

- [54] **METHOD FOR CONSTRUCTING A THERMIONIC COUPLE**
- [75] Inventor: **Gianni A. Dotto**, Dayton, Ohio
- [73] Assignee: **Pro International Corporation**
- [22] Filed: **Sept. 20, 1972**
- [21] Appl. No.: **290,730**

Related U.S. Application Data

- [63] Continuation of Ser. No. 42,301, June 1, 1970, abandoned.
- [52] U.S. Cl. **29/25.14, 29/573**
- [51] Int. Cl. **H01j 9/00**
- [58] Field of Search **29/573, 574, 584, 25.14**

References Cited

UNITED STATES PATENTS

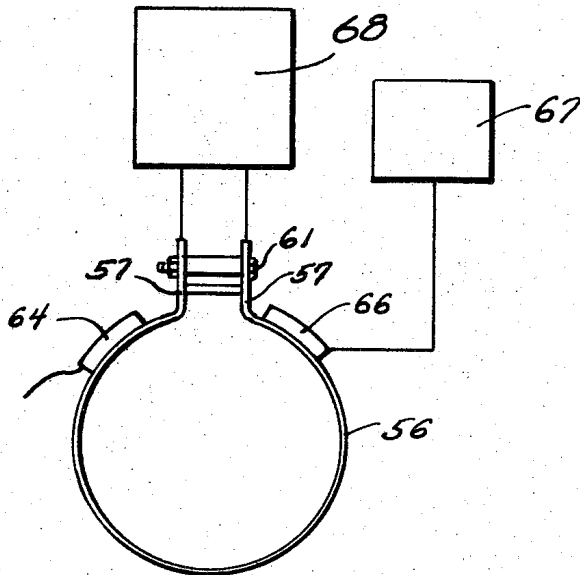
3,307,974	3/1967	Davis	29/573
3,373,061	3/1968	Pessel	29/573
3,466,200	9/1969	Mellor	29/573

Primary Examiner—W. Tupman
Attorney, Agent, or Firm—Woodard, Weikart, Emhardt & Naughton

[57] **ABSTRACT**

A method for constructing a thermionic couple comprising an apparatus in the form of a ring or loop of metal such as copper having high electrical and thermal conductivity. The ring has spaced ends forming a gap joined by a bridge member formed of material having significantly lower electrical and thermal conductivity than the ring. A substantial thermal unbalance is induced between the junctions of the ring and the bridge member. The width of the gap and the effective length of the bridge member is adjusted to produce a recurrent cyclic thermoelectric unbalance, resulting in repeated changes in the energy level of the metal atoms of the ring.

1 Claim, 2 Drawing Figures



METHOD FOR CONSTRUCTING A THERMIONIC COUPLE

This is a continuation of application Ser. No. 42,301 filed June 1, 1970, now abandoned.

SUMMARY OF THE INVENTION

In a typical embodiment of the present invention, an electrically and thermally conductive metal strip has end portions thereof bridged by a member of a material having substantially different thermoelectric properties. Means are provided to establish a substantial temperature difference between the opposite end portions of the metal strip and bridge member, with an appropriate adjustment being made with respect to the point of connection of the bridge to one end portion of the strip, to provide a loop wherein oscillation involving high electrical excursions occurs, resulting in continuing changes in energy levels of the metal atoms in the strip.

FIG. 1 is a plan view of one embodiment of the apparatus.

FIG. 2 is an enlarged fragmentary section showing detail of the bridge member and opposite ends of the ring of the embodiment of my invention shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 2, a ring or loop 56 is formed with spaced apart ends or ears 57 defining a gap therebetween. In an embodiment of the invention constructed and operated successfully, the ring was formed of a copper bar having a width of 9 inches and a thickness of $\frac{1}{2}$ inch, formed into a loop of approximately 27 inches in diameter, with a gap between the ears 57. The copper material used was an annealed copper having a purity of 99.99 percent copper, and an electrical resistivity of [1.7 microhm-cm] ohms-circular mil per foot at 20°C. This is the international standard of resistance for annealed copper and is equal to 100 percent electrical conductivity. The thermal conductivity of this copper is in the order of 1 calorie per second through a thickness of 1 centimeter and across an area of one square centimeter at a temperature difference of 1°C.

On the outer sides of the ears 57 there are blocks 58 of insulating material which are both electrically and thermally insulative. Insulating tubes 59 (one shown in FIG. 2) extend through the blocks 58 and the ears 57, providing an insulating passage for bolts 61 having suitable threaded fasteners 62 at one or both ends. This provides a means for adjusting the gap between the ears 57 without short circuiting across the gap either thermally or electrically.

Attached to the ears 57, as by brazing or the like, is a bridge member 63 forming a separate "short circuit" electrical and thermal path between the ears, apart from the continuity of the bar. The bridge member is formed of one or more rods of a metal alloy such as Constantan, which is an alloy of essentially 60 percent copper and 40 percent nickel, having a significantly lower electrical and thermal conductivity than the copper bar and hence a significantly higher electrical and thermal resistance than the ring 56. For example, Constantan has an electrical resistivity in the order of 49 microhm-centimeter at 20°C. and a thermal conductiv-

ity in the order of 0.054 calories per second through a thickness of 1 centimeter across one square centimeter at a temperature of 1°C.

A means for heating one end of the ring 56 is provided in the form of an electrical heater 64 connected to a suitable source of electrical power, and in the case of the specific device disclosed, having a capacity of 6000 watts and a heat exchanging area on the order of 200 in.². A means for cooling the other end of the ring 56 is provided in the form of a refrigerating coil 66 connecting through suitable tubing to a refrigerating unit 67. In the case of the specific device disclosed, the refrigerating unit has a cooling capacity of 10,000 B.T.U., and the cooling coil 24 has a heat exchanging area on the order of 200 square inches.

A two channel recording electroencephalograph 68 (FIG. 1) has one of its channels connected to the ears 57, to record the potential difference between the junctions of the ears and the bridge member. While operating the heating and cooling means, and observing the output of the oscillograph, the apparatus is initially "tuned" by fastening one end of the bridge member 63 to one of the ears 57, having the other end of the bridge member in contact with the other ear, and adjusting the threaded fasteners of the bolts 61 until the output of the oscillograph is observed to fluctuate in recurrent cyclic fashion. When this condition is achieved, the other end of the bridge member 63 is brazed to the other ear 57 of the ring.

Potential differences between the ears 57 have been recorded in the order of 0.156 millivolts, and the electrical resistance of the ring is in the order of 5.27×10^{-6} ohms. According to Ohm's Law, these conditions would indicate a current in the order of 30,000 amperes, at a frequency which, from observing the oscillograph readings, is in the order of 100 Kilocycles per second. With modulation frequency of 10 Kilocycles.

It appears that in operation of the device there is a change caused in the energy level of the electrons of the metal (copper) atoms, which is exhibited in a form of electron acceleration around the ring. No electron emission from the ring has been observed, by irradiating the ring with ultraviolet light during operation of the device whereupon a pale blue-white "halo" appears about the ring or by enclosing the ring in a foggy chamber "curie" method. On the other hand, if a bar of cadmium is positioned in the center of the ring and the bar is heated high enough to thermally increase the kinetic energy of the outer orbit electrons to a point where their kinetic energy ($\frac{1}{2} MV^2$) will be greater than the work function and allow discharge into space; the electron will be attracted by the proton energy of the ring. The phenomenon is shown by the deposit of cadmium on the internal service of the copper ring as if cadmium plated.

It is sometimes desirable to maintain the magnetic field of the ring between 240 and 160 Gauss. The amount of energy is determined by the temperature difference and the amount of the resistance in the ring. The high temperatures are obtained by conventional electrical heaters. As an example, a heater having three elements, each one with a 1000 watt rating, may be used. It is desirable to obtain a temperature of about 600° to 800° Fahrenheit. For the cold side a conventional coil like that of a freezer cabinet can be used, and connected to a refrigeration compressor.

3

The invention claimed is:

1. The method of constructing a thermionic couple capable of exhibiting a cyclic thermionic unbalance in operation, comprising the steps of:

forming a ring of material such as copper having a low electrical resistivity in the order of 1.7 microhm-centimeters (at 20°C.) and a relatively high thermal conductivity in the order of one calorie per second through a thickness of 1 centimeter and across an area of 1 square centimeter at a temperature difference of 1°C. with the ends of the ring defining a gap therebetween;

forming a bridge member spanning said gap of a material such as Constantan having a significantly higher electrical resistivity in the order of 49 microhm-centimeters (at 20°C.) and a significantly lower thermal conductivity in the order of 0.054 calories per second through a thickness of 1 centimeter

4

meter across an area of 1 square centimeter at a temperature difference of 1°C;
causing a substantial temperature difference between the ends of said ring to induce an electrical potential gradient between the ends of said ring;
placing the bridge member in contact with the ends of said ring resistance between the ends of said ring;
measuring the potential difference between the ends of said ring while the temperature difference is induced;
and adjusting the spacing between the ends of said ring and hence adjusting the effective length of the bridge member until the observed potential difference fluctuates in a cyclic manner;
and then securing said bridge member to the ends of said ring.

* * * * *

20

25

30

35

40

45

50

55

60

65

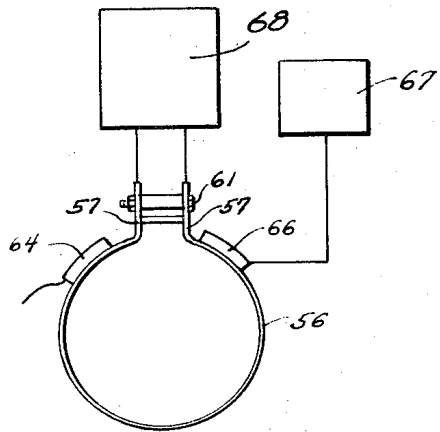


FIG. 1

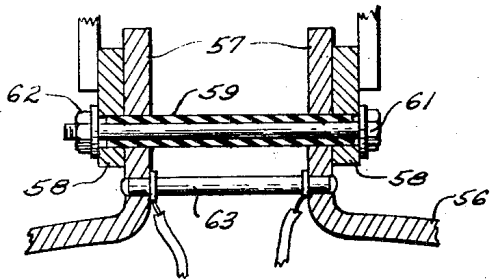


FIG. 2