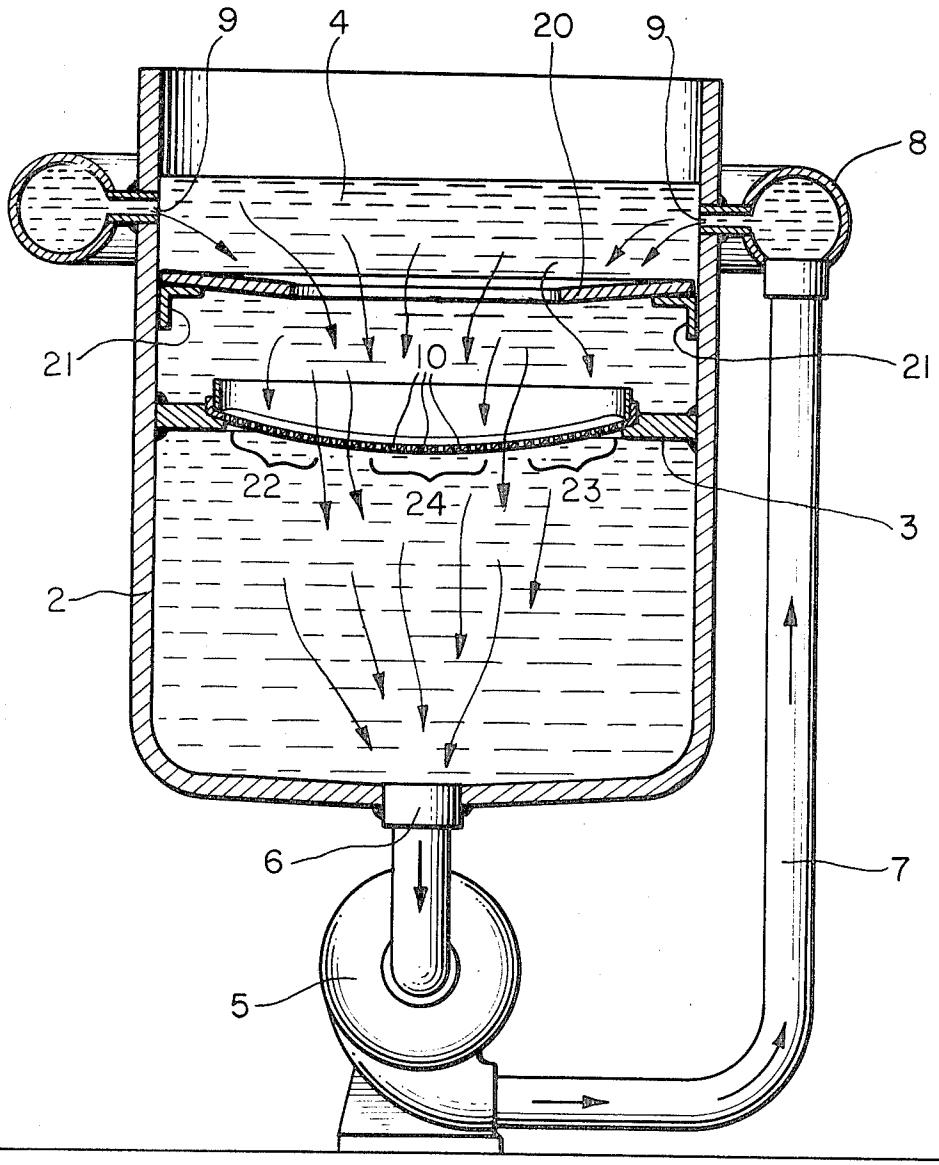
May 8, 1973 J. W. SCHWARTZ 3,732,133

RE-ETCH METHOD

Filed Aug. 2, 1971



Inventor
James W. Schwartz

By John J. Anderson
Attorney

United States Patent Office 3,732,133
Patented May 8, 1973

3,732,133

RE-ETCH METHOD

James W. Schwartz, Glenview, Ill., assignor to Zenith Radio Corporation, Chicago, Ill.

Filed Aug. 2, 1971, Ser. No. 168,223
Int. Cl. C23f 17/00
U.S. Cl. 156—6 2 Claims

ABSTRACT OF THE DISCLOSURE

A process for re-etching the apertures of a color cathode-ray tube shadow mask to increase the diameter of each aperture by an amount dependent upon its spacing from the center of the mask by flowing a fluid etchant through the mask apertures and controlling the velocity of etchant flow through the apertures to differ from aperture to aperture as a function of the spacing.

BACKGROUND OF THE INVENTION

The subject invention concerns processing of shadow mask color picture tubes which feature what has come to be known as re-etch. In accordance with such screening techniques, the shadow mask is originally etched and formed with apertures that are smaller in size than required for the mask as finally installed in the color tube but are dimensioned appropriately to use the mask in locating and dimensioning the phosphor dots of the screen. After screening has been accomplished, the mask is etched a second time, that is to say, it is re-etched to attain a hole size that is larger by a predetermined amount than the individual phosphor deposits. This screening technique is used in the fabrication of different types of color tubes, especially those which feature black-surround or post-deflection acceleration.

A black-surround tube of a preferred form is the subject of Pat. 3,146,368 issued Aug. 24, 1964 in the name of Joseph P. Fiore et al. and assigned to the assignee of the present invention. It differs from conventional shadow mask types of cathode ray tubes in two material respects: (1) each phosphor dot of the screen is surrounded by a material, such as graphite, that is absorptive of light, and (2) its electron beam is larger than the diameter of the phosphor dots. A post-deflection focus or post-deflection acceleration color tube differs from the conventional shadow mask device in that additional beam focusing is accomplished between the center of deflection and the screen. Because of the added focusing, more beam current impinges upon the screen than otherwise and it is necessary, because of the post-deflection focusing, that the phosphor dots be smaller than the apertures of the mask. As stated above, in this respect, it is similar to the black-surround tube.

The concept of establishing apertures in the shadow mask of a relatively small size to accommodate the mask for use in printing of the screen and then enlarging the apertures after screening and before final installation of the mask into the tube is indeed well known. In prior proposals, the mask blank is originally etched to have apertures of a desired final size and the apertures are then temporarily filled with a removable material in order to step down the aperture size for screening purposes. As a matter of practice, this approach is found to have serious difficulties including, among others, non-uniformities of the phosphor dots obtained in the screening process.

In a preferred approach, the technique of re-etching or etchback as descrbied above is practiced because it affords a materially greater degree of precision in dimensioning of the phosphor dots of the screen, and also distinctly superior results from the standpoint of uniformity of the phosphor deposit.

It has been discovered that by grading the final aperture, sizes, that is to say, by making the apertures in the center area larger than the apertures at the edges of the mask, improved color reproduction can be attained. The present invention takes full advantage of the inherent features of the re-etch process while also affording a means to provide an aperture mask where the aperture sizes are graded to make possible such improved color reproduction.

Accordingly, it is an object of the invention to provide an improved re-etch process for use in fabricating color cathode ray tubes.

It is a specific object of the invention to provide a process for re-etching the apertures of a color cathode-ray tube shadow mask to increase the diameter of each aperture by an amount dependent upon its spacing from the center of the mask.

SUMMARY OF THE INVENTION

The present invention provides a process for re-etching the apertures of a color cathode ray tube shadow mask to increase the diameter of each aperture by an amount dependent upon its spacing from the center of the mask. The process comprises the steps of flowing a fluid etchant through the mask apertures and controlling the velocity of etchant flow through the apertures to differ from aperture to aperture as a function of the spacing.

DESCRIPTION OF THE DRAWING

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which the single figure is a side view, partly in cross-section, of a re-etch apparatus which may be used to practice the present invention.

The apparatus shown in the figure which may be used to practice the present invention is the subject of and claimed in co-pending application, Ser. No. 139,482, filed May 3, 1971 in the name of Leonard Dietch and assigned to the assignee of the present invention.

Referring now to the figure, shadow mask **1** is disposed in tank **2** with its convex side pointed downwardly. The shadow mask **1** rests on and is supported by mounting ring **3**. The tank **2** contains a fluid etchant **4** which is typically a solution of ferric chloride suitable for attacking the cold rolled steel material of shadow mask **1**. The etchant **4** is circulated through the tank by pump **5** which pumps the etchant out of the bottom of the tank through outlet **6**. The etchant is then pumped through line **7** to distributing line **8** where it is reintroduced into the tank through inlets **9**. In the figure, only two inlets are shown but actually any number can be employed to obtain the desired circulating rate of the etchant.

Mounting ring **3** is preferably shaped to conform to the inner dimensions of the tank **2** and the outer dimensions of the shadow mask **1** to force all of the etchant to circulate through the mask apertures **10** of shadow mask **1**.

As shown, the shadow mask is disposed horizontally but may be disposed in any plane so long as the etchant can flow freely through the apertures **10**.

The re-etch apparatus as thus far described is suitable for uniformly re-etching the apertures across the aperture field of the mask. The increase in the diameter of each aperture by an amount dependent upon its spacing from the center mask **1** is accomplished by controlling the velocity of etchant flow through the apertures **10** to differ from aperture to aperture as a function of the spacing. This is achieved by baffle **20** which rests on bracket **21** and is disposed between inlets **9** and shadow mask **10**. The

baffle **20** is held onto bracket **21** by gravity and can be easily removed for mounting the shadow mask **10** on its position on mounting ring **3**. Once the mask is in place, the baffle is placed back onto bracket **21**.

Of course, different baffle configurations can be chosen to meet particular aperture size-center spacing requirements. As depicted in the figure, the baffle **20** is a single element, but multiple-element baffling systems may be employed. The baffling system may be designed in accordance with well-known principles of fluid mechanics, but as a practical matter empirical design approaches are ordinarily employed.

The velocity of the etchant **4** is affected by the baffle as represented by the arrows. The etchant flows at a much slower rate at the peripheral areas **22, 23** of the shadow mask **10** than at the center area **24**, resulting in less etching of the apertures at the outer portions of the aperture field than at the center. Therefore, the diameters of the apertures gradually decrease from the center **24** of mask **10** to the edges **22, 23.**

The present invention has all of the advantages of the re-etching processes previously described with the added feature of increasing the diameter of each aperture by an amount dependent upon its spacing from the center of the mask. By properly controlling the rate at which the etchant flows through each aperture, any aperture diameter and spacing relationship may be obtained.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and therefore, the aim in the appended claims is

to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A process for re-etching the apertures of a color cathode-ray tube shawdow mask to increase the diameter of each aperture by an amount depedent upon its spacing ing from the center of said mask, which process comprises:

providing a source of fluid etchant capable of attaching said mask;

flowing said fluid etchant through said apertures;

and controllably varying the velocity of said etchant flow through said apertures causing said etchant flow velocity to differ from one aperture area to another aperture area by controlling the rate of flow at one said area as against the rate of flow at the other of said area.

2. A process for re-etching the apertures of a color cathode-ray tube shadow mask in accordance with claim **1** where said etchant velocity is varied such that said etchant velocity differs inversely with aperture spacing from the center of said mask.

References Cited

UNITED STATES PATENTS

2,762,149 9/1956 Mears ---------- 156—345

JACOB H. STEINBERG, Primary Examiner

U.S. Cl. X.R.

156—9, 11, 345