United States Patent

Holz

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[45] **Aug. 29, 1972**

[54] **METHOD OF AGING A DISPLAY PANEL**

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[52] **U.S. Cl.** **316/20,** 29/25.13, 316/24

[51] **Int. Cl.**.....**H01j 9/38**

[58] **Field of Search**.....316/22, 26, 17, 18, 19, 20, 316/24; 29/25.1, 25.11, 25.13, 25.16; 315/169, 1

[56] **References Cited**

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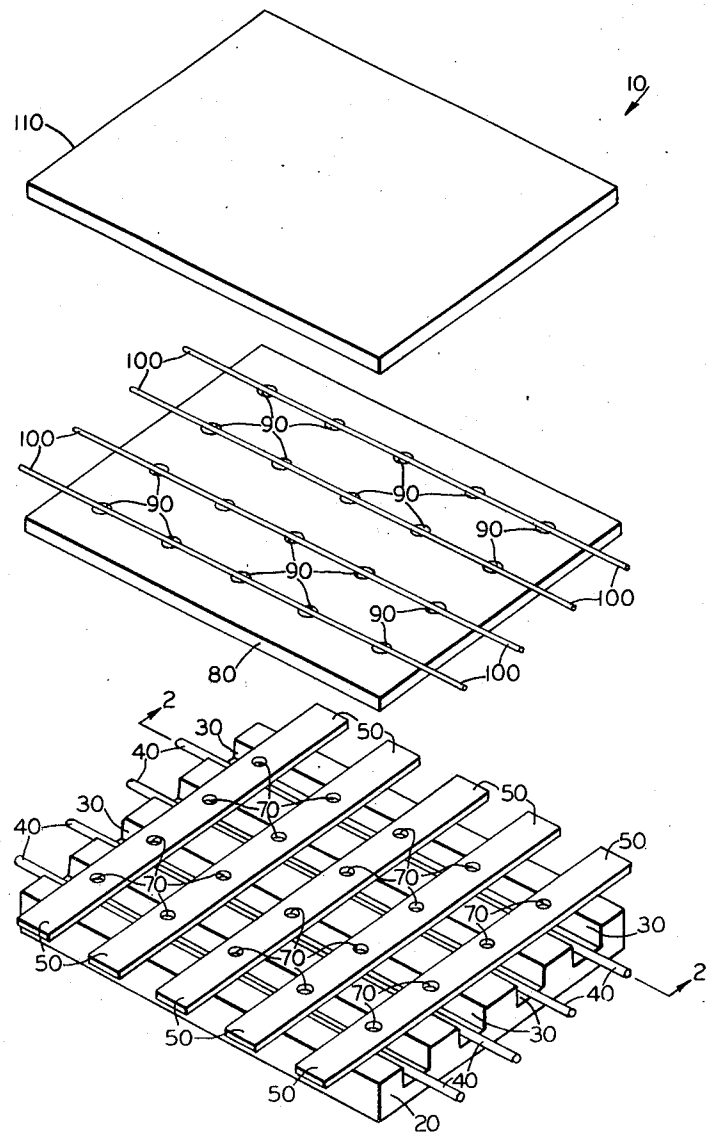
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[57] **ABSTRACT**

The method comprises assembling the various parts of a display panel made up of rows and columns of tiny dot-like display cells and including elongated anode and cathode electrodes, filling the panel with the desired gas, and then aging the panel by turning on all of its cells in a sequential pattern and with the panel held at an elevated temperature.

8 Claims, 2 Drawing Figures



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SHEET 1 OF 2

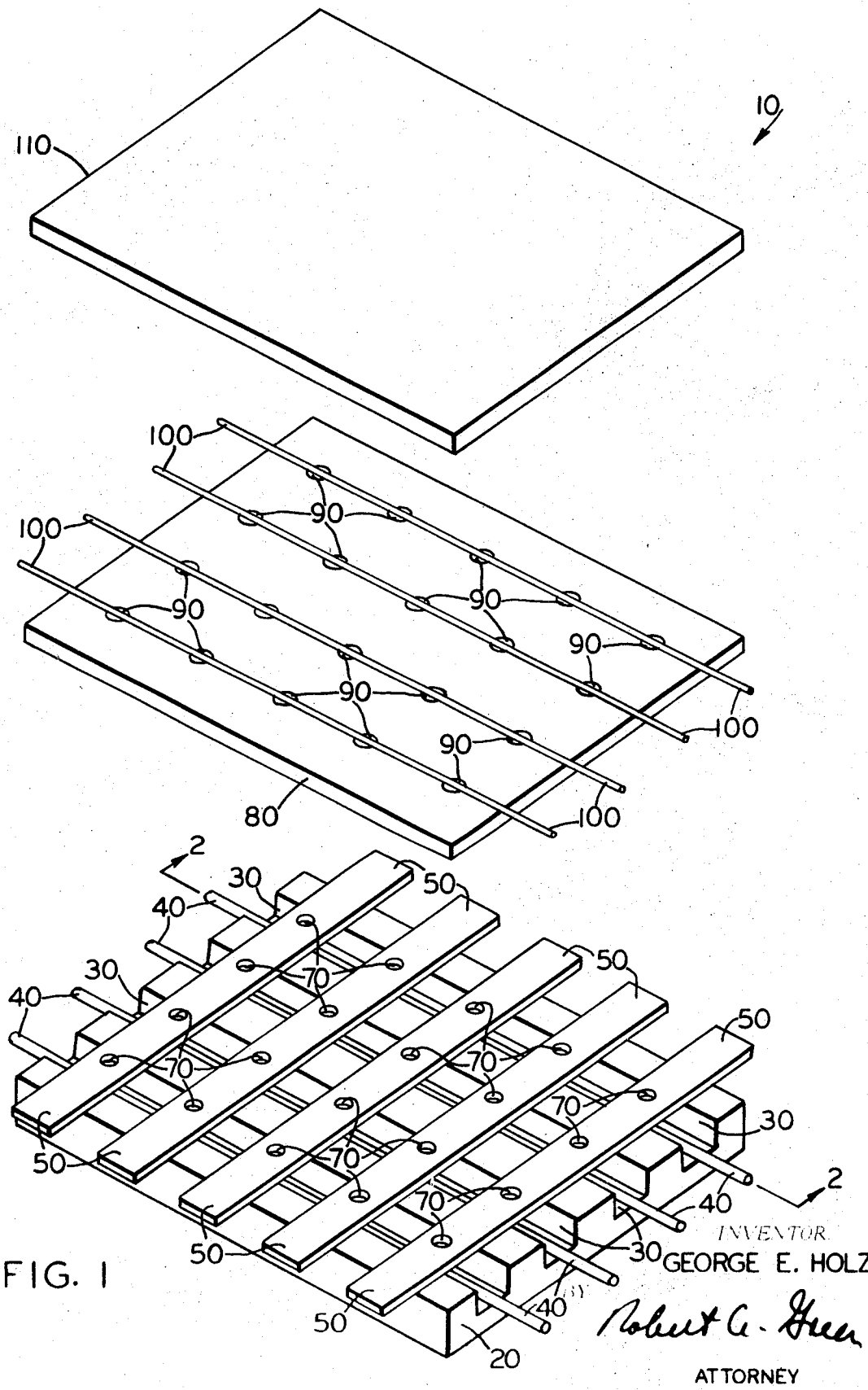


FIG. 1

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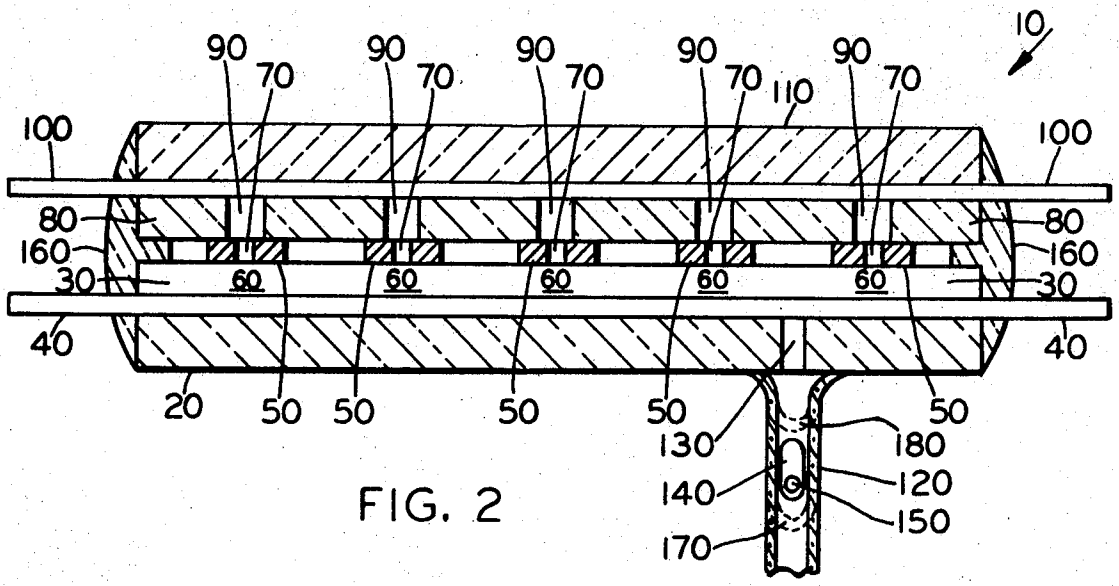


FIG. 2

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BY

METHOD OF AGING A DISPLAY PANEL

BACKGROUND OF THE INVENTION

One type of display panel processed according to the present invention is known as a SELF-SCAN panel, and these panels include large numbers of tiny gas-filled cells. These panels have been available commercially for some time, and have been manufactured generally satisfactorily by methods normally employed in the gas tube art in manufacturing display tubes having relatively large number cathodes. In general, the method comprises assembling the various parts and sealing them together, filling the panel with the desired gas, aging by operating the panel at room temperature but at higher than normal operating currents, and finally, introducing mercury to minimize cathode sputtering during normal panel operation. Although this method of manufacturing and processing a display panel produces good panels, problems arise because aging is performed without mercury present in the gas filling, and this is done because, with the prior art method, it is not possible to achieve proper aging with mercury present. However, when a display panel is aged without mercury, there is some cathode sputtering onto the walls of the panel cells, and this reduces the viewing angle of the cells to some extent. In addition, this aging method produces cathodes which, although their operation is generally satisfactory, have surface non-uniformities which produce non-uniformities in cathode glow. This is a feature which, although it does not render panels unusable, should be eliminated. In addition, it has been found that occasionally the cathodes in display panels cannot be aged at all by prior art methods.

SUMMARY OF THE INVENTION

Briefly, the invention comprises assembling all of the parts of a display panel, filling the panel with the desired gas, and aging the panel at elevated temperature.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective exploded view of a display panel prepared according to the method of the invention; and

FIG. **2** is a sectional view, along the lines **2—2** in FIG. **1**, showing the panel assembled.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A display panel **10**, embodying the invention, is known as a SELF-SCAN panel and includes a plate **20** of insulating material, such as glass or ceramic, having a plurality of parallel slots **30** formed in the top surface thereof. Electrodes **40**, which are used as scanning anodes in one mode of operation of the panel, are seated in each of the slots **30**, and electrodes **50**, of stainless steel or the like, used as scanning cathodes, are seated on or in the top surface of plate **20**. Each cathode electrode **50** crosses each anode electrode **40**, and each crossing defines a scanning cell **60**. The cathodes include rows of tiny apertures **70**, each of which is located at a scanning cell. The scanning cells are arrayed in rows and columns, and each cathode **50** is oriented along a vertical column of scanning cells in the panel as illustrated.

The panel **10** includes an insulating plate **80** disposed over the cathodes **50** and having apertures or display cells **90** arrayed in rows and columns, with each cell **90** being in operative relation with and positioned over a cathode aperture **70** and a scanning cell **60**. Display anode wires **100** are disposed on or in the top surface of the insulating plate **80**, and each is aligned with a row of display cells **90**. A glass cover plate **110** completes the panel.

A glass tubulation **120** is secured to the base plate **20** and communicates with the interior of the panel through a hole **130** in plate **20**. A capsule **140** containing a droplet of mercury **150** is suitably supported in the tubulation near base plate **20**. The capsule **140** is preferably of infrared absorbing glass.

In practicing the method of the invention, all of the parts described are properly cleaned and assembled and secured together by means of an airtight seal **160** (FIG. **2**) formed along the periphery thereof by means of a glass frit or the like. A particularly suitable material for the seal is known as Pyroceram, and this material is applied as a fluid mixture of powdered glass in a suitable binder or carrier. With the parts suitably held together, the fluid cement is placed along the aligned edges of the panel parts, and the assembly is then heated to form the desired seal upon cooling. After the seal has been formed, the panel is baked and evacuated through the tubulation **120**, and then it is filled with the desired gas through the tubulation.

The gas filling may be any of the well known ionizable gases such as neon, argon, xenon, etc., singly or in combination. In addition, the gas used is preferably a Penning mixture in which the gases of the mixture have related energy levels such that the metastable atoms of one gas produce ions of the other gas. Neon and xenon comprise a particularly effective Penning mixture. The gas pressure at room temperature is preferably between 50 and 350 Torr or more, and 175 Torr has been found to be a convenient pressure.

After the display panel has been assembled and filled with the desired gas, the tubulation **120** is sealed off below the mercury capsule, as represented by dash lines **170**, and the mercury capsule is opened to release the mercury into the tubulation. This may be accomplished by heating the capsule with infrared radiation or in any other suitable manner. Next, the panel is aged by firing all of the scanning and display cells in any suitable manner. In one suitable arrangement, operating potentials are applied to the anode electrodes **40**, and each of the scanning cathodes **50** has potential applied to it, in turn, so that the scanning cells are turned on column by column. At the same time, generally positive potentials are applied to all of the display anodes **90** so that, as each of the columns of scanning cells is turned on, each of the columns of display cells is also turned on.

The cell currents are of the order of 1 milliampere in the scanning cells and 2 milliamperes in the display cells. This procedure is performed with the panel held at an elevated temperature of the order of 120°C. for a period of 12 to 48 hours. The heating may be achieved by placing the panel in an oven or in any other suitable manner. As noted, this aging step may also be performed cell by cell or row by row, or in any other suitable cell pattern. After this aging process has been performed, the panel is ready for use.

The aging currents, the aging temperature, and time of aging may be varied as can be readily determined by those skilled in the art. The aging parameters set forth above are typical and are found to be suitable for one type of display panel such as the Burroughs SSR 1000 panel. Panels of this type include, typically, gas display cells having a diameter of the order of 30 mils and a depth of the order of 30 to 50 mils, cathodes and anodes of a nickel-chrome-iron alloy, and gas pressure of the order of 170 Torr at room temperature. The same principles of aging can be applied to other types and sizes of display panels and display devices.

One of the most important advantages of the present invention resides in the fact that a display panel can be aged after mercury is introduced into the display cells thereof, although this was not feasible in the prior art. With such an arrangement, cathode sputtering during aging is either prevented, or it is so minimal that it is of no effect. Thus, there is no deposit of sputtered material on the display cell walls, and the viewing angle is a maximum. In addition, aging with mercury in the gas atmosphere produces cathode electrodes which are impregnated with a uniform, permanent coating of mercury, and this in turn provides improved low temperature cathode life and greater uniformity of glow across a cathode. In addition, it has been found that some panels which could not previously have been aged at room temperature can now be aged. This appears to be because, at elevated temperatures and with considerable mercury vapor in the gas, the breakdown voltage of each cell increases. However, the sustaining voltage of each cell remains generally constant so that the margin between the two voltages increases and the panel can be aged harder and thus more effectively.

What is claimed is:

1. The method of making multi-cell, gas-filled display panels comprising the steps of

assembling a plurality of insulating plates and electrodes to form a gastight envelope including a large number of tiny cells, each having operating electrodes,

filling said envelope with a gas filling and a quantity of mercury, and

heating the panel in a chamber while turning on and operating each of said cells with said panel at an elevated temperature above 90° C.

2. The method defined in claim 1 wherein said cells are turned on and operated cyclically.

3. The method defined in claim 1 wherein said elevated temperature is of the order of 120° C. and said cells are turned on and operated cyclically at said temperature for a period of about 12 to about 48 hours.

4. The method defined in claim 1 wherein said elevated temperature is of the order of 120° C., and said cells are turned on and operated cyclically at said temperature and at a current of the order of 2 milliamperes for a period of about 12 to about 48 hours.

5. A method of making a multi-cell, gas-filled display panel comprising the steps of

assembling a first base plate having a plurality of slots with a first array of first electrodes seated in said slots and a second array of apertured second electrodes seated on the top surface thereof and oriented at 90° to said first electrodes.

said first and second electrodes defining a first array of first scanning cells,

seating an apertured insulating plate on said second array of electrodes,

the apertures in said second plate being arrayed in rows and columns and comprising display cells, each aligned with an aperture in said second electrodes,

seating an array of third electrodes on said second plate, each third electrode being aligned with a row of said apertures in said second plate,

seating a glass cover plate on said second plate,

sealing together said first plate, said second plate, and said cover plate to form a gastight envelope,

filling said envelope with a gas filling and a quantity of mercury, and

heating the panel in a chamber while turning on and operating each of said scanning cells and display cells with said panel at an elevated temperature above 90° C.

6. The method defined in claim 5 wherein said scanning and display cells are turned on and operated cyclically.

7. The method defined in claim 5 wherein said elevated temperature is of the order of 120° C. and said scanning and display cells are turned on and operated cyclically at said temperature for a period of about 12 to about 48 hours.

8. The method defined in claim 5 wherein said elevated temperature is of the order of 120° C., and said scanning and display cells are turned on and operated cyclically at said temperature and at a current of the order of 2 milliamperes for a period of about 12 to about 48 hours.

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