(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 041 420**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **81400733.2**

(51) Int. Cl.³: **H 01 R 13/658**

(22) Date of filing: **08.05.81**

(30) Priority: **02.06.80 US 155718**

(43) Date of publication of application:
09.12.81 Bulletin 81/49

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: **THE BENDIX CORPORATION**
Executive Offices Bendix Center
Southfield, Michigan 48037(US)

(72) Inventor: **Punako, Stephen**
RD 2 Box 253
Bainbridge New York 13733(US)

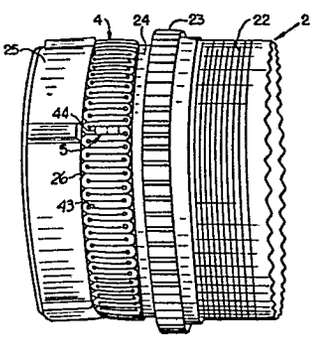
(72) Inventor: **Duguay, Francis Joseph**
1 Silver Street
Sidney New York 13838(US)

(74) Representative: **Maguet, André et al,**
Service Brevets Bendix 44, Rue François 1er
F-75008 Paris(FR)

(54) **Electrical connector with provision for electromagnetic shielding.**

(57) Electrical connector having first and second connector shells connected together by a coupling nut, and a grounding strap (4) secured around a portion of one of the shells to suppress electromagnetic radiations entering the connector, the grounding strap (4) being formed of a substantially flat elongated piece (4) of electrically conducting material having, on the one hand, first and second pluralities of holes arranged along a common axis along both elongated sides of said elongated piece (4) and, on the other hand, a plurality of slits (43) with each slit (43) extending from a respective hole to the edge of the elongated side of said elongated piece (4) furthest from said respective hole.

FIG. 1



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Electrical connector with provision for electromagnetic shielding

This invention relates to an electrical connector with provision for electromagnetic shielding of the type having a first connector shell, a second connector shell, means for coupling the first shell to the second shell, and a grounding strap secured around a portion of one of the shells to suppress electromagnetic radiations entering the connector.

Electrical connectors are used to connect together a plurality of electrical wires into predetermined circuit relationship with another plurality of electrical wires. The interconnected wires convey signals from one circuit to another. One example of such a connector may be found in U.S. Patent No. 3,663,926. In some instances, the circuits are very sensitive or the signals being conveyed are very weak and electromagnetic radiations entering into the connector can interfere with the signals being communicated between the circuits. When this occurs false signals are conveyed between the circuits.

Accordingly, if there is not good grounding between the interconnected connector shells and/or there are voids within the connector, electromagnetic radiations may enter and interfere with the circuitry.

The present invention overcomes the disadvantages and limitations of the prior art arrangements by providing an electrical connector with provision for electromagnetic shielding of the type having a first connector shell, a second connector shell, means for coupling the first shell to the second shell, and a grounding strap secured around a portion of one of the shells to suppress electromagnetic radiations entering the connector, said grounding strap comprising: a substantially flat elongated piece of electrically conducting material; a first plurality of holes arranged along a common axis along one of the elongated sides of said elongated piece; a second plurality of holes arranged along a common axis along the other elongated side of said elongated piece; and a

plurality of slits in said elongated piece, each of the slits extending from one of the holes to the edge of the elongated side of said elongated piece furthest from said one hole.

The electrical connector of the present invention is advantageous in that the grounding strap reduces the amount of electromagnetic radiations passing through the connector shells, and in that the configuration of the grounding strap maximizes the electrical contact between mated shells of the electrical connector.

One way of carrying out the invention is described in detail below with reference to the drawings which illustrate one specific embodiment, in which:

FIGURE 1 is a view of a connector shell with a grounding strap mounted thereon;

FIGURE 2 is a cross-sectional view of an electrical connector assembly utilizing the grounding strap of this invention;

FIGURE 3 is a detailed view of a portion of the grounding strap;

FIGURE 4 is a side view of a grounding strap; and

FIGURE 5 is a side view of the sleeve used to connect the ends of the grounding strap.

Referring now to the drawings, FIGURE 1 shows a connector shell 2 having mounted thereon a grounding strap 4. The connector shell generally includes a plurality of threads 22 for engaging another piece (not shown), an enlarged portion or shoulder 23, a recessed portion 24 and an end portion 25. The recess portion 24 receives the grounding strap 4 and also includes an annular groove 26 for receiving one end of the grounding strap 4. Securing the ends of the grounding strap is a sleeve 5. The last leg 44 at each end of the grounding strap 4 extends through the sleeve 5, thereby securing the grounding strap 4 to the shell 2. The legs 44 are defined by slits 43 extending across the grounding strap 4.

FIGURE 2 illustrates the grounding strap 4 within a mated electrical connector. The electrical connector comprises: a first shell 1 having a plurality of electrical contacts 6 that mate with a plurality of contacts of a second

shell 2. The first shell 1 and the second shell 2 are connected together by a coupling nut 3. The coupling nut 3 is rotably mounted to the second shell 2 and is coupled to the first shell 1 by threads 31. When the connector is in the mated relationship as shown, the grounding strap 4 is in the void 27 which might otherwise allow electromagnetic radiations to pass through the connector and to the signal carrying contacts 6.

FIGURE 3 illustrates the details of the grounding strap 4. The grounding strap 4 is stamped and formed from a flat piece of beryllium copper. There are a plurality of holes 41 and 42 that align with slits 43 that define a plurality of legs 44. Each slit 43 extends from one edge of the grounding strap 4 to one of the holes 41, 42. The width of each slit is less than 13/100 mm, preferably formed by shearing. A slot, which is larger than the slits, will allow electromagnetic radiations to pass through them. Accordingly, slots provide too much space for electromagnetic radiations to pass while a slit minimizes the space that electromagnetic radiations may pass into the connector. The noise level (electromagnetic radiations) attenuated by a grounding strap with slots (about 25/100 mm), on a mated connector was about 108-114 decibels. The attenuation of the noise level on the same connector and under the same conditions but with a grounding strap with slits 10/100 mm was 120-126 decibels. The slits eliminated high frequency noise which could pass through slots. The holes 41 on one side of the grounding strap 4 are generally arranged on an axis that is parallel to the axis of the holes 42 arranged on the other side of the grounding strap 4. Each slit 43, cut into the grounding strap 4, is along a second axis perpendicular to the parallel axes of the holes 41 and 42, each second axis intersecting only one hole, i.e., either 41 or 42. The holes 41 and 42 provide strain relief, i.e., tearing the slits break the grounding strap.

FIGURE 4 illustrates how the grounding strap 4 is formed to have a curvature and an end 45 which is bent at an angle of about 90° from the main body of the grounding strap 4. The curvature of the grounding strap 4 allows it to

be compressed radially inward when the second shell 2 is mated with the first shell 1. The angled end portion 45 of the grounding strap 4 is adapted to be placed in the groove 26 of the connector shell 2, shown in FIGURE 2. The angled end 45 and the groove 26 assist in maintaining the grounding strap 4 along a predetermined path around the connector shell 2.

FIGURE 5 illustrates a side view of the oblong sleeve 5 shown in FIGURE 1. The oblong shape of the sleeve 5 minimizes the overall height of the sleeve so that it does not interfere with the mating of the connector shells 1 and 2.

Claims:

1. Electrical connector with provision for electromagnetic shielding of the type having a first connector shell (1), a second connector shell (2), means (3) for coupling the first shell (1) to the second shell (2), and a grounding strap (4) secured around a portion of one of said shells (1,2) to suppress electromagnetic radiations entering the connector, characterized in that said grounding strap (4) comprises: a substantially flat elongated piece (4) of electrically conducting material; a first plurality of holes (41) arranged along a common axis along one of the elongated sides of said elongated piece (4); a second plurality of holes (42) arranged along a common axis along the other elongated side of said elongated piece (4); and a plurality of slits (43) in said elongated piece (4), each of the slits (43) extending from one of said holes (41,42) to the edge of the elongated side of said elongated piece (4) furthest from said one hole (41 or 42).

2. Electrical connector as claimed in Claim 1, characterized in that the width of each slit (43) is less than 13/100 mm.

3. Electrical connector as claimed in Claim 1, characterized in that the edge (45) along at least one of the elongated sides of said elongated piece (4) is bent at an angle of about 90° to be received in an annular groove (26) provided in said one shell (2).

4. Electrical connector as claimed in Claim 1, characterized in that the electrically conducting material is comprised of beryllium copper.

5. Electrical connector as claimed in Claim 1, characterized in that each of the slits (43) is along a second axis perpendicular to the parallel axes of the holes of the first and second plurality of holes (41,42).

FIG. 1

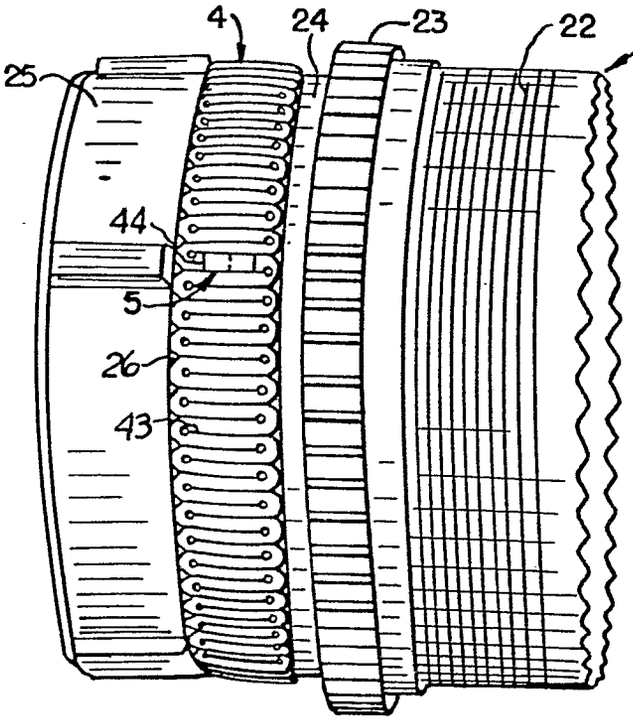

FIG. 5

FIG. 2

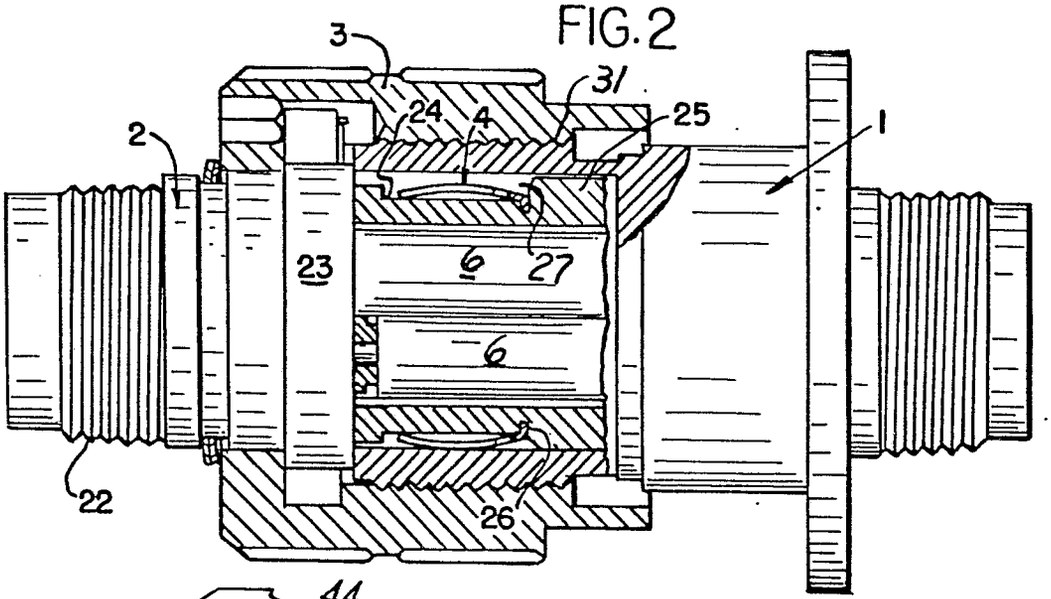

FIG. 3

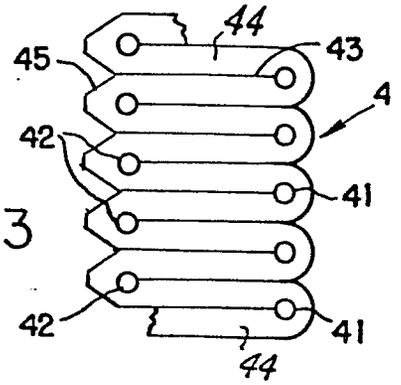

FIG. 4

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European Patent Office

Application number

EP 81 40 0733

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 2 025 158 (BENDIX) * page 2, lines 14-30; figures *	1,5
	US - A - 3 336 566 (L.R. BARKER) * column 2, lines 40-64; figures *	2,4
	FR - A - 2 360 191 (AUTOMATION) * page 16, line 22 - page 19, line 11; figures *	2-4
A	US - A - 3 466 590 (SYLVESTER) * column 3, line 36 - column 4, line 29; figures *	1
A	US - A - 3 678 445 (ITT) * column 1, line 59 - column 2, line 17; figures *	3
P	US - A - 4 239 318 (ITT) (publ. 16-12-1980) * column 3, line 19 - column 4, line 35; figures *	1,2,4, 5
P	US - A - 4 248 492 (BENDIX)(publ. 03-02-1981) * column 3, lines 20-66; figures *	1-4

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

H 01 R 13/658

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

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13/648

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15-09-1981	RAMBOER