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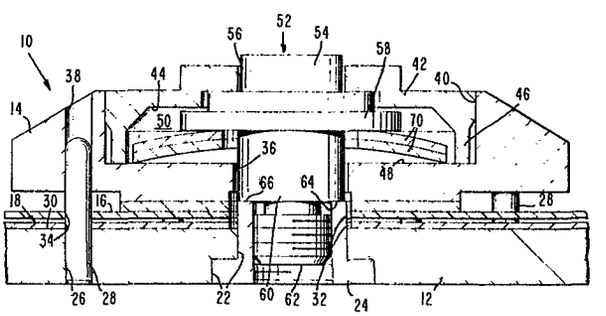
(54) Mechanical clamping device for electrical flat circuits.

(57) A pressure cap (14) is screwed down over circuitry (16, 18) by means of a screw (52) and one or more curved spring washers (70), the bolt engaging a nut (24) or a threaded part of a base plate (12) urging the base plate against the circuitry. Continuous pressure is sustained on the contacts even during extreme temperature cycling of –85° F to 392° F (–65° C to 200° C).



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MECHANICAL CLAMPING DEVICE FOR ELECTRICAL FLAT CIRCUITS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to means for interconnecting electrical cables or electrical cables and components together without use of conventional, frictionally engaging electrical connectors.

2. Description of the Prior Art

In our British Patent Specification 1,563,139 there is described an electrical connector assembly which employs a silicone or fluorosilicone rubber washer alone or in combination with a supplementing Belleville washer to sustain the pressure on the electrical contacts between a pair of flat cables or a flat cable and a termination of an electronic component. It was discovered that, at temperatures less than -25°F (-31°C), the rubber washer shrank to the extent that it took a set. This set permitted the pressure on the electrical contacts to become relieved, thereby causing the circuits to open.

SUMMARY OF THE INVENTION

The present invention overcomes this and other problems by providing an arrangement whereby the pressure necessary to mate the elctrical contacts is a sustained continuous pressure, even during such extreme temperature cycling as between -85°F and 392°F (-65°C and 200°C). It incorporates a cap which applies continuous pressure on the circuitry and electrical contacts, preferably by means of a screw and one or more wave or curved washers. The extent of pressure may involve a screw clamping down on the circuitry either to a mechanical stop or to a specific torque value.

It is, therefore, an object of the present invention to provide an electrical connector clamping system which is capable of providing continuous pressure upon mating electrical contacts.

Another object is to provide for such continuous pressure which is sustainable during extreme temperature cycling, e.g., from -85°F to 392°F (-65°C to 200°C).

Another object is to provide for such sustained continuous pressure which is capable of being precisely applied.

Another object is to provide for such precise pressure which is not easily susceptible to operator error.

Other aims and objects as well as a more complete understanding of the present invention will appear from the following explanation of an exemplary embodiment and the accompanying drawings thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is top view of the present invention;

FIG. 2 is a sectional view of the invention depicted in FIG. 1; and

FIG. 3 is a partial view of one of the flat circuits coupled by the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As depicted in FIGS. 1 and 2, a mechanical clamping device 10 includes a base plate 12 and pressure cap 14, between which a pair of flat electrical cables or circuits 16 and 18 are clamped together. Such circuits 16 and 18 are configured as shown in our British Patent 1,563,139 or United States Patent No. 4,125,310, patented November 14, 1978. Cables 16 and 18 may be fabricated from identically chemically milled thin metallic wafers, in which wafer 18 is plated with metallic buttons 20, or formed with equivalent deformations so that, when the two wafers are placed opposing each other and pressed between base plate 12 and pressure cap 14, contact is made only by the buttons. Preferably, the plastic memory of the buttons is used as a spring, which is correlated with a force applied by the opposing plates, as will be further hereinafter described.

Base plate 12 is formed with a stepped hole 22 into which a nut 24 is inserted and retained, such as by a press fit. Alternatively, hole 22 may be threaded directly. A plurality of surrounding holes 26 extend through the base plate, into which registration pins 28 are press fit or otherwise secured. Both pins 28 and nut 24 extend above the surface 30 of the base plate in order to pass through holes 32 and 34 in cables 16 and 18 in order to properly register and align the mating contacts thereof.

Pressure cap 14 is similarly provided with holes 36 and 38 which respectively align with holes 22 and 26. The pressure cap is further provided with a recess 40 into which a screw retaining ring 42 is placed and secured, such as by a press fitting. The retaining ring has a dished configuration to provide a bowl-shaped interior 44 surrounded by circular walls 46. Walls 46 are disposed to touch the bottom 48 of recess 40 of pressure cap 14. Thus, dish-shaped retaining ring 42 and pressure cap 14 form a compartment 50.

In compartment 50 is placed a bolt 52 having a head 54. The head extends through an opening 56 in retaining ring 42 and is provided with a hexagonal opening 68 (see FIG. 1) for engagement with an allen head wrench. At least one shoulder 58 underlies head 54. The bolt is completed by a shank 60, which extends through hole 36 of pressure cap 14, and a threaded terminus 62 which is threadedly engageable with nut 24. In this configuration, shank 60 is provided with an end surface 64 which is disposed to abut against an end surface 66 of nut 24 so that, when bolt 52 is fully screwed into nut 24, shoulders 64 and 66 abut to form a mechanical stop.

Sandwiched between shoulder 58 of bolt 52 and bottom surface 48 of pressure cap recess 40 are one or more curved spring washers 70. These washers are formed preferably of a commercially available high carbon steel. The particular curved spring washers used conform to MIL SPEC S46049, No. 1075. Such spring washers have a free standing height of 0.044 inches (0.11 cm) which, when preloaded to 0.024 inches (0.06 cm) provide a load of one pound (0.45 kg). In the present invention, it is desired to press the spring washer to 0.009 or 0.010 inches (0.2 to 0.3 cm) to provide a preloaded height of about 0.018 inches (0.05 cm), which results in a load of about 8 pounds (3.63 kg). It is preferred that two washers be placed together to provide a total load of 16 pounds (7.26 kg). This 16 pounds (7.26 kg) results in a pressure of about 10,000 psi (7.031×10^3 kgs/sq. m) on the faces of buttons 20 when utilizing approximately thirty buttons 20. Prior to abutment between end surfaces 64 and 66, it is therefore possible to screw bolt 52 down to a specific torque value of less than the illustrative 10,000 psi (7.031×10^3 kgs/m^2.

In operation, circuitry 16 and 18 are aligned and oriented with respect to each other when they are slipped over pins 28 onto base plate 12. Pressure cap 14, as

assembled with retaining ring 42, bolt 52 and washers 70, is then located over base plate aligning pins 28 and is clamped down over circuitry 16 and 18 by screwing bolt 52 into nut 24 to either a predetermined torque value or to a positive stop when surfaces 64 and 66 contact. The pressure cap thus is capable of exerting a continuous pressure within a prescribed range upon the contacts of cables 16 and 18 over a wide temperature range without failure. Actual test results showed that repeated connect and disconnect between contacts on cables 16 and 18 in this system performed without failure or set through temperature ranges of -85°F to 392°F (-65°C to 200°C).

Although the invention has been described with reference to a particular embodiment thereof, it should be realized that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

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Claims:

1. In an electrical connector assembly having a first member with a surface and a pattern of first solid contact pads on said surface terminating first electrical conductors, a second member with a surface contiguously matable with said first member surface and a pattern of second solid contact pads on said second surface terminating second electrical conductors in positions which mirror those of said pattern of first contact pads, buttons of electrically conductive material terminating said first contact pads and extending from and above said surface of said first member for electrical contact with said second contact pads, and a pair of coupling means placed about and electrically insulated from said first and second contacts and securing said members together in the electrical contact in a preselected orientation of said patterns of said first and second contact pads, the improvement comprising at least one curved washer bearing against one of said coupling means for resiliently urging contact between all said contact pads.

2. An electrical connector assembly according to Claim 1 further including a bolt having a shoulder in engagement with said curved washer for exerting, in combination therewith, the resilient contact.

3. An electrical connector assembly according to Claim 1 wherein at least one of said members has dielectric insulation encasing its electrical conductors, the further improvement in which said dielectric insulation is sufficiently resilient for evenly distributing any uneven forces between said members.

4. An electrical connector assembly according to Claim 1 wherein said coupling means includes a pair of pressure plates placed about said members with fastening means joining said pressure plates together for clamping said members together under pressure, the improvement further comprising a shoulder on said fastening means in contact with and forcing said curved washer against one of said pressure plates.

5. An electrical connector assembly according to Claim 4 further comprising a resilient pad positioned between one of said members and one of said plates for evenly distributing any uneven forces between said members.

6. In an electrical connector assembly having first and second members respectively provided with pairs of matable contact pads, means including a pressure plate securing said members and said pairs of contact pads together in electrical contact, and resilient means coupled to said securing means for exerting a resilient force on said members and a resiliently urged contact between all said contact pads, the improvement comprising a retaining ring coupled to said pressure plate and capturing said resilient means therebetween.

7. An electrical connector assembly according to Claim 6 wherein said securing means includes a fastener extending through said plate and having an enlarged head bearing against said resilient means, said retaining means extending partially over said enlarged head also for capturing said fastener.

8. In an electrical connector assembly having at least first and second members respectively with at least pairs of matable contact pads, means for securing said members and said pairs of contact pads together in electrical contact, and resilient means acting as individual springs upon said pairs of matable contact pads for ensuring contact between each of said pairs of pads, the improvement in compressible means sandwiched between said securing means and said first members, comprising at least one curved washer.

9. An electrical connector assembly according to Claim 8 wherein said resilient means comprise buttons of electrically conductive material having plastic memory extending from and above said contact pads of said first member for defining the sole contact with said contact pads of said second member, the pressure exerted by said compressible means on said buttons preventing said buttons from exceeding their limit of plastic memory.

10. An electrical connector assembly according to Claims 8 or 9 wherein said securing means comprises a pressure cap and a base plate positioned about said members, a recess in said pressure cap, a dish-shaped retaining ring in the recess and press-fitted to said pressure cap for defining therewith a compartment, a hole extending through said retaining ring, said pressure cap, said members and said base plate, a bolt having a head and an enlarged shoulder contained within said compartment and a threaded shank extending through the hole, a nut threadedly engaging said bolt shank and said base plate for securing said pressure cape, said members and said base plate together, and at least one metallic curved washer in said compartment sandwiched between said shoulder and said pressure cap for exerting a continuous pressure upon said matable contact pads through temperature cycling ranges of -85°F to 392°F.

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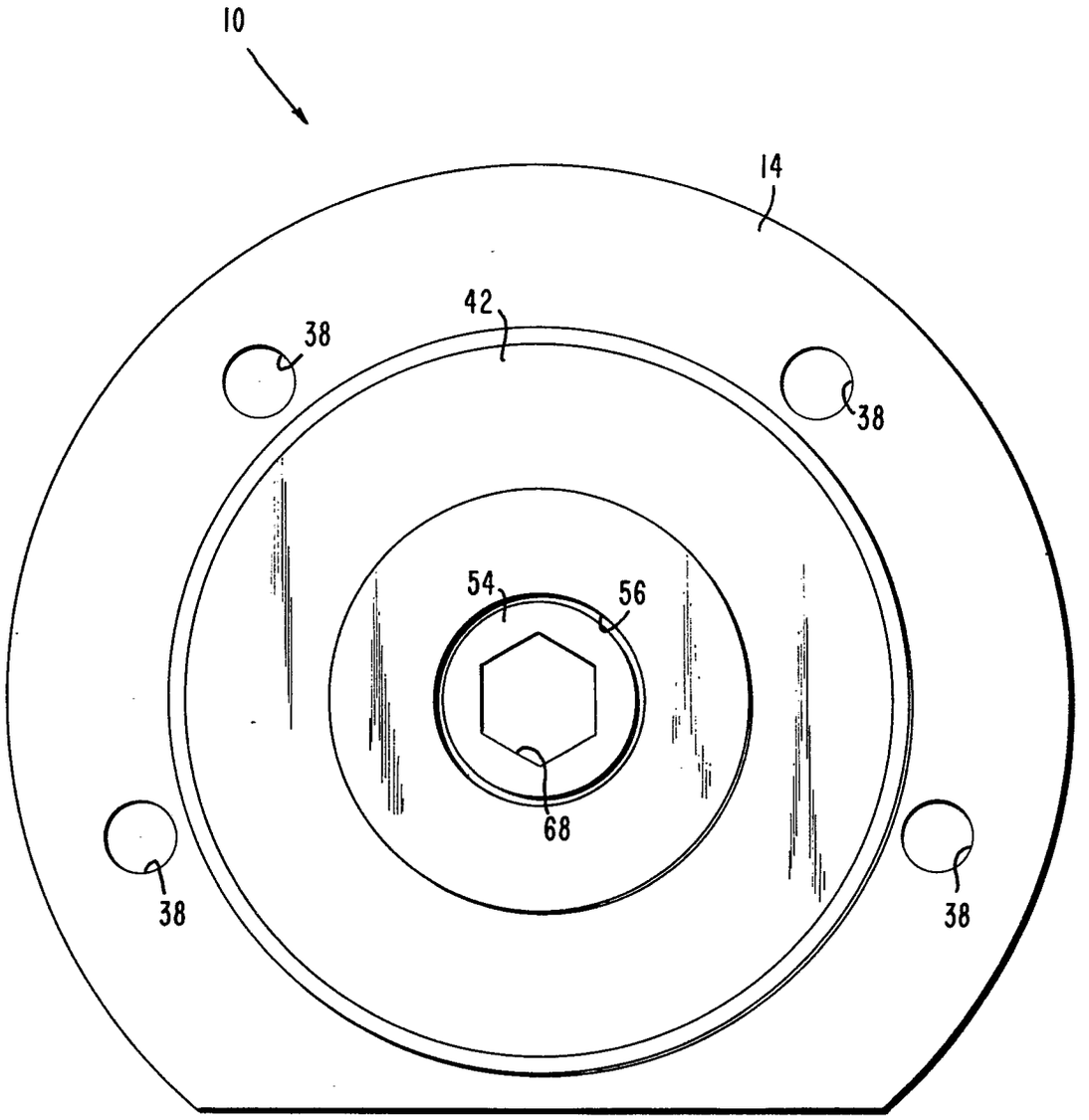
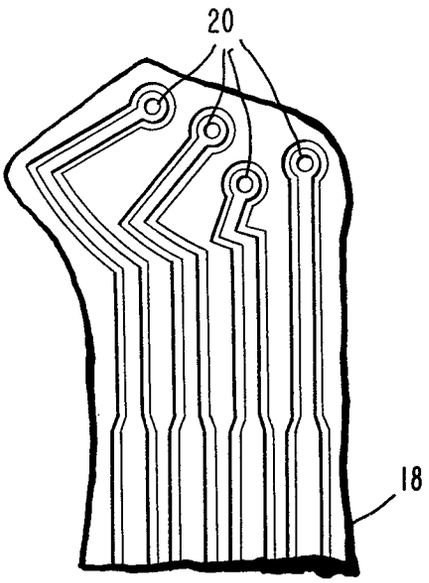


Fig. 1.

Fig. 3.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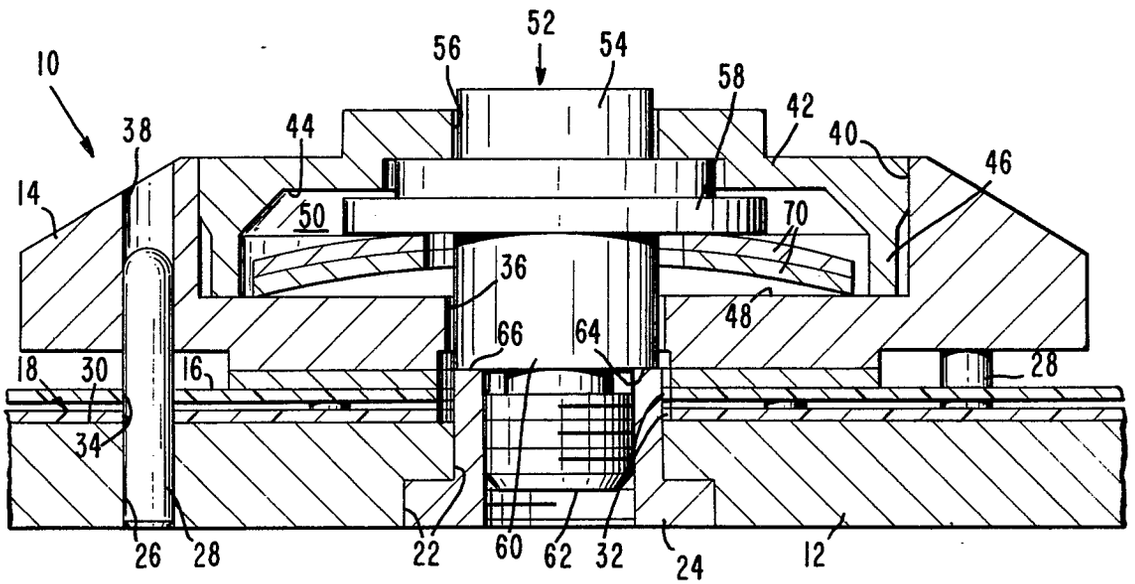
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Fig. 2.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 80 30 1738

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 629 787 (BELL) * column 2, lines 6-75; figures *	1,2,5
	DE - B - 1 142 923 (KRONE) * column 5, line 56 - column 6, line 25; figures *	1,2
	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 10, no. 6, November 1967 NEW YORK (US) M.E. ECKER: "Connector for memory planes" page 786 * page 786 *	1
D	US - A - 4 125 310 (REARDON) * abstract; figures *	1,9
D/E	GB - A - 1 563 139 (HUGHES) (publication date: March 19, 1980) * page 2, line 93 - page 3, line 30; figures *	1,2,4, 5,8,9
	DE - A - 2 259 127 (VDO) * page 5, paragraph 3 - page 6, paragraph 2; figures *	1,5,8, 9

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CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

H 01 R 9/07

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

H 01 R 9/07
9/09
13/24
23/66
23/72
4/52

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	29-08-1980	RAMBOER

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EUROPEAN SEARCH REPORT

Application number
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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	US - A - 3 271 627 (GENERAL MOTORS) * column 3, lines 11-23; figures * --	1, 5, 8, 9	
A	DE - C - 912 118 (BASF) * page 2, lines 35-88; figures * ----------	1, 2	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)