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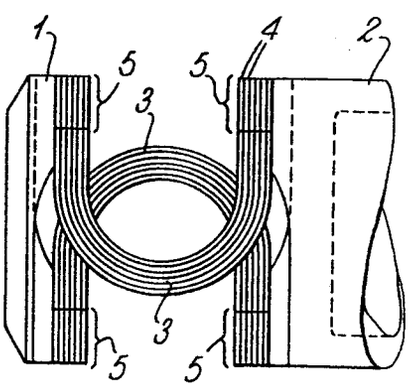
(54) **Heat conducting device.**

(57) A heat transfer device, especially for use in a Stirling-cycle cooling engine, comprises one or more U-shaped members (3), the or each of which is made up of a plurality of thin strips (4) being joined together, for example by vacuum brazing, at their ends (5).



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HEAT CONDUCTING DEVICE

This invention relates to a device for conducting heat from one to another of two members between which the spacing may vary, for example, because of tolerances in manufacture of the apparatus comprising the two members and conducting assembly and/or because of relative movement of the two members during operation of the apparatus. More particularly, but not exclusively, the invention is concerned with heat conduction at very low temperatures in cryogenic apparatus, for example a Stirling-cycle cooling engine.

The operating principles of Stirling-cycle cooling engines are known and such engines have potential benefits in the field of aerospace for cooling optical sensor components especially infra-red sensor components down to the very low temperatures at which they operate best.

There are many published proposals for Stirling-cycle cryogenic engines. A problem, is the past at least, is that such engines are not very amenable to multiple production, even on a small scale, because each unit made may well require a good deal of post-production adjustment and/or customization in order to get it to work at all, let alone to work properly. What may appear at first sight to be fairly minor design variations can, by improving the chances of the relevant parts working properly first time, ie without any post-production adjustment and customization , become a most important factor affecting the success or otherwise of a production program. In this respect, a relevant part is the device by which heat is conducted from the substrate or substrate support member of the optical sensor

component which is to be cooled to the cold end of the Stirling-cycle engine cold finger (the cold finger is the element, usually elongate, within which the working fluid displacer moves and along which heat is transferred to cool one end and warm the other). The distance between the component and the cold finger may vary due to manufacturing tolerances from one to another engine unit, or it may vary with time within the same unit due say to expansion and contraction. Meanwhile highly efficient transfer between the two elements must be guaranteed. It has been proposed to fit between the component and cold finger a pad made of wire wool, somewhat like a small household scouring pad but of course made of material with high heat conductivity. We have not found this to be satisfactory however and the object of this invention is to provide a heat conducting device for use in the described situation which gives efficient transfer of heat without requiring any post-production adjustment. Accordingly, we provide between two members between which heat is to be transferred one or more resilient strips each made up of a plurality of thin laminae of thermally conductive metal, for example copper and the laminae being joined together at two spaced positions at which they are also fixed to respective ones of the members. The fixing of the laminae together and to the members may be by vacuum brazing. Advantageously the or each strip is U-shaped, the two fixing position being at the ends of the limbs of the U-shape.

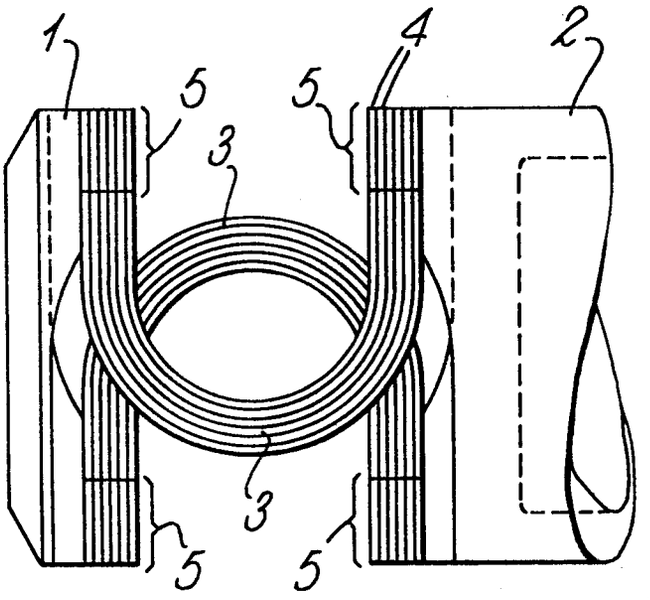
The single figure of the accompanying drawing, given by way of example, is an elevation of part of a Stirling-cycle cooling engine.

The engine comprises a cold-finger 2, namely a hollow elongate cylinder containing a working fluid such as helium and a displacer (not shown) which is reciprocated within the cylinder while at the same time pressure variations are engendered within the working fluid, say by a separate piston and cylinder arrangement (not shown). As a result, heat is drawn away from the illustrated cold end of the cold finger. The theory of Stirling-cycle cooling engines is well-known - further information about design and operation can be found in many publications. Also illustrated in the drawing is a gold-plated member 1 which is intended to support an infra-red sensitive transducer component (not shown). The component is to be cooled down to the very low temperature a few degrees Kelvin say, at which it best operates. Insulation is provided by a Dewar flask enclosure (not shown). The items 1 and 2 are fixed to respective support elements (not shown) such that the spacing between the two may vary from one engine to another and /or, with time, in the same engine (due to expansion and contraction with temperature for example). To transfer heat from member 1 to cold finger 2, there are provided two U-shaped flexible members 3 each made up of plurality of copper foil strips 4 which are vacuum brazed to each other and to the elements 1 and 2 in the region 5 of their ends, ie the ends of the limbs of the U-shape. This arrangment provides proper heat transfer while permitting the spacing between elements 1 and 2 to vary.

CLAIMS

1. A heat conducting device made of thermally conductive metal in resilient contact with each of two members between which heat is to be transferred characterized in that the device comprises at least one flexible elongate element (3) made up of a plurality of metal foil strips (4) which, at two spaced positions along the member, are attached one to another and to respective ones of said members.

2. Cryogenic apparatus comprising a Stirling cycle cooling engine having a cold finger and comprising an electronic component support member from which heat is to be conducted to said cold-finger, the member and cold-finger being coupled by way of two U-shaped elements each made up of a plurality of face-to-face copper foil strips which are fixed together and to the member and cold-finger, by brazing, at the ends of the limbs of the U-shape.



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EUROPEAN SEARCH REPORT

Application number 0225138

EP 86 30 9112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP-A-0 139 335 (PHILIPS) * Abstract; page 1, lines 1-7; page 4, lines 6-38; pages 5,6; figure 2 *	1	F 25 B 29/00
Y		2	
Y	US-A-3 609 992 (J.A. CACHEUX) * Abstract; column 3, lines 33-41; figure *	2	
A	US-A-3 999 403 (BOWER) * Abstract; column 2, lines 32-64; figures 1,2 *	1,2	
A	US-A-4 194 119 (MAC KENZIE)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-3 851 173 (TAYLOR)		F 25 B
A	EP-A-0 127 109 (HONEYWELL)		
A	US-A-4 365 982 (DURENEC)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-02-1987	ERNST J.L.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
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