Ce 136

Published May 18, 1943

Serial No. 367,391

ALIEN PROPERTY CUSTODIAN

MANUFACTURING SELENIUM CELLS

Heinrich Herrmann, Nurnberg, Germany; vested in the Alien Property Custodian

No Drawing. Application November 27, 1940

In the manufacture of selenium cells, as dry rectifiers and photo-electric cells, the practice has been to proceed as follows. Selenium is welded onto a hot metallic base plate which, for instance, is made of a metal of the iron group and is heated to about 300° C. After this assembly has become cold the selenium is an amorphous layer firmly united with the base plate. Between the selenium structures so obtained mica discs and discs of a suitable elastic material are interposed in a suitable stacking device, the mica discs being arranged to contact with the selenium layers. The stack so produced is then compressed by spring-actuated means of the stacking device.

The stacking device with the selenium structures and intermediate discs contained in it is now heated in a formation furnace to about 150° C. The selenium layers are thereby transformed from the amorphous condition into the crystalline condition. This forming process takes several hours and is stopped after the desired degree of formation has been attained.

At the commencement of heating, the amorphous selenium layers soften. Inequalities and bubbles in these layers will be removed by the elastic discs acting to distribute the pressure of the spring-actuated means uniformly over the selenium layers. The selenium layers crystallize and thus harden again. After finishing this forming process the selenium structures are removed from the stacking device and subjected to a second forming process. The temperature employed in the case of such second process is higher than in the former case. The duration of the second process, however, is shorter than that of the former. By the second process the selenium layers are completely transformed into the metallic condition, in which they are well conductive in the traversing direction of the cell.

It has also been proposed that amorphous selenium be applied to the metallic base plate by pressing it cold thereagainst. For this purpose selenium powder is arranged on the base plate and fixed to it by a high pressure. The two said forming processes are then employed as in the case before.

These methods have the drawback that several hours pass away until the selenium layers have been finished. Also, during the first said forming process, which is of long duration and involves the use of a high temperature, the selenium layers should be prevented from contacting with a metal because traces of such metal may be able to penetrate into the selenium layers so as to increase the return current of the valve and to prevent a proper blocking layer from forming at the surface of the selenium. Therefore, care should be taken that during this process the selenium layers only contact with the said neutral mica discs, which in their turn should be carefully cleaned, every time they have been used.

As regards methods which comprise the step of welding selenium onto the base plate this step is time-wasting and much depends upon the skill of the workman, thus constituting a disadvantage that has to be contended with in addition to the long forming period.

All these drawbacks are overcome by the following method.

Amorphous selenium is applied to the cold metallic base plates which preferably are roughened. The selenium is applied thereto either as a powder or in the form of thin pressed plates calculated to cover the base plates. The base plates so provided with selenium are placed on the table of a press. This table and the die of the press are heated to about 200° C. and are maintained at this temperature. Preferably, a self-regulating electric heating apparatus serves this purpose. The structures comprising base plate and selenium and located on the hot table are now highly compressed by means of the hot die. The heat and the pressure to which the selenium is in this way subjected act to firmly unite the amorphous selenium layer with the base plate and at the same time to transform it into the grey crystalline condition. The pressure on base plate and selenium is so calculated that the forming process shall be finished as quickly as possible at the said temperature. This temperature should not be substantially exceeded since otherwise the selenium layer would melt. With a suitable pressure employed in this regard the pressing and forming process will have been finished after about 30 seconds. A selenium structure manufactured in accordance with the invention, in the state it has been removed from the press, corresponds to the structure obtained by means of the said first forming process. Thus, the known method taking several hours is replaced by a method that takes a number of seconds only.

In addition to such saving of time the output of the selenium structures so obtained is better and above all is much more uniform than previously, this advantage being due to the fact that mechanical operation has been introduced to replace in part manual labour.

Another advantage is that the said discs of electric material as well as the mica discs may be dispensed with. The elastic discs, which serve to equalize the pressure exerted on the uneven surface of selenium layers produced by manual labour alone, are not needed because the surface of selenium layers as produced by the novel method is uniform throughout. Equally, mica discs need not be arranged to contact with the selenium layers, as the time during which the hot pressing die is contacting with a selenium layer is too short to enable detrimental quantities of metal to enter this layer.

Preferably that surface of the die by which it contacts wth the selenium is highly polished in order that the selenium, transformed into the crystalline condition, shall readily come off from the die. Furthermore, the die may be coated with hard chromium or another suitable metal with a view to obviating chemical reaction between selenium and die.

The novel method also renders it possible to provide a selenium layer which is thinner than in prior devices without being less rigid. Its thickness may be less than 0.1 mm, whereby the ohmic resistance in the traversing direction of the cells will be considerably reduced, this being highly important in the case of dry rectifiers.

The selenium structures so manufactured are then finished in well-known manner, that is to say, the selenium is subjected to the said second thermal forming process, known from the prior methods. In special cases such second forming process may be dispensed with. The desired selenium cells are thereupon obtained by adding the so-called counterelectrode. In the case of rectifiers the counterelectrode is a metallic layer produced by spraying metal onto the selenium layer, while in the case of photo-electric cells such electrode is a light-permeable metal film produced on the selenium by the so-called cathode sputtering.

HEINRICH HERRMANN.