereof and extending through said holes in said base portion thereof to define terminals for said contacts, a first open faced rectangular shell enclosing the base portion of one of said connector members and confining said supported contacts thereon at the outer faces of said rib portion thereof while leaving said rib portion unenclosed, means insulating said shell from said contacts, a second open faced shell enclosing said contact supporting part of the other of said connector members and providing a recess between said second shell and the inner face of said rib portion of said other contact supporting part, said recess being dimensioned to receive the unenclosed rib portion of said first connector member in a manner such that said inner faces of said rib portions oppose each other and said contacts of both said rib portions are disposed for mating engagement.

6. A multi-contact connector comprising a pair of mating connector members, each said member including identical contact supporting parts, each part being comprised of insulating material having an L-shaped cross section, said part being adapted to interlock with a mating contact supporting part, said part cross section being defined by a base portion by means of which a connector member is supported and a rib portion extending from said base, said rib portion having an outer and inner face and said base portion having a plurality of holes extending therethrough terminating adjacent to the inner face of said rib portion, each said member also including a plurality of spring metal contacts formed over the inner and outer faces of said rib portion thereof, said contacts extending through and protruding from said holes in said base portion thereof to provide terminals for said contacts, and said mating connector members also including open faced shells, said contacts being insulated from the shells, said shells each having openings therein in alignment with said base portion openings and through which said contact terminals protrude from said base portions, one of said shells for a first of said connector members substantially enclosing the contact supporting part of said first connector member, and the other of said shells for the second of said connector members enclosing the base portion of said second connector member, the shell and contact supporting part of said first connector member providing a recess for receiving the rib of said second connector member, and said inner faces of said ribs lying adjacent to each other when said connector members are in mating relation whereby the contacts of said first connector member engage the respective contacts of said second connector member.

7. A multi-contact connector comprising a pair of mating connector members, each of said members including a contact supporting part and a shell therefor, each said part being comprised of insulating material having an L-shaped cross section defined by a base portion and a rib portion, said rib portion having a front face and a rear face, said rear face being defined by said base and rib portions, said base portion having a plurality of holes aligned with the front face of said rib portion, and each of said members also including a plurality of spring metal contacts extending through said holes and formed over said rib portion adjacent to the front and rear faces thereof, said contacts protruding from said base portion to form terminals for said contacts, one of said shells enclosing a first of said connector members to provide a socket connector member, and the other of said shells enclosing the base portion of a second of said connector members to provide a plug connector member, said shells each having openings therein for the terminal ends of said contacts, said shell and rib portion of said socket connector member providing a recess for receiving the exposed rib portion of said plug connector member, said shells being insulated from said contacts, and said socket and plug connector members being adapted to be engaged in mating relation and to be interlocked whereby the contacts of said first connector member engage the respective contacts of said second connector member.

8. A multi-contact connector comprising a pair of connector members, each of said connector members including a contact supporting part, each said part being comprised of insulating material having a base portion and a rib portion, said rib portion having a front and rear face, said base and rib portions defining an L-shaped cross section, said part having a rear face defined by said base and rib portions, said rear face having a plurality of transverse grooves therealong, said base portion being provided with a plurality of holes aligned with the front face of said rib portion, said holes lying in a transverse plane defined by said grooves, and each said connector member also including a plurality of spring metal contacts, one disposed in each of said grooves and formed around said rib portion to extend through one of said holes, and each of said connector members also including an open faced shell, one of said shells enclosing said contact supporting part of a first of said connector members, the other of said shells enclosing the base portion of the second of said connector members, said shells having openings therein in alignment with said base portion openings and through which said contact terminals protrude from said base portions, said shell and said rib portion of said first connector member providing a recess for receiving the exposed rib portion of said second connector member, said shells being insulated from said contacts, and said contacts of said first and second connector members being spaced for mating engagement whereby the contacts of said first connector member engage the respective contacts of said second connector member.

9. A multi-contact connector comprising a pair of mating connector members, each member including identical contact supporting parts, each said part being comprised of insulating material having an L-shaped cross section and being adapted to interlock with a mating connector member part, each said part being defined by a base portion by means of which the connector member of which it is a part is supported and a rib portion having an inner and an outer face, the inner face of said rib portion intersecting the base portion, said base portion having a plurality of holes extending therethrough and terminating adjacent to the inner face of said rib portion, each said connector member also including a plurality of spring metal contacts formed over said rib portion thereof adjacent to the inner and outer faces thereof, said contacts extending through and protruding from said holes in said base portion to provide terminals for said contacts, the portion of said contacts lying adjacent to the inner face of said rib portion being bowed away from said face and providing the contacting portions of said contacts, and each connector member also including

an open faced, rectangular shell, said shells each having openings in the face opposite from its open face for said contact terminals of each connector member, said shells confining the portions of said contacts lying adjacent to the outer face of said rib portion of each connector member and insulating them therefrom, one of said rectangular shells for a first of said connector members enclosing the contact supporting part thereof, and the other of said rectangular shells for the second of said connector members enclosing the base portion of said second connector member, said part and shell of said first connector member providing a recess for receiving the exposed rib of said second connector member, and said inner faces of said rib portions lying adjacent to each other when said connector members are in mating relation whereby the contacts of said first connector member engage the respective contacts of said second connector member.

10. A multi-contact connector comprising a pair of mating connector members, each of said connector members including a contact supporting part, a plurality of flat spring metal contacts, and an open faced shell, said supporting part comprising a base portion and a rib portion extending beyond said base, said part having a rear face defined by said base and rib portions, said rear face being provided with a plurality of transverse grooves, said base portion being provided with a plurality of holes aligned with the front face of said rib portion, said holes each being aligned in a common transverse plane with a different one of said grooves, said rear face of said base portion having a longitudinal groove, said contacts each having a clip end and a terminal end, said contacts being disposed on said contact supporting part with the clip ends thereof engaging said longitudinal grooves and said terminal ends thereof protruding from said base portion, the intermediate portion of said contacts lying in said transverse grooves and being formed over said inner rib portion to extend through said holes, portions of said contacts being bowed to extend away from the front face of said rib portion, said shells having openings in the face opposite from the open face thereof, said terminal ends of said contacts protruding through said shell openings opposite from said open face, an insulating strip disposed between said contacts and said shells to insulate said contacts from said shells, one of said shells enclosing the base and rib portions of a first of said connector members to provide a socket connector member, the other of said shells enclosing only the base portion of the second of said connector members to provide a plug connector member, said shell and said rib portion of said socket connector member providing a recess for receiving the rib portion of said plug connector member whereby the bowed portions of the contacts of said first and second connector members are engaged, and said shells of said first and second connector members providing an enclosed shield for said connector members when said members are engaged.

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