July 4, 1967 C. R. A. JOHNSON ETAL 3,329,925

INTERLOCKING SHIELDED CONNECTOR

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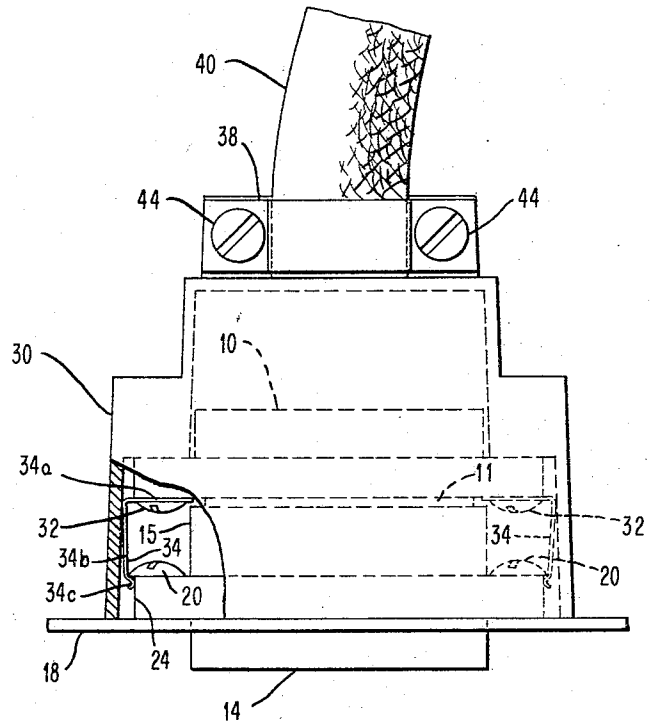
FIG. 1



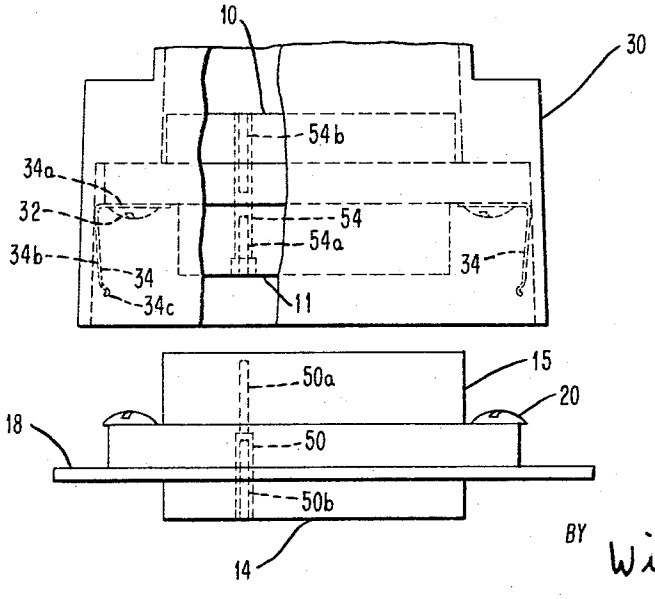


FIG. 2

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INTERLOCKING SHIELDED CONNECTOR

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ABSTRACT OF THE DISCLOSURE

An electrical connector mounted on a panel with round head screws is constructed so that the screw heads overhang the connector body. A mating connector is surrounded by a shielding housing and has flat springs with crimped ends mounted inside the housing. These springs cam over the round heads of the mounting screws to interlock the connectors in their mated position with the housing abutting the panel. The interlocked and shielded connectors can be disengaged by the application of sufficient force to the housing to disengage the crimped ends of the springs from the heads of the mounting screws.

This invention relates to electrical connectors having a housing for shielding the connections with the housing being designed with an interlock to maintain the connectors coupled in mating position. More particularly this invention is related to the locking means for interlocking such shielded connector housings.

Connectors which are utilized for the connection of elements of electrical circuits frequently require shielding to avoid pickup of unwanted signals or noise in the circuits being connected. In such circuits the wires which are to be connected by the connector are usually shielded, but it is also necessary in order to avoid pickup from external sources that the connectors for providing the connections should also be shielded. Such shielding of the connectors may advantageously be accomplished by the use of an electrically conductive housing for the connectors which encloses them when they are coupled together, that is when the connectors are mated for the completion of electrical circuits.

It is an object of this invention to provide an improved means for locking mating connectors having a shielding housing in avoidance of accidental disconnection of the connector.

Another object of this invention is the provision of an inexpensive means for providing the locking of connectors in their mated positions without the necessity of providing the locking means as a part of the connector.

Another object of this invention is the provision of means for mounting one connector block so as to provide means for interlocking the other connector block when the respective connector elements are mated for completion of their associated electrical circuits.

In carrying out this invention there is provided an interlocking means for a shielded connector which utilizes a spring element mounted to one of an interconnecting pair of electrical connectors. The spring element is constructed to have a crimp at one end. The other of the pair of electrical connectors is mounted by a fastening means which has a head so shaped as to overhang the edge of the connector that is mounted. This overhanging edge forms a camming surface over which the crimped end of the spring element rides and with which the crimped end interlocks when the electrical connectors are mated.

For a more detailed understanding of the invention and for an illustration of a preferred form thereof reference is made to the drawings in which:

FIG. 1 is a front elevation of the connectors with the shielding housing showing the connectors in their mated position with the interlock engaged.

FIG. 2 is a partial front elevation of the connector blocks showing the housing surrounding one of the blocks and showing the connectors disengaged in a noninterlocked position.

In FIG. 1 a first connector includes connector block **10** having a male end portion **11** shown interlocked with a connector block **14** of a second connector, connector block **14** having a female end **15**. The connector block **10** and the connector block **14** are shown in their mated positions with the male end **11** of block **10** inserted into the female end **15** of block **14**.

The connector block **14** is shown as being mounted to a metal panel **18** such as an amplifier chassis by a plurality of fasteners **20** inserted through holes on the edge of block **14**. In FIG. 1 the fasteners **20** are shown as being of the type which has a slotted head for receiving a screw driver. Such fasteners are generally of the type having threads along the shaft portion (not shown) such as machine screws, for example.

As shown in FIG. 1, the heads of the fasteners **20** are of diameter sufficient to overhang the edge **24** of the connector block **14**. That portion of the heads of fasteners **20** which overhang the edge **24** may be a small portion. The overhang may advantageously be on the order of three or four thousandths of an inch. In FIG. 1 the fasteners **20** are shown as having rounded heads. Other types of fasteners may be used which have heads which are not constructed to have the amount of curvature shown in FIG. 1.

The connector block **10** is shown in FIG. 1 as being mounted internally to an electrically conductive shielding housing **30** by machine screws **32**. The machine screws are also shown being utilized as a means for affixing internally to the housing **30** one end of each of two retainers, such as the flat spring elements **34**.

The flat spring elements **34** have horizontally disposed portions **34***a* which are engaged by the heads of the machine screws **32**. Extending from each of the portions **34***a* is a length which is angled toward the interior of the housing **30**. These lengths of the flat spring elements **34** are identified by the reference character **34***b* and each has at the end thereof a crimp **34***c* which is formed so as to engage the overhanging portion of the head of the associated fastener **20**, as shown in FIG. 1, when the connector blocks **10** and **14** are mated. The overhanging portions and the associated spring, therefore, form detenting elements. The interlocking of the connector blocks **10** and **14** by the engagement between the crimps **34***c* and the overhanging portion of the heads of fasteners **20** causes the housing **30** to abut against the panel **18** so as to provide for the connectors a continuous metal shield to thereby protect the circuits coupled by the connectors from receiving electrical pickup from external sources.

The housing **30** may advantageously be cast zinc and may include, as shown in FIG. 1, a cable clamping portion **38** which is utilized for clamping the cable **40**, which will generally be of the type having a shielded covering. As shown in FIG. 1, cable **40** with its shielded covering is clamped by the clamping portion **38** attached to the housing **30** by machine screws **44**.

Connectors of the type shown in FIG. 1 are frequently utilized to interconnect a plurality of electrical circuits. Therefore, the cable **40** will normally carry a number of wires going to one connector to be interconnected with a like number of wires leading from the other connector. The wires to each connector are connected to individual connector elements in the connector blocks which will upon the mating of connector blocks **10** and **14** be mated one to another.

From the connector elements in connector block **14**, for example, a number of wires will normally be extended to circuit elements which may, for example, be mounted to the underside of panel **18**, as where panel **18** is part of a chassis of an electronic amplifier. For simplicity the wires connected to terminal connector block **14** are not shown in FIG. 1.

In FIG. 2 the housing **30** is shown in a position above panel **18** with the housing **30** not in abutting relationship with the surface of panel **18** and with the connector blocks **10** and **14** disconnected or uncoupled. FIG. 2 also shows the flat spring elements **34** with their crimped ends **34***c* disengaged from the overhanging portion of the fasteners **20**.

The connector blocks **10** and **14** are both designed in the illustrated arrangement of FIG. 2 to have a plurality of electrically conductive connector elements so that upon the mating of connector blocks **10** and **14** there is a mating of the corresponding connector elements to provide a coupling of the plurality of electrical circuits. For simplicity there is shown in FIG. 2, in phantom, one only of the plurality female connector elements required and one only of the male connector elements required to mate with the female elements.

In connector block **14** there is a plurality of holes each adapted to receive a male connector element such as the male connector element **50**, shown in phantom. Male connector **50** has a male end **50***a* and a female end **50***b*. The male end **50***a* is designed for engagement with the associated female connector element of connector block **10** while the female portion **50***b* of connector element **50** is designed for receiving the male portion of a pin, not shown, which would normally be used as a means for connecting a wire to the male connector element **50**. The pin could, for example, be crimped to the wire so a good electrical contact would be made between the wire and the pin. Upon insertion of the pin into the female portion **50***b* of connector element **50**, the wire would then be effectively connected to the male portion **50***a* of connector element **50**.

The housing **30** in FIG. 2 is shown with a section broken away so that a portion of connector block **10** is visible. Connector block **10** would have a number of holes corresponding with the number in connector block **14**.

Each of these holes is designed to receive a female connector element **54** having a female end **54***a* designed to receive the male end **50***a* of male connector element **50** and having another female end **54***b* designed to receive a pin of the type previously referred to as being a means for connecting a wire to the male connector element **50**. The pin which could be inserted into the female end **54***b* of female connector element **54** could be connected to one of the wires of the cable **40** by crimping the pin to the wire.

To mate the male end **50***a* of connector element **50** with the female end **54***a* of the female connector element **54** the housing **30** is positioned so that the male portion **11** of the connector block **10** is inserted into the female portion **15** of the connector block **14**. As this coupling of the connector blocks **10** and **14** occurs the crimped ends **34***c* of the flat spring elements **34** engage the top portions of the heads of fasteners **20** and upon the forcing of the housing **30** into abutment with the surface of panel **18** the crimped ends **34***c* will first cam over the round top portion of the head of fastener **20** and then engage the underside of the overhanging portion as shown in FIG. 1. The heads of fasteners **20** therefore provide both a camming and locking surface respectively by virtue of the rounded top and the flat bottom.

When the housing **30** is abutted to the surface of panel **18** and the crimped ends **34***c* of the flat springs **34** engage the underside of the overhanging portion of the heads of fasteners **20** the housing **30** is interlocked with the panel **18** and the connector elements are interlocked

so that connector elements **54** and **50** are maintained in electrical contact in avoidance of disengagement or disconnection of the contacts by accidental means. The engagement by the crimped ends **34***c* on the underside or bottom of the overhanging portion of the heads of fasteners **20** is normally sufficient to require for disengagement an amount of force upon the housing **30** in a direction away from panel **18** which would not normally be applied by accident but would normally only occur when disengagement of the connector elements was desired.

One specific example of a design for the flat spring elements **34** which can be advantageously utilized would incorporate an angular relationship between the portion **34***a* and the portion **34***b* on the order of 88°. The crimped end portion **34***c* could extend into the housing **30** away from the portion **34***b* by an amount which may, for example, be .028 inch. This amount of crimp has been found to be sufficient to provide satisfactory engagement and intercoupling of the flat spring elements **34** with the heads of fasteners **20** to provide the necessary locking of the housing **30** to panel **18** to maintain a mating of the connector elements.

These dimensions are, of course, exemplary only of a particular design which has been found to be effective. It will be evident to those skilled in the art that there are many relative dimensions which the portions of spring **34** can have and still be useful for the novel structure disclosed.

The particular interlocking means shown in FIGS. 1 and 2 by which the flat spring element engages the head of fastener **20** and therefore acts as a retainer for maintaining the housing **30** in abutting relationship with panel **18** is advantageous in that it utilizes the fastener **20** for both the purpose of holding the connector block **14** in fixed relationship with panel **18** and to provide a detenting element by virtue of the overhanging portion of the head of fasteners **20** thus making it unnecessary that the connector block **14** be designed to include a detent element which could be engaged by an interlocking retainer spring such as spring **34**.

What is claimed is:

1. A shielded connector for electrical circuits comprising

a first connector,

an electrically conductive housing for receiving said first connector,

a second connector for mating with said first connector to provide a plurality of electrical circuit connections therebetween,

a surface for mounting said second connector,

a plurality of fasteners positioned along the edge of said second connector and inserted through said second connector in fastening relationship with said surface, said fasteners each having a head so shaped as to overhang the edge of said second connector whereby said overhanging portion is in spaced relationship with said surface, and

spring retainers mounted internally to said housing for engagement with each of said overhanging heads, said spring retainers each having a crimped portion at the end thereof forming a camming surface for engaging said overhanging heads when said housing is positioned to abut said surface with said first and said second connectors in mating relationship thereto and to disengage from said heads by camming said crimped portions away from said heads upon application of sufficient withdrawal force to said housing, whereby said mating relationship is maintained and said housing forms a shield for said first and said second connectors upon engagement of said spring retainers and said mating relationship is discontinued upon withdrawal of said housing from said surface abutting position.

2. A shielded connector for electrical circuits comprising

a first connector,

a metal housing for receiving said first connector,

a second connector mateable with said first connector to provide a plurality of electrical circuit connections therebetween,

a panel for mounting said second connector,

a plurality of fasteners positioned along the edge of said second connector and inserted through said second connector in fastening relationship with said panel, said fasteners each having a head overhanging the edge of said second connector whereby said overhanging portion is spaced from said panel,

a plurality of flat spring retainers mounted internally to said housing and oriented to engage with said overhanging heads, said spring retainers each having a crimped portion at the end thereof forming a camming surface for providing said engagement of said overhanging heads when said housing is positioned to abut said panel and said first and said second connectors are in mating relationship thereto and to provide disengagement of said spring retainers from said heads by camming said crimped portions away from said heads upon application of sufficient withdrawal force to said housing.

3. A shielded connector as set forth in claim 2 in which said fasteners are threaded fasteners having heads which are rounded on the top portion and flat on the bottom portion engaging said second connector so that said crimped ends of said retainers may be easily cammed over said rounded top surface of said fastener while providing sufficient restraining force when said retainers engage said overhanging portions to prevent said connectors from being accidentally disengaged.

4. A shielded connector as set forth in claim 2 in which said fasteners are machine screws having heads which are rounded on the top portion and flat on the bottom portion engaging said second connector so that said crimped ends of said retainer readily cam over said rounded top surface of said fastener as said connectors are mated while providing sufficient restraining force when said crimped portion engages the edge formed by said flat bottom and said rounded top.

5. An interlocking means for a shielded connector comprising,

flat spring elements mounted to one of an interconnecting pair of electrical connectors, said spring elements each having a crimp at one end thereof forming a camming surface, and

fastening means for the other of said pair of electrical connectors for mounting said other connector, said fasteners having heads so shaped as to overhang the edge of said other connector to form a camming surface thereby for interaction with said crimped ends of said spring elements so that said connectors are interlocked by the engagement of said crimp ends and said fastener heads upon the mating of said electrical connectors and said interlock is broken upon disengagement of said crimped ends by camming said crimped ends away from said heads when sufficient withdrawal force is applied to said connectors.

6. An interlocking means for a shielded connector comprising,

a spring element mounted to one of an interconnecting pair of electrical connectors, said spring element having a crimp at one end thereof forming a camming surface, and

a fastening means for the other of said pair of electrical connectors for mounting said other connector, said fastening means having a head so shaped as to overhang the edge of said other connector to form a camming surface thereby for interaction with said crimped end of said spring element so that said connectors are interlocked by the engagement of said crimp end and said fastener head upon the mating of said electrical connectors and said interlock is broken upon disengagement of said crimped end by camming said crimped end away from said head when sufficient withdrawal force is applied to said connectors.

7. A shielded connector for electrical circuits comprising

a female connector block carrying a plurality of male connector elements,

a male connector block carrying a plurality of female connector elements so positioned as to mate with said male connector elements when said male and female connector blocks are mated,

said connector blocks each having a plurality of holes positioned at the edges thereof for the mounting of said blocks,

a plurality of round-head mounting screws positioned in said holes so as to mount one of said blocks to a panel member, said round heads being sufficiently large in diameter to overhang the edge of the connector block mounted by said screws,

a shielding housing of electrically conductive material carrying the other of said blocks mounted in a recessed position, and

a plurality of flat spring retainer elements positioned internally to said housing, said retainers each having a length extending from its secured end toward the open end of said housing at an angle inclining said length toward the center of said housing with the ends of said retainers opposite the secured ends being crimped to form a camming and locking surface for engaging said overhanging heads upon the mating of said connector elements and blocks by the positioning of said housing to abut against said panel and for disengaging said heads by camming said crimped ends away from said heads and disconnecting said connector elements upon sufficient application of withdrawal force to said housing, whereby said connector elements are maintained in interlocked relationship with said housing in shielding position around said connector elements during engagement of said heads.

8. A shielded connector for electrical circuits comprising

a female connector block carrying a plurality of male connector elements,

a male connector block carrying a plurality of female connector elements so positioned as to mate with said male connector elements when said male and female connector blocks are mated,

said connector blocks each having a plurality of holes positioned at the edges thereof for the mounting of said blocks,

a plurality of round head fasteners positioned in said holes so as to mount one of said blocks to a panel member, said round heads being sufficiently large in diameter to overhang the edge of the connector block mounted by said fasteners,

a shielding housing of electrically conductive material carrying the other of said blocks mounted in a recessed position, and

a plurality of flat spring elements positioned internally to said housing, said spring elements each having a secured end and a length extending from its secured end toward the open end of said housing at an angle inclined toward the center of said housing with the ends of said spring elements opposite the secured ends being crimped to form a camming and locking surface for engaging said overhanging heads when said connector elements are mated by the positioning of said housing to abut against said panel to place said housing in shielding position around said connector elements and for disengaging from said heads by camming said crimped ends away from said

heads when sufficient withdrawal force is applied to said housing.

9. A locking shielded connector comprising,

a first and second connector for establishing a plurality of electrical circuit connections,

fastener means for mounting one of said connectors in a shielding housing,

fastening means for mounting the other of said connectors to a supporting element to be engaged by said housing upon the mating of said connectors so that said housing forms a shield for said mated connectors, said fastening means for mounting said other connector having a head which overhangs the edge of said other connector so that the overhanging portion of said head forms a camming and locking surface, and

a flat spring mounted to said housing and having a crimped portion forming a camming surface for engaging said overhanging portion of said fastener head, said flat spring being angled toward the center of said housing to maintain engagement between said flat spring and said head after said crimped portion at the end of said spring has cammed over said overhanging head portion, said crimp portion of said spring being operative to prevent accidental disengagement of said connectors while allowing intentional disengagement by camming said crimped portion away from said head upon application of sufficient withdrawal force to said housing.

10. A locking shielded connector comprising,

a first and second connector for establishing a plurality of electrical circuit connections,

fastener means for mounting one of said connectors in a shielding housing,

fastening means for mounting the other of said connectors to a supporting element to be engaged by said housing upon the mating of said connectors so that said housing forms a shield for said mated connectors, said fastening means for mounting said other connector including a plurality of fasteners each with a head which overhangs the edge of said other connector so that the overhanging portions of said heads form camming and locking surfaces, and

flat springs mounted to said housing, each of said springs having a crimped portion forming a camming surface for engaging said overhanging portion of each of said fastener heads, said flat springs being angled toward the center of said housing to maintain engagement between said flat springs and said heads after said crimped portion at the end of said springs has cammed over said overhanging head portion, said crimped portion of said springs being operative to engage said heads to prevent accidental disengagement of said connectors while allowing intentional disengagement by camming said crimped portion away from said heads upon application of sufficient withdrawal force to said housing.

11. An interlock for a shielding connector housing engageable with a panel mounted connector comprising

a fastener for mounting said panel mounted connector, said fastener having a head which overhangs the edge of said connector to form by said overhanging portion a detent surface, and

a detenting spring mounted inwardly of said housing, said spring having a crimp in its end forming a camming surface positioned to ride over said overhanging portion of said head as said housing is engaged with said panel so that said crimp engages said head to prevent accidental disengagement of the connectors associated with said housing and panel and allows intentional disengagement of said connectors by camming said crimp away from said head upon application of sufficient withdrawal force to said housing.

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