

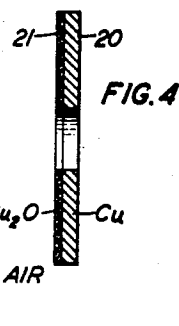
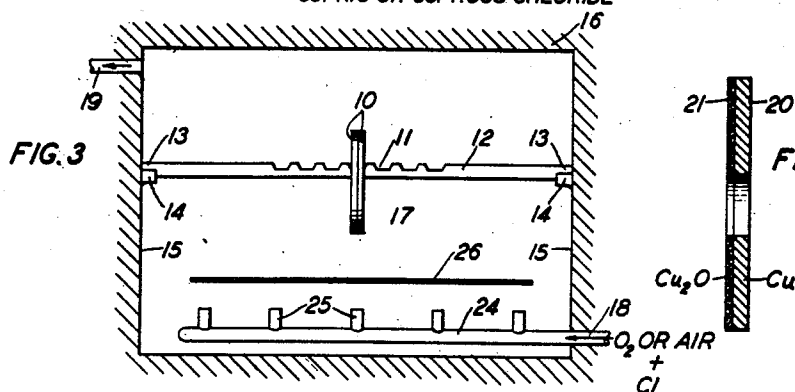
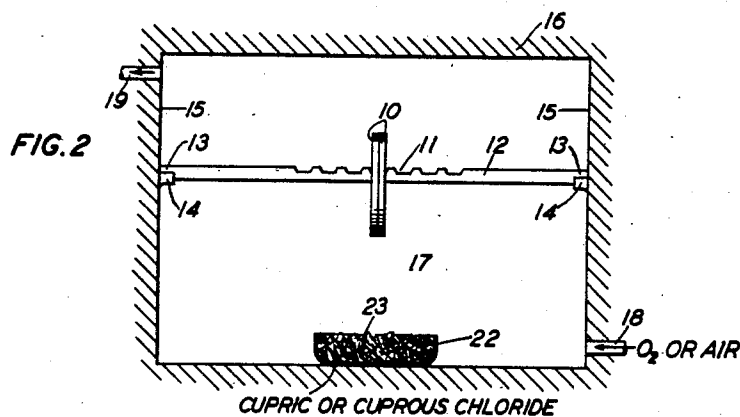
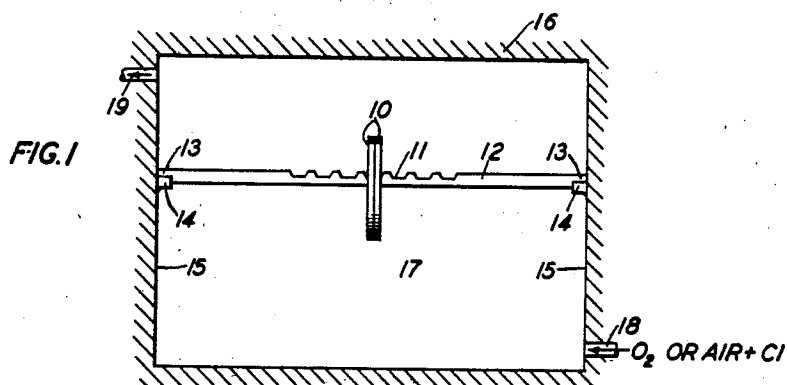
Nov. 17, 1936.

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2,060,905

ASYMMETRICAL CONDUCTOR

Filed March 30, 1935



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UNITED STATES PATENT OFFICE

2,060,905

ASYMMETRICAL CONDUCTOR

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Application March 30, 1935, Serial No. 13,888

14 Claims. (Cl. 175—366)

This invention relates to the manufacture of devices that offer a greater resistance to current flow in one direction therethrough than in the reverse direction, and, more particularly, to such devices of the copper-cuprous oxide type.

An object of this invention is to improve the method of manufacture of copper-cuprous oxide rectifiers.

Another object is to increase the rectification ratio of copper-cuprous oxide rectifiers.

A feature of this invention comprises providing in the oxidizing atmosphere in which the rectifier disc or unit is formed a small amount of a halogen, specifically, chlorine.

In accordance with this invention, the oxidizing atmosphere in which the copper blank is heated to form a layer of cuprous oxide thereon contains a small amount of chlorine. The chlorine may be contained in the oxygen or in a mixture of oxygen and nitrogen supplied to the furnace; or may be added to the oxidizing atmosphere during the heat treatment of the copper blank by being liberated from a suitable chlorine compound, for instance, cupric or cuprous chloride.

A more complete understanding of this invention will be obtained from the detailed description which follows, read with reference to the appended drawing, wherein:

Figs. 1, 2 and 3 show cross-sections of furnaces in which asymmetrical conductors may be manufactured in accordance with this invention; and

Fig. 4 shows a cross-sectional view of a copper-cuprous oxide rectifier manufactured in accordance with the invention.

It is known that copper-cuprous oxide rectifiers may be manufactured by placing copper blanks in an oxidizing atmosphere at about 1000° C., leaving them therein for a predetermined length of time, for example, six to eight minutes, and thereafter, cooling them in a suitable quenching medium or allowing them to cool slowly in an atmosphere maintained at about 500°–600° C. until the latter temperature is reached, and thereafter, cooling them in a suitable quenching medium.

In accordance with this invention, the atmosphere in which the copper blank is oxidized is caused to contain a small amount of a halogen, specifically, chlorine.

As indicated by Fig. 1, a pair of copper blanks 10, 10, annular in shape, are supported on and in a trapezoidal cut 11 in a supporting rod 12, carried at its end portions 13 by suitable ledges 14 on the walls 15 of a furnace 16, which may be an electric furnace. The chamber 17 is main-

tained, preferably, at a temperature of about 1000° C. while a gas containing oxygen is introduced therein through inlet or port 18. An outlet is provided at 19, whereby there is a continuous flow of the oxidizing agent through the chamber and over the blanks to be oxidized. In accordance with this invention, the gas introduced into the furnace contains a small quantity of a halogen, specifically, chlorine. Chlorine in amounts ranging from .015 to .1% by volume has been added with good results.

The chlorine may be present in the oxidizing atmosphere throughout the period during which the blanks are being oxidized, or only during the latter part thereof. For example, copper blanks have been oxidized in atmospheres in which .05% chlorine was present during the last two minutes of the oxidizing period; or in which .02 to .05% chlorine was present during the last four minutes of the oxidizing period; or in which .015% chlorine was present during the entire oxidizing period, for example, eight minutes.

Upon subsequent cooling by quenching, or cooling to an intermediate temperature and quenching, and removal of cupric oxide in accordance with known practice, each blank 10 presents a cross-section such as shown by Fig. 4, wherein the mother copper 20 has an integral layer of cuprous oxide 21.

Instead of introducing the chlorine with the oxidizing agent, the blanks 10 may be initially provided with a film of copper chloride, and, thereafter, oxidized at about 1000° C. in an atmosphere containing oxygen or oxygen and nitrogen, only. The chloride compound decomposes to provide the free element chlorine. Alternatively, a dish or other receptacle 22 containing cuprous or cupric chloride 23 may be placed in the furnace, as shown by Fig. 2, during the oxidation process, as a source of chlorine, the oxidizing atmosphere being supplied through the port 18. If the chlorine is introduced with the oxygen or the oxygen-nitrogen mixture, a more uniform distribution is ensured by providing, as shown in Fig. 3, a continuation 24 of the entrance port 18, with a plurality of outlet pipes 25 and a baffle plate or member 26 disposed over and in spaced relation to the outlet openings.

Copper-cuprous oxide rectifier units manufactured in accordance with this invention have shown increased rectification ratios over units manufactured in the ordinary oxidizing atmosphere, as a result of a decrease by a factor of two to four in the forward or current passing direction resistance.

It will be understood that this invention has been disclosed with reference to preferred forms thereof, and that it is to be considered as limited in scope by the appended claims, only.

5 What is claimed is:

1. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere containing about .015 to .1% chlorine by volume.
- 10 2. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere containing approximately .02% chlorine by volume.
3. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere at about 1000° C., said atmosphere containing about .015 to .1% chlorine by volume.
4. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere, said atmosphere for a portion of the time containing about .015 to .1% chlorine by volume.
5. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere, said atmosphere for a portion of the time containing .02 to .05% chlorine by volume.
6. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere, said atmosphere for the entire time containing about .015% chlorine by volume.
7. The method of manufacture of an electrically conductive device comprising a body of copper having a layer of cuprous oxide thereon, which comprises placing the copper body and a source of chlorine in an oxidizing atmosphere at an oxidizing temperature to form an oxide on the copper body, said chlorine source adding about .015 to .1% chlorine by volume to said atmosphere, and thereafter cooling said body.
8. The method of manufacture of an electrically conductive device comprising a copper body having a layer of cuprous oxide thereon, which comprises placing the copper body and a chloride

in an oxidizing atmosphere at an oxidizing and chlorine-liberating temperature to form a layer of oxide on the body, said chloride adding about .015 to .1% chlorine by volume to said atmosphere.

9. A conductive device comprising a copper body having a layer of oxide that has been formed thereon by heating the copper body in an oxidizing atmosphere containing about .015 to .1% chlorine by volume.

10. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere for six to eight minutes, said atmosphere containing about .015% chlorine by volume.

11. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere for six to eight minutes, said atmosphere containing about .02 to .05% chlorine by volume for the last five minutes.

12. The method of manufacture of a copper-cuprous oxide rectifier that comprises heating a copper blank in an oxidizing atmosphere for about six to eight minutes, said atmosphere containing about .05% chlorine by volume for the last two minutes.

13. The method of manufacture of an electrically conductive device comprises a copper body having a layer of cuprous oxide thereon, that comprises coating the copper body with copper chloride, placing it in an oxidizing atmosphere at a temperature to decompose the chloride to add chlorine to the atmosphere to about .015 to .1% by volume, forming an oxide on said body, and thereafter cooling said body.

14. The method of manufacture of an electrically conductive device comprising a copper body having a layer of cuprous oxide thereon, that comprises placing the copper body and a body of copper chloride in an oxidizing atmosphere at a temperature to decompose the chloride to add chlorine in the atmosphere to about .015 to .1% by volume, forming an oxide on said body, and thereafter cooling said body.

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