Jan. 9, 1968 V. E. HAMILTON 3,362,804

METHOD OF MAKING CATHODE RAY TUBE WITH INTEGRAL LIGHT TRAPPING FILTER

Filed May 17, 1965 2 Sheets-Sheet 1

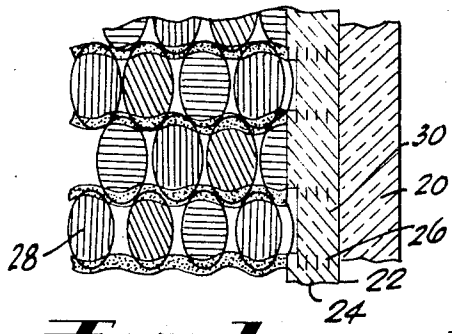


Fig. 1

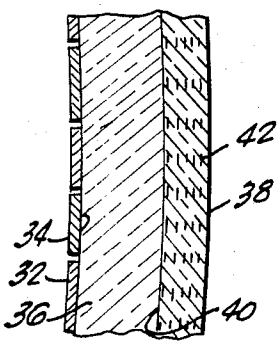


Fig. 2

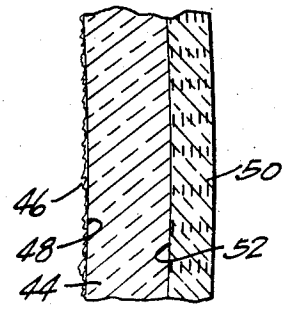


Fig. 3

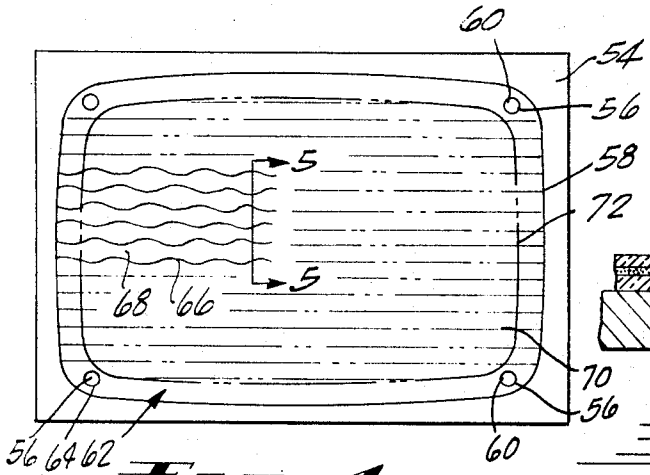


Fig. 4

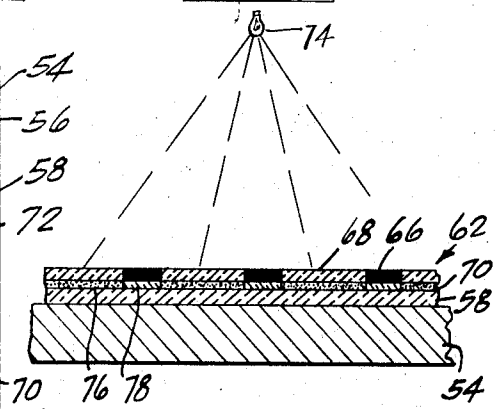


Fig. 5

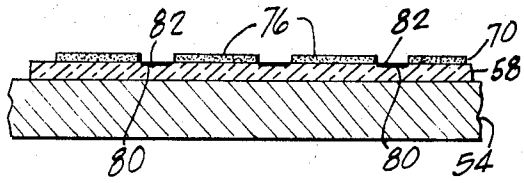


Fig. 6

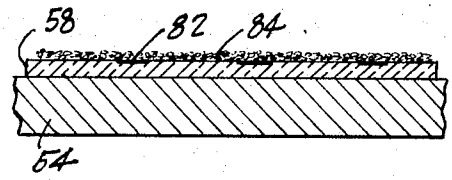


Fig. 7

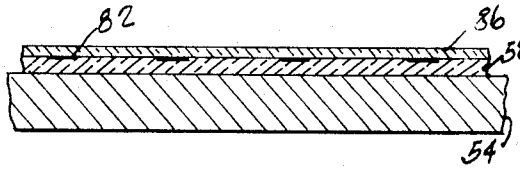


Fig. 8

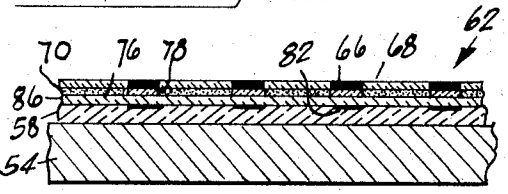


Fig. 9

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Jan. 9, 1968 V. E. HAMILTON 3,362,804

METHOD OF MAKING CATHODE RAY TUBE WITH INTEGRAL LIGHT TRAPPING FILTER

Filed May 17, 1965 2 Sheets-Sheet 2

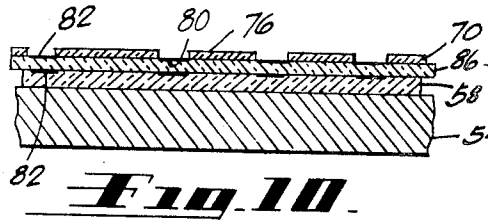


Fig. 10

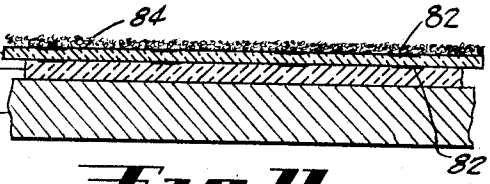


Fig. 11

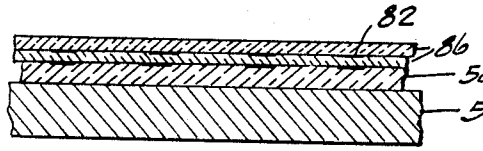


Fig. 12

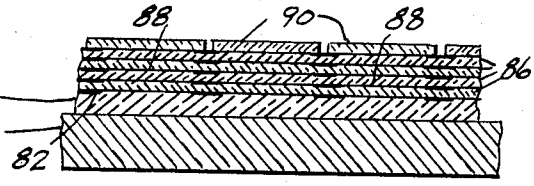


Fig. 13

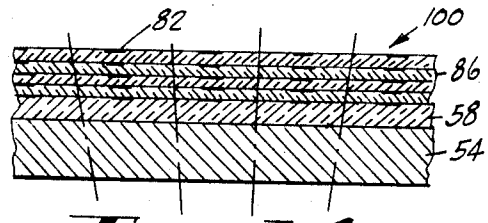


Fig. 14

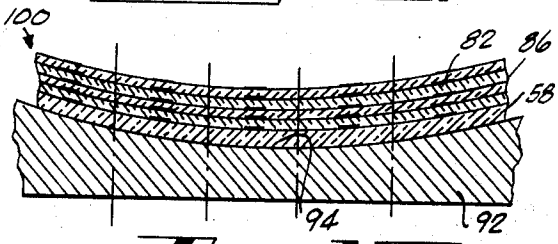


Fig. 15

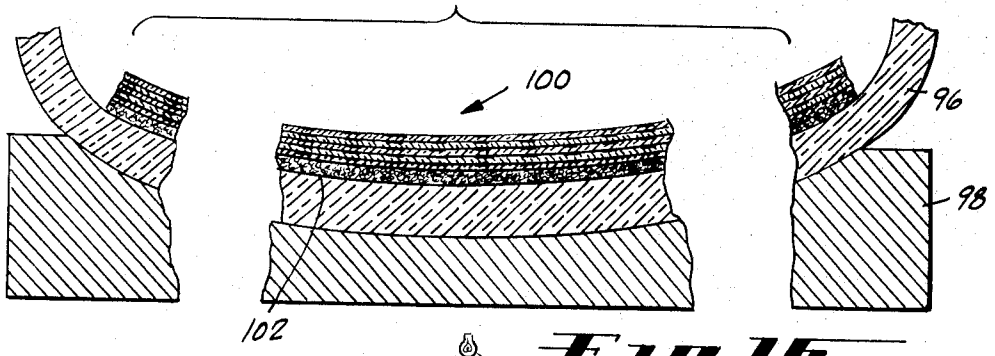


Fig. 16

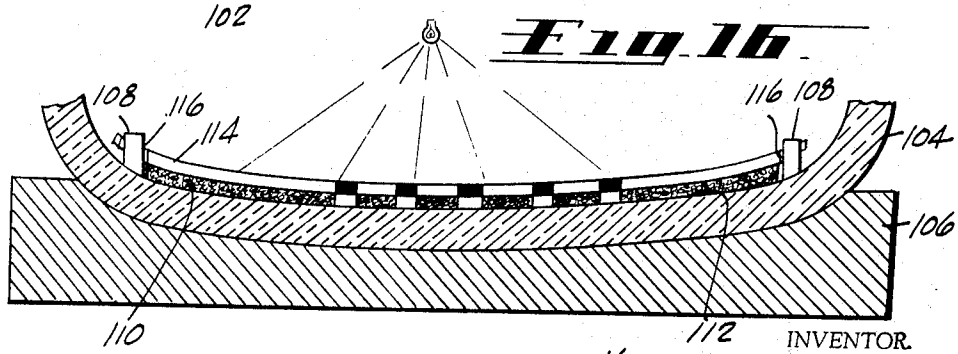


Fig. 17

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METHOD OF MAKING CATHODE RAY TUBE WITH INTEGRAL LIGHT TRAPPING FILTER

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Filed May 17, 1965, Ser. No. 456,295
10 Claims. (Cl. 65—18)

This invention lies in the field of the manufacture of cathode ray tubes. While it is applicable to any type of cathode ray tube, it has particular utility in the manufacture of that type which is used in home receiving sets for color television. The invention provides a novel method for the manufacture of ambient light trapping filters and for making them integral with the face plates of the tubes.

Cathode ray tubes are particularly susceptible to the effects of being struck by ambient light rays. As is generally known, a cathode ray tube has a glass front wall or face plate, the inner surface of which is coated with phosphors which are caused to glow momentarily when struck from the rear by electrons from one or more electron guns in a selective manner to produce an image of some sort. When ambient light rays strike the front surface of the glass they are refracted inwardly and strike a multiplicity of phosphors. The light energy is reflected diffusely from these phosphors whether or not they are also being activated by electron guns. The result is that many of the shadow areas, or low lights, are illuminated and confused with the highlights, thus degrading the contrast. These low lights may be made as bright as the highlights in some cases and the picture may be completely lost.

Various schemes have been devised to prevent ambient light rays from striking the "screen" but these have been very clumsy or ineffective or both. My co-pending application for patent on Ambient Light Filter, Ser. No. 230,644, filed Oct. 15, 1962, which is a continuation in part of my abandoned application Ser. No. 138,855, filed Sept. 18, 1961, discloses a novel construction which solves the problem.

Briefly, that novel construction comprises a filter body of transparent material in which are embedded a plurality of filter elements having duplicate grid patterns. Each element constitutes a tier of alternating transparent and light absorbing areas in closely spaced relation to constitute a multiplicity of light transmitting apertures bordered by light absorbing material. The grid pattern may take various forms including generally parallel straight or wavy lines, or lines crossing each other to produce cells of varying shapes including but not limited to squares, rectangles, and diamonds. The tiers are in generally parallel relation to each other and are spaced depthwise of the filter body, forming a three-dimensional light trapping "space lattice" with the light transmitting apertures in depthwise registry to constitute depthwise directed viewing cells. The axes of the cells may be normal to the general plane of the filter body or at some other preselected angle, and may be parallel or divergent within limits.

Ambient light rays striking the surface of the filter body at acute angles from light sources outside a predetermined cone of viewing angles are refracted into the cells at various angles, striking one or another of the depthwise spaced areas of light absorbing material and are absorbed thereby. The success of such filter results from the fact that the cells are very small in at least one lateral dimension and the light absorbing material forming the cell boundaries is extremely thin in the depthwise direction. The construction and operation of the "space lattice" filter are fully described in the co-pending application previously mentioned.

A filter of the type described above has proven to be very satisfactory when mounted directly in front of the face plate of a black and white television tube, oscilloscope tube and the like. To avoid the need for side shields, it is ordinarily cemented directly to the front wall of the face plate, thus preventing any undesirable edge leakage. It is, of course, spaced from the phosphor screen by the thickness of the face plate which may exceed a half inch in large tubes. This is not a matter of concern when the image signals are all "while light" because the "lines" of the filter block only a small proportion of the total image and what is seen is all one color.

However, the situation is quite different with color television. Here the phosphor image screen is composed of a multiplicity of discrete phosphor dots having blue, green, and red color effects. The dots are arranged in horizontal lines, each having repeated series of successive colors, and each line of dots is set over a half space from the preceding line. The arrangement is such as to produce a multiplicity of triads of color dots which are selectively activated to produce the primary colors and the effect of intermediate colors. Large grid patterns tend to block unequal portions of the areas of the different colored dots at different times and from different viewing points, sometimes seriously modifying the color composition. This has been overcome to some extent by using extremely fine grid lines, as narrow as .002 inch, and correspondingly narrow clear spaces between them. When the lines are much narrower than the dots, the blocked out areas of the different color dots tend to average out and the effect on the color composition becomes insignificant.

A further improvement is disclosed in my previously filed copending application Ser. No. 388,895, filed Aug. 11, 1964, now Patent No. 3,209,191, which is a continuation-in-part of my application Ser. No. 206,229, filed June 29, 1962. In each of these applications a construction is disclosed in which the filter is cemented to the inner face of the face plate of the tube and the color dots of phosphor are deposited directly on the rear face of the filter adjacent to the grid patterns.

These patterns may take various forms such as generally straight or wavy lines or closed figures, but the principle which provides the greatly improved result is that the lines follow the outlines of the dots and cover or block the same percentage of area of each dot. Thus they do not modify the color composition. Considered another way, each dot is in depthwise alignment with a viewing cell. Another extremely important advantage derives from the fact that an activated dot glows only in the central portion of its area, and its margin remains dark. Therefore, in fact, the filter arranged as described does not block any of the emitted image signal. Since my filter eliminates the need for dark or gray glass in the face plate or implosion shield, the resulting picture which is viewed becomes as bright as the phosphors themselves. In effect, except for losses in the clear glass, the transmission can be said to be one hundred percent.

It has been determined that the filters which can be used successfully on the exterior of the face place cannot be used internally. The various plastic materials constituting the layers of the earlier filters outgas under the high vacuum in the tube and interfere with its operation. In most cases they also cannot withstand the high temperatures involved in the various operations involved in tube-making and may break down completely. Consequently it became necessary to produce a filter composed entirely of glass. The present invention constitutes a method of producing such a filter and incorporating it into a tube so that it becomes integral with the face plate. The filter produced by the method can also be applied to the exterior of any cathode ray tube with equal facility.

Generally speaking the method comprises providing a thin layer of transparent glass and depositing on it a substantially opaque black frit—glass ground to an extremely fine powder and preferably mixed with an evaporable liquid carrier in known manner—arranged in a desired grid pattern. This frit is now fused in place with a flame or in an atmosphere of sufficiently high temperature to cause it to become integral with the glass layer and form an opaque and highly light absorbing grid. The thickness of the "black lines" may be as slight as .0001 inch and in any event the margins are knife edges. The width of the lines is of the order of .002 inch.

Next, a layer of clear frit is deposited on the combined grid and layer surface. This frit is preferably mixed into a paste with an evaporable liquid carrier in the same manner as the black frit to the consistency of thin paint or printing ink. The layer is then fused to drive off the evaporable carrier and becomes a solid homogeneous layer integral wtih the first layer. Sufficient frit is used so that the melted and hardened layer will have a thickness of about .002 inch, corresponding to the width of the black lines. While the frit appears white in its paste form it becomes clear upon fusing.

Another grid pattern of black frit is now deposited in registry with the first grid pattern and spaced from it by the thickness of the fused layer. The cycle is repeated until the desired number of grid patterns and intermediate clear layers has been built up to form a suitable space lattice as has been described above, with depthwise directed viewing cells in predetermined directional relation. They may be parallel or convergent. If the face plate is curved, as is usually the case, the completed filter is heated to softening temperature and shaped, as by sagging, to a spherical form to match the face plate. It is now fused to the inner or outer face of the face plate as desired, in most cases using a clear flux similar to the clear frit.

In the ultimate form of the invention the phosphor dots are deposited, either before or after shaping, on the rear face of the filter which has been fused to the inner face of the face plate. Each dot is so placed that it is registered with a clear viewing cell and some or all of its margin is masked by one or more grid lines. The dots are, of course, immediately adjacent to the rearmost grid pattern. As pointed out above, the margin of each dot produces no appreciable glow so that all of the signal image will be transmitted through the viewing cell to the exterior. The complete composite face plate can now be assembled to the body of the tube and secured thereto in conventional manner, as by fusing.

Instead of starting with a glass plate to be ultimately fused to the face plate, it is possible to start with the face plate itself, depositing the first grid pattern directly thereon, fusing and building up the composite article in the manner previously described. This eliminates the shaping and final fusing operations.

In order to insure that the black frit adheres to the glass layer in the proper grid pattern until it is fused it is desirable to first etch the grid pattern on the layer and then deposit the black frit on the etched areas. The etching produces shallow depressions little more than .0001 inch deep in their centers and tapering toward their margins, and the fused frit lies in the depressions and has substantially a knife edge. The etching process includes depositing masking portions of an etchant-resist in a pattern corresponding to the desired grid pattern, applying an etchant of known type which attacks the exposed glass, and then removing the etchant-resist.

In one mode of operation the etchant-resist is applied through a silk screen suitably masked. In another mode, an etchant-resistant, light sensitive emulsion is applied, an exposure mask having a proper pattern is laid over the emulsion, the assembly is exposed to a light source and the exposed portions are tanned. The mask is removed and the untanned portions of the emulsion are removed, leaving a grid pattern of exposed glass which is then subjected to the etchant. The tanned emulsion is now removed and the layer is ready for further processing.

Various other advantages and features of novelty will become apparent as the description proceeds in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary perspective view of a composite filter and face plate produced by the method of the invention;

FIGURE 2 is a fragmentary sectional view of another form of article produced by the method of the invention;

FIGURE 3 is a fragmentary sectional view of still another form of article produced by the method of the invention;

FIGURE 4 is a plan view of a fixture and mask for carrying out one form of the invention;

FIGURE 5 is a fragmentary schematic sectional view taken on line **5—5** of FIGURE 4 illustrating a first step in carrying out one form of the invention;

FIGURES 6 through 13 are similar views illustrating subsequent steps of the method;

FIGURE 14 is a similar view illustrating a variation;

FIGURE 15 is a similar view illustrating the shaping of a completed filter;

FIGURE 16 is a similar view illustrating a completed filter in place ready to be fused to a face plate; and

FIGURE 17 is a similar view illustrating another mode of carrying out the invention.

The construction illustrated in FIGURE 1 is a composite article resulting from the manufacturing steps involved in the method. Face plate **20** has integrally secured to its rear face **22**, by fusing, a completed filter **24** which is a body of glass in which are embedded a plurality of depthwise spaced grids, each of the same pattern, made up of horizontal wavy lines **26**. It will be seen that each grid pattern consists of a multiplicity of alternating opaque areas being generally horizontal lines having a pitch equal to the vertical center distance between the dots **28**. Exterior ambient light rays striking the face plate at substantial angles are refracted inwardly at somewhat lesser angles and strike one or another of the grid lines **26** and are absorbed. The succession of depthwise spaced grid lines define between them a multiplicity of depthwise directed viewing cells **30** which extend generally horizontally toward the viewer.

It will be noted that dots **28** are deposited so that each is centered in a viewing cell and at least portions of its margin are masked or blocked by a pair of grid lines. As previously mentioned, substantially the entire illumination of each dot occurs in its mid-portion, leaving the margins dark for all practical purposes. Consequently the full image signal is transmitted through the viewing cells and, since no optical filter is used, the resulting picture is much brighter than with conventional tubes. The grid pattern shown is only one of many which are suitable for the purpose. Any of those illustrated in my copending application Ser. No. 388,895 may be used.

In FIGURE 2 the color dots **32** are secured directly on rear wall **34** of face plate **36**, and the filter **38** is fused to the front wall **40**. The grid lines **42** are finer and more closely spaced than those of FIGURE 1 to reduce the effect on color composition resulting from their spacing away from the color dots. This arrangement is suitable for application to existing color tubes.

The face plate **44** of FIGURE 3 carries a conventional black and white uniform phosphor screen **46** on its rear wall **48** and has a filter **50** fused to its front face **52**. The construction is basically similar to that of FIGURE 2, and is suitable for use with any black and white tube.

A suitable fixture for the practice of one preferred form of the method is shown in FIGURE 4 and comprises a simple flat plate base **54** of rectangular planform having an upstanding cylindrical guide pin **56** near each corner. A thin, laterally extensive, transparent layer of

glass **58** is laid on the base. The layer has the general planform of a cathode ray tube face plate and is of slightly larger area than the filter which is to be built up. Its rounded corners are provided with guide apertures which accurately fit over the guide pins **56**.

A mask **62**, which may be of the same size as layer **58**, is also provided with guide apertures **64** fitting over the same guide pins **56**. The mask comprises a thin layer of material which may be glass or photographic film having a desired grid pattern of alternating opaque and clear areas. By reference to FIGURES 4 and 5, it will be seen that the opaque areas are indicated as generally straight and parallel wavy lines **66** having the same pattern as lines **26** of FIGURE 1. These lines define between them the clear areas **68**. The opaque and clear areas may have any grid pattern found suitable for the purpose, including closed figures.

To carry out the first step of the operation, a film **70** of light-sensitive, etchant resisting emulsion is applied to the major portion of the area of one surface of the glass layer **58**, its bounds being indicated by the phantom line **72** in FIGURE 4. The mask **62** is then laid on the film and the assembly is exposed to a source of light **74**, as illustrated in FIGURE 5. The mask is removed and the light struck portions **76** of the film are developed or tanned, after which they resist solution in warm water above 95 degrees Fahrenheit. The portions **78** which were not light struck remain soluble in water above 95 degrees Fahrenheit and are rinsed or washed out in known manner so that the underlying portions of glass layer **58** are again exposed for processing.

Any suitable glass etchant is now applied to the upper side of the assembly. The tanned film portions **76** protect the glass which they cover and the remainder is etched in the desired grid pattern as indicated at **80** in FIGURE 6. The forward surface of the glass, of course, is always protected during the etching operation because it must remain clear. Portions **76** are now removed by a suitable solvent, such as a chlorine solution, and substantially opaque black glass frit is applied to the etched lines. The frit, designated by **82**, is then fused in place to produce permanent, opaque, highly light absorbing grid lines having the desired pattern. Because of the limitations of illustration the various elements are shown far out of proportion. The etched portions of the glass are extremely shallow depressions, as little as .0001 inch deep and .002 inch wide, and only enough frit is fused in place to fill the depressions with a slight surplus. The frit is preferably mixed with an evaporable liquid carrier to form a paste of the consistency of printing ink or thin paint.

The next step consists in depositing a substantially uniform thin layer of clear frit **84** on the combined layer and grid over the major portion of the exposed area, as illustrated in FIGURE 7. The frit is then fused and melted down into a clear layer **86** integral with layer **58**, as illustrated in FIGURE 8. This second layer may be of any suitable thickness related to the geometry of the total filter and is approximately .002 inch thick when used with grid lines which are approximately .002 inch wide. The clear frit is preferably mixed into a paste in the same manner as the black frit.

A new emulsion film **70** is now applied to the new exposed face of layer **86** and the mask **62** is laid over the film. Since the mask is again guided by pins **56**, its opaque areas **66** are in registry with the grid lines **82** depoisted on layer **58**, as illustrated in FIGURE 9. The assembly is then subjected to a source of light in the same fashion as described in connection with FIGURE 5, portions **76** of the film being tanned and portions **78** being removed as shown in FIGURE 10. The new exposed grid areas are etched, portions **76** removed, and opaque black frit deposited on the etched lines and fused to produce a second grid pattern **82** in registry with the first grid pattern and separated depthwise from it by the thickness of the second layer **86**.

Another layer of clear frit **84** is now deposited on the combined second layer and grid as shown in FIGURE 11. The frit is fused into a clear layer **86** and made integral with the preceding layer **86** as shown in FIGURE 12. The cycle is repeated until the desired number of layers and grids have been deposited and unitized. A completed filter is shown in FIGURE 13. There is a first grid pattern **82** on the initial layer **58** and four additional grid patterns on the four added layers **86**. All of the grid patterns are in registry and combine to define depthwise directed viewing cells **88**. As illustrated in this figure the axes of all of the viewing cells are parallel to each other and normal to the general plane of the filter. By setting the mask over laterally by small increments in each cycle of prodcction, the axes of the viewing cells can be tilted to any desired angle.

The color phosphor dots **90** are now deposited on the upper or rear face of the filter. It will be seen that each dot is substantially centered on the axis of its respective viewing cell and that only a narrow marginal portion is masked or blanked out by the grid lines. As mentioned above, only the mid-portion of the dot is activated sufficiently to emit a significant image signal. Since this area is completely unmasked, it is apparent that the entire image signal will be transmitted through the viewing cell. The dots are located immediately adjacent to the rearmost grid lines, thus avoiding the parallax which would result if there were any substantial spacing. Since the conventional dark or gray glass optical filter is not needed or used, the only substantial loss is the glass-air interface reflection, and the resulting picture brightness approaches twice that of the conventional construction. It should be noted that lines of separation between layers have been shown only to facilitate explanation of the invention. In fact the completed filter is substantially homogeneous and integral and there are no internal reflecting surfaces.

Other materials having suitable characteristics may be used in place of the ground black glass to produce the opaque black grid patterns. Various finely divided metallic oxides have been found to be very suitable, and they have the property of being adsorbed and/or absorbed into the surface of the glass, making an extremely thin line. The term "black frit" or "opaque black frit" as used herein is intended to apply to any of scch suitable materials.

The face plates of oscilloscope and some other cathode ray tubes are usually flat. However, the conventional television tube has a spherical face plate, necessitating further processing of the filter. If the flat filter of FIGURE 13 is shaped to match the surface of a television tube face plate, the axes of the viewing cells will be made divergent to such an extent as to be unsatisfactory for the intended use. This difficulty is overcome, as illustrated in FIGURE 14 by initially making the axes of the cells convergent to a predetermined extent. One way to accomplish this is to use a series of graduated masks instead of the single mask **62**, each mask producing a slightly wider pattern as seen in FIGURE 14. The filter **100** is then heated sufficiently to soften it and it is allowed to sag into a fixture **92**, FIGURE 15, having a spherical seat **94**. The original convergency of the axes has been made just sufficient to result in final collimation. In many cases it is desirable to have the axes of the viewing cells converge toward the viewer. This is accomplished by making the initial convergence great enough so that full collimation is not achieved in the shaping process.

FIGURE 16 illustrates the final stage of assembly. Face plate **96** is seated on a fixture **98**. The completed shaped filter **100** is then set in place and fused to the interior wall of the face plate. Although it is not essential, it is preferable to provide a thin layer of clear flux **102** having a lower melting point than that of either

the face plate or the filter so that they can be adequately adhered without danger of distortion.

The phosphor dots may be deposited while the filter is still in its flat state, as illustrated in FIGURE 13, or after it is curved to the form of FIGURE 15. If desired, this step may be deferred until the filter is installed on the face plate as in FIGURE 16. In any event, when the entire assembly has been completed and unitized, face plate **96** is fused to the body of the tube in the conventional manner.

A method has been described on the basis of forming a separate and distinct filter in the flat, shaping it, and fusing it into place in a tube. However, essentially the same method can be practiced in building the filter in situ. In FIGURE 17, a face plate **104** is mounted on a suitable support **106**. Guide pins **108** are formed on the interior concave surface of the face plate for use in accurately locating the electron beam mask with respect to the phosphor screen in conventional color tube construction. These guide pins are now used to serve the same purpose as guide pins **56** in FIGURE 4. A film of emulsion **110** as previously described is laid down directly on the inner wall **112** of face plate **104**. A spherically curved mask **114**, otherwise identical in construction to mask **62**, is provided with guide apertures **116** which fit accurately on guide pins **108**. The film is exposed in the same way and all subsequent steps are substantially identical to those of the method described in detail. When the filter is completed it is already properly shaped and integrated with the face plate. The same system can be used to build up a filter body in situ on the outer convex surface of the face plate.

The presently preferred method utilizing photographic techniques has been fully outlined. The same basic steps may be carried out in various ways within the scope of the invention. By proper selection and preparation the black frit grid lines may be laid down directly on the glass layers, in the general manner of printing, using a somewhat flexible printing grid in the manner of a rubber stamp. Separate, discrete etching masks may be used. An etchant-resist deposit may be laid down by conventional printing means. An additional technique which is highly satisfactory is the silk screen system, well known in the printing arts.

In this system a silk screen is prepared of the same size and shape as the mask **62** of FIGURES 4 and 5, and provided with the necessary guide apertures. Those portions of the screen which correspond with the opaque areas of the grid pattern are blocked in known manner to prevent the passage of any liquid material. They correspond to areas **66** of mask **62**. The mask is mounted on the guide pins **56** and engages the layer **58**. A suitable etchant-resist is then forced through the porous portions of the screen corresponding to portions **68** of mask **62** into contact with the glass and adheres thereto. The screen is removed, the etching process is carried out, and the etchant-resist is removed. The remainder of the process is the same as with the photographic technique, and the entire process can be carried out in connection with any of the variations described above.

It will be apparent to those skilled in the art that various changes and modifications may be made in the processes disclosed herein without departing from the spirit of the invention, and it is intended that all such changes and modifications shall be embraced within the scope of the following claims.

I claim:

1. A method of producing a cathode ray tube having an integral space lattice type ambient light trapping filter to improve the image presented thereby, comprising: providing a first laterally extensive, transparent layer of glass; depositing on the major portion of the area of one face thereof substantially opaque black frit in a desired grid pattern of alternating opaque and clear areas and uniting it with said first layer; depositing on the combined layer and grid over the major portion of the exposed area a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined layer and grid; depositing on the major portion of the area of the new exposed face substantially opaque black frit in a grid pattern substantially identical with the first grid pattern, in depthwise registry therewith and spaced depthwise therefrom by the thickness of said fused layer of clear frit; repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a multiplicity of depthwise directed viewing cells having axes in predetermined directional relation to each other; shaping the so-built-up filter body to conform to a surface of the face plate of a cathode ray tube; fusing the filter body to the surface of the face plate; depositing on the inner surface of the combined filter body and face plate a phosphor image screen; and fusing the combined filter body and face plate to the body of the cathode ray tube.

2. A method of producing a space lattice type ambient light trapping filter for use in a cathode ray tube to improve the image presented thereby, comprising: providing a first laterally extensive, transparent layer of glass; depositing on the major portion of the area of one face thereof substantially opaque black frit in a desired grid pattern of alternating opaque and clear areas and uniting it with said first layer; depositing on the combined layer and grid over the major portion of the exposed area a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined layer and grid; depositing on the major portion of the area of the new exposed face substantially opaque black frit in a grid pattern substantially identical with the first grid pattern, in depthwise registry therewith and spaced depthwise from said first grid pattern by the thickness of said fused layer of clear frit; and repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a multiplicity of depthwise directed viewing cells having axes in predetermined directional relation to each other.

3. A method as claimed in claim **2**; and, in addition thereto, depositing color phosphor dots on the last completed surface of said filter in depthwise registry with the clear areas of the grid patterns.

4. A method as claimed in claim **2**; and, in addition thereto, shaping the filter to conform to a surface of the face plate of a cathode ray tube.

5. A method as claimed in claim **4**; and, in addition thereto, fusing said filter to the surface of said face plate.

6. A method as claimed in claim **2**; each of said grid patterns varying slightly from the preceding one to produce convergence of the axes of said viewing cells in one direction; and deforming said filter into a concavo-convex shape to reduce said convergence.

7. A method of producing a space lattice type ambient light trapping filter for use in a cathode ray tube to improve the image presented thereby, comprising: providing a first laterally extensive, transparent layer of glass; etching on the major portion of the area of one face thereof a grid pattern consisting of a multiplicity of alternating etched and clear areas; depositing substantially opaque black frit on said etched areas; fusing said frit in place to make it integral with said first layer; depositing on the combined layer and grid over the major portion of the exposed area a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined layer and grid; etching on the major portion of the area of the new exposed face a grid pattern substantially identical with the first grid pattern, in depthwise registry therewith and spaced depthwise from said first grid pattern by the thickness of said fused layer of clear frit; and repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a multiplicity of depthwise directed viewing cells having axes in predetermined directional relation to each other.

8. A method of producing a space lattice type ambient light trapping filter for use in a cathode ray tube to improve the image presented thereby, comprising: providing a first laterally extensive, transparent layer of glass; applying to one surface of said layer an etchant resist arranged in a desired grid pattern of marked and exposed areas; applying an etchant to the exposed areas to etch shallow depressions therein having the desired grid pattern; removing the resist; depositing substantially opaque black frit in said depressions and uniting it with said first layer; depositing on the combined layer and grid a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined layer and grid; applying to the new exposed face an etchant resist arranged in a grid pattern substantially identical with the first grid pattern, in depthwise registry therewith and spaced depthwise therefrom by the thickness of said fused layer of clear frit; and repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a multiplicity of depthwise directed viewing cells having axes in predetermined directional relation to each other.

9. A method of producing a space lattice type ambient light trapping filter for use in a cathode ray tube to improve the image presented thereby, comprising: providing a first laterally extensive, transparent layer of glass; applying to one surface of said layer a film of light-sensitive, etchant resisting, emulsion; placing on said film an exposure mask having a multiplicity of alternating opaque and clear areas arranged in a desired grid pattern; exposing said mask and underlying film to a source of light and tanning the exposed portions of said film; removing said mask; removing the untanned portions of said film; etching those portions of said layer not covered by the tanned film to produce an etched grid pattern; removing the tanned film; depositing substantially opaque black frit on said etched grid pattern and uniting it with said first layer; depositing on the combined layer and grid a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined layer and grid; applying to the new exposed face a second film of light-sensitive, etchant resisting emulsion; placing on said second film a second exposure mask substantially identical to said first mask with its grid pattern in registry with the first grid pattern; exposing, tanning, etching, depositing and fusing in the same manner as the first series of operations; and repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a multiplicity of depthwise directed viewing cells having axes in predetermined directional relation to each other.

10. A method of producing a cathode ray tube face plate having an integral space lattice type ambient light trapping filter for use in a television tube to improve the image presented thereby, comprising: providing a face plate of transparent glass having a convex outer face and a concave inner face; depositing substantially opaque black frit on the concave inner face in a desired grid pattern of alternating opaque and clear areas and uniting it with said face plate; depositing on the combined face plate and grid a substantially uniform thin layer of clear frit; fusing said layer to make it integral with the combined face plate and grid; depositing on the new exposed concave face substantially opaque black frit in a grid pattern substantially identical with the first grid pattern, in depthwise registry therewith and spaced depthwise therefrom by the thickness of the fused layer of clear frit; and repeating the cycle until the desired number of added layers and grid patterns have been deposited and unitized to produce a composite unitary face plate having an integral space lattice type filter immediately adjacent to its rear, inner face providing a multiplicity of depthwise directed viewing cells in predetermined directional relation to each other.

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