Jan. 2, 1968 V. E. HAMILTON ETAL 3,361,548

METHOD FOR MAKING CATHODE RAY TUBE FILTERS

Filed June 21, 1965 3 Sheets-Sheet 1

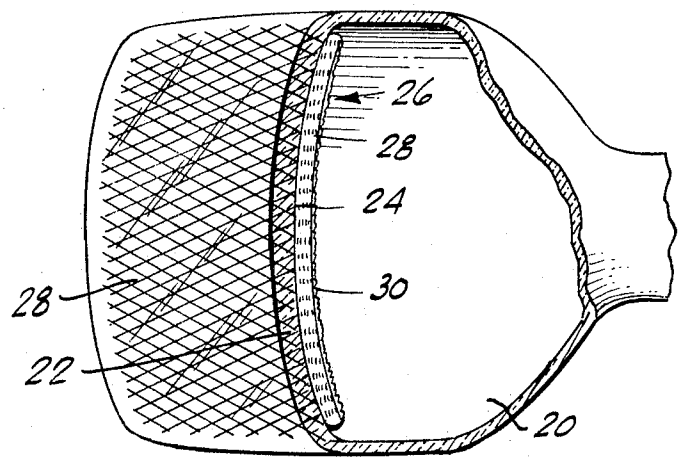


Fig. 1

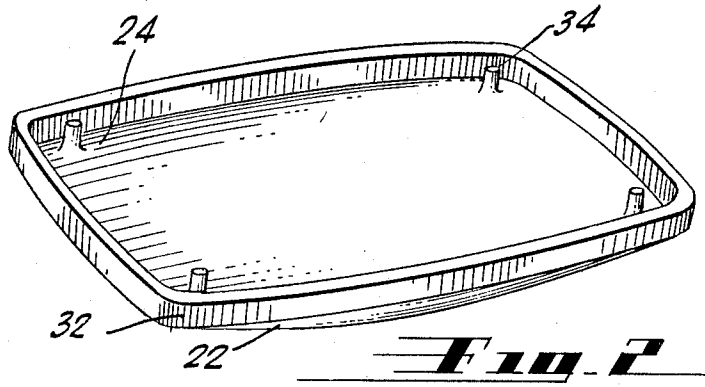


Fig. 2

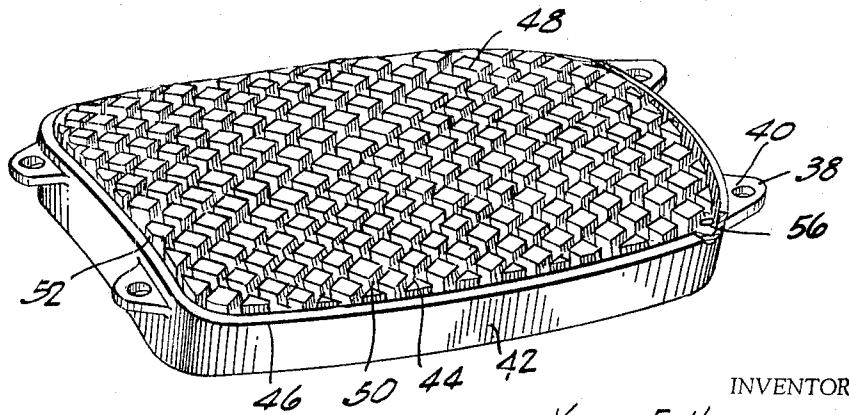


Fig. 3

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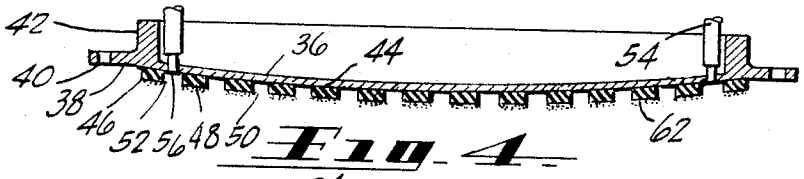


Fig. 4

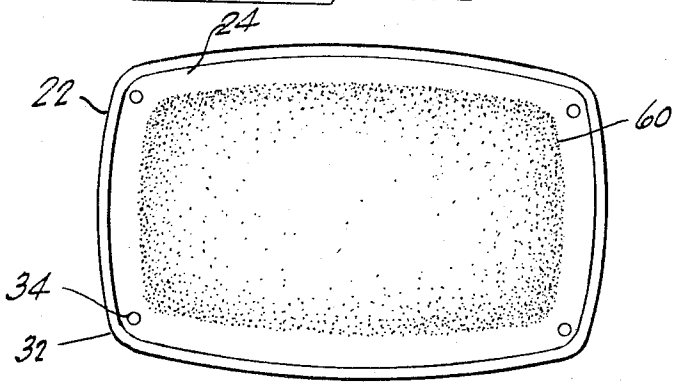


Fig. 5

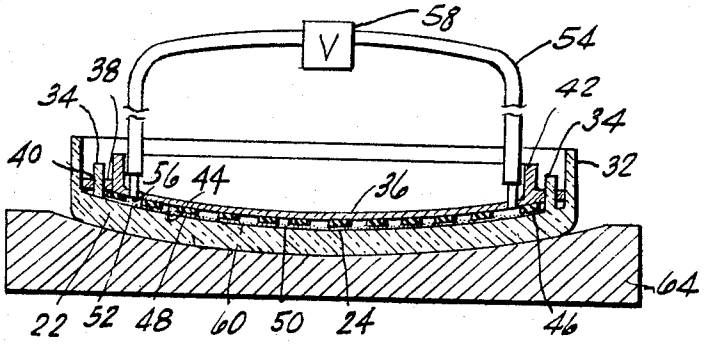


Fig. 6

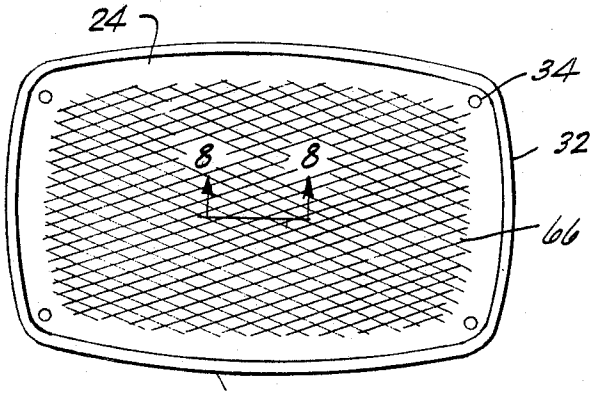


Fig. 7

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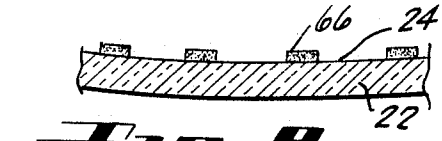


Fig. 8

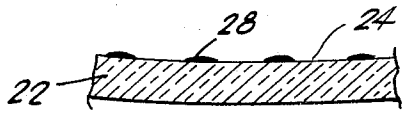


Fig. 9

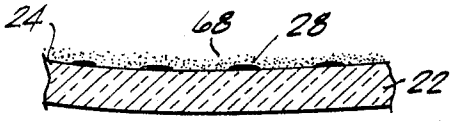


Fig. 10

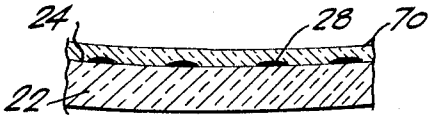


Fig. 11

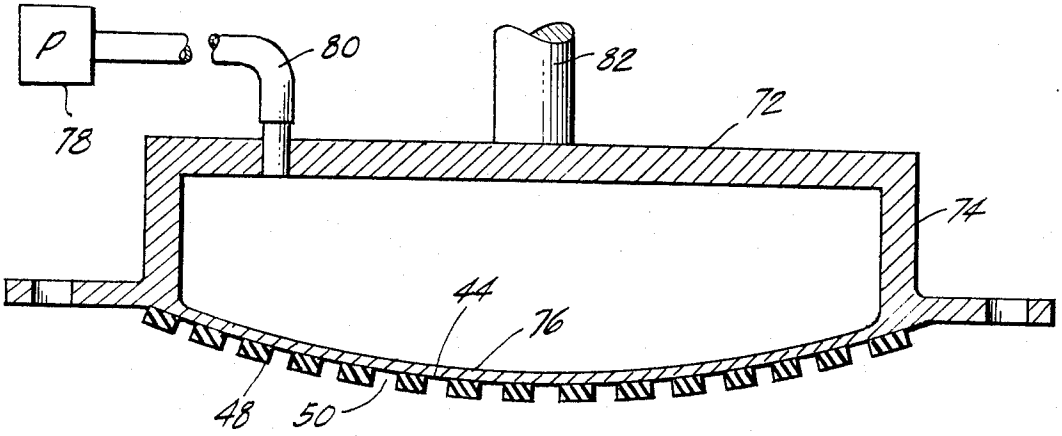


Fig. 12

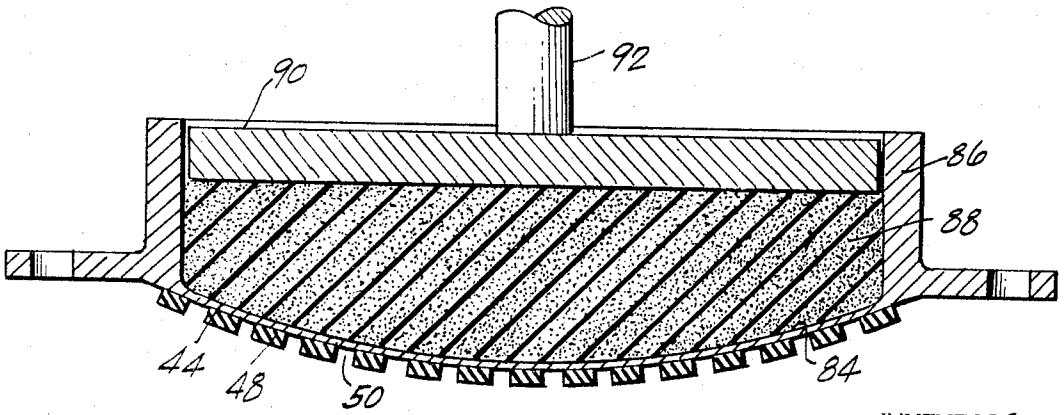


Fig. 13

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3,361,548

METHOD FOR MAKING CATHODE RAY TUBE FILTERS

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Filed June 21, 1965, Ser. No. 465,462
9 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 and means for the manufacture of space lattice type ambient light trapping filters and for making them integral with the face plates of the tubes.

For many years television sets have been plagued by ambient light rays striking the front face of the cathode ray tube or of the safety glass associated with it. In either case, angular rays are refracted inwardly and strike the radiant screen, in many cases illuminating the low lights to such an extent as to confuse them with the highlights, thus degrading the image contrast.

The co-pending application of Vern E. Hamilton for patent on Ambient Light Filter, Ser. No. 230,644, filed Oct. 15, 1962, discloses a novel constructiin which solves the basic problem very satisfactorily. 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 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. 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 construction and operation of the space lattice filter are fully described in the co-pending application previously mentioned.

Another co-pending application of Vern E. Hamilton, Ser. No. 388,895, filed Aug. 11, 1964, now Patent No. 3,209,191, discloses a particular type and arrangement of filter adapted for use with color television tubes using color triad phosphor dot image screens. It has been determined that the filter bodies which are mounted inside the tube should be made of glass and unitized with the inner wall of the face plate to avoid various problems associated with filters made of synthetic plastic materials and to obtain optimum results. An additional co-pending application of Vern E. Hamilton, Ser. No. 456,295, filed May 17, 1965, discloses various methods and means for building up such filters entirely of glass and securing them integrally to the face plate, and also building them up in situ. All of them produce satisfactory results but entail considerable difficulty in operation. The present application discloses certain other means and methods which offer greater facility and economy in manufacture.

The present invention, in general terms, comprises the manufacture of an all-glass filter or a composite filter and face plate by a deposit and removal process. A first, laterally extensive transparent layer of glass is coated on one face with a uniform thin layer of substantially opaque

black frit. The frit is usually black glass but it may be made from any suitable black metallic oxide or the like which can be fused into a solid homogeneous mass. The frit is first mixed with a liquid to make a paste or a flowable mixture which can be applied by brushing, rolling or spraying. The liquid must be readily evaporable without leaving a reflective residue. Distilled water is ideal for the purpose.

The mixture is preferably applied by spraying to give a uniform coating or layer of the desired thickness, usually about one-half mil. The liquid can be evaporated at ambient temperature or by the application of heat well below the fusing temperature of the glass. When the coating is dry or very nearly so it is soft and powdery. Its adhesion to the glass is sufficient to prevent accidental dislodgement or blowing away.

Selected portions of the layer of frit are now removed to leave the desired grid pattern in black frit. Removal is best accomplished by the use of a rubber stamp device which is of about the same planform and area as the frit coating. The device is provided on one face with a plurality of projections of elastomeric material having selected planforms which are spaced apart and so arranged that they present a negative of the desired final grid pattern, with valleys or channels between them which correspond to such grid pattern. The faces of the projections are coated with a tacky material, which may be a varnish or oil, and the stamp is pressed down on the layer of glass so that the projections contact the corresponding areas of the black frit. The tacky material penetrates the thin layer and causes the particles in these areas to adhere to the corresponding projection. Consequently, when the stamp is withdrawn, these particles are removed, leaving clear areas defined by the remaining frit which constitutes the grid pattern. Since the clear areas are several times larger than the light absorbing areas in the finished product it is considerably easier to make and use this removal stamp than to make and use a stamp which would "print" the grid pattern. Also it is easier to obtain a layer of the desired thickness, since the printing action tends to produce a grid marking thinner than desired.

Since the grid pattern is now complete it is subjected to heat in any desired fashion to fuse the frit into solid masses integrally united to the glass layer in the desired locations. The pattern usually consists of lines about .002 inch wide with a thickness of about .0002 inch or less and the fusing tends to produce knife edges on the lines, which is highly desirable.

Next a layer of clear frit is coated over the entire surface of the glass layer and the grid pattern and is fused in place, further bonding the grid pattern in position. Sufficient clear frit is used so that the fused layer will have a thickness of the order of .002 inch.

A second coating of black frit is now applied, and portions are removed with the same stamp in the same way, the stamp being guided so that the second grid pattern will be in exact registry with the first and spaced depthwise from it by the thickness of the fused layer of clear frit. The cycle is continued and repeated in the same way until the desired number of layers and grid patterns have been produced and unitized.

The first transparent layer of glass may be merely an element of the filter body or it may be the actual face plate of a cathode ray tube, just as in the previous patent application last referred to above. In the first case the filter may be made planar and used that way or it may be softened and shaped to match a face plate and fused to the inner or outer surface. In the second case the filter may be built up on the exterior surface of the face plate for black and white tubes or on the interior surface for color tubes.

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 perspective view, partially broken away, of a cathode ray tube incorporating an integral filter made in accordance with the invention;

FIGURE 2 is a perspective view of a cathode ray tube face plate with a rearwardly extending peripheral wall to be joined to a tube body;

FIGURE 3 is a perspective view of a removal stamp in accordance with the invention, positioned to show the projections and grid pattern;

FIGURE 4 is a sectional elevational view of the stamp in normal working position;

FIGURE 5 is a plan view of the face plate of FIGURE 2 with a coating of black frit deposited in place;

FIGURE 6 is a sectional elevational view showing the removal operation;

FIGURE 7 is a plan view similar to FIGURE 5 showing the grid pattern remaining after the removal operation;

FIGURE 8 is a fragmentary sectional view taken on line 8—8 of FIGURE 7;

FIGURE 9 is a view similar to FIGURE 8, showing the black frit fused in place;

FIGURE 10 is a view similar to FIGURE 9, showing the layer of clear frit;

FIGURE 11 is a view similar to FIGURE 10, showing the clear layer resulting from fusing the clear frit;

FIGURE 12 is a view similar to FIGURE 4, showing a modified form of stamp; and

FIGURE 13 is a view similar to FIGURE 4, showing a further modified form of stamp.

An example of a combined face plate and integral filter is illustrated in FIGURE 1, in which the tube body 20 has a face plate 22 having an inner wall or surface 24 to which is integrally secured a filter body 26. The latter is made up of a plurality of layers of clear glass which cannot be distinguished separately because they are integrated in the process, and between each pair of adjacent layers is an opaque black grid pattern indicated at 28. The pattern here illustrated is a multiplicity of straight diagonal lines crossing each other to form diamond shaped apertures and viewing cells but it may be any of various types shown in the co-pending applications mentioned above. A phosphor coating 30 formed on the rear face of the filter body is the image screen.

The face plate 22 is shown in FIGURE 2 separate from the tube body and is provided with a rearwardly extending wall 32 which is fused to the tube body after the filter is built up and the other tube elements are in place. Extending rearwardly or upwardly from the inner wall 24 are a plurality of guide pins 34 which are used to register the removal stamp in its repeated applications.

The basic construction of the removal stamp is shown in FIGURES 3 and 4, and comprises a laterally extensive diaphragm 36 of any suitable plastic or metallic material, stainless steel being preferred, provided with guide members in the form of ears 38 with apertures 40 to receive guide pins 34. The diaphragm may be provided with a rearwardly extending peripheral wall 42 to stiffen or reinforce the margin although it is not essential. The diaphragm itself is elastic and is preferably about .005 to .010 inch thick so that it can be yieldingly urged into conforming relation with the inner wall 24 of the face plate.

The forward or confronting face 44 of the diaphragm is provided around its margin with a continuous lip or seal 46 of elastomeric material such as rubber. Within the outline of the seal are a plurality of projections 48 of the same material. These projections, as seen in FIGURE 3, have a selected planform which has the shape of a diamond for illustration only, and they are separated and arranged to provide a plurality of channels 50 between them which are in the form of the desired grid pattern. Thus they present a negative of the final desired grid form. The channels 50 connect with each other and with channel 52 just within the peripheral seal. The seal and projections are all of the same height, of the order of .005 inch, and are formed on the diaphragm by the usual technique used in making rubber stamps. Conduit means 54 communicate with channel 52 as shown at ports 56 and with a vacuum source 58, shown in FIGURE 6.

The first step in the process consists in mixing substantially opaque black frit with a suitable liquid which will evaporate readily without leaving a reflective residue which would reduce the light absorbing properties of the frit. The frit may be glass or a suitable metallic oxide. Distilled water has been found to be a superior liquid for the purpose. Preferably, the mixture is fluid enough to be sprayed as a coating 60 on the concave inner wall 24 of face plate 22, as seen in FIGURE 5. The layer covers an area somewhat larger than the area of the face plate which will be visible to the viewer in the finished television set. It is thick enough so that when the water is evaporated by ambient temperatures or by heat applied with an oven or radiant heater the thickness of the remaining layer will be of the order of one half mil. The dried layer is powdery but adheres to the glass sufficiently to carry out the subsequent steps of the process. If the coating layer is damaged or irregular in any way it can be readily cleaned off at this stage and replaced.

A tacky coating 62, such as a varnish or oil, is now placed on the faces of the projections 48, as seen in FIGURE 4. The face plate is mounted on a suitable fixture 64, FIGURE 6, and the stamp is guided into operative position by the interaction of guide pins 34 on the face plate and ears 38 and apertures 40 on the diaphragm. The stamp is lowered until projections 48 and seal 46 contact the frit layer 60. While the surface 24 of the face plate and surface 44 of the diaphragm are designed to be spherical, they are never exactly so because of manufacturing difficulties. To overcome the disparities in form it is necessary to force the diaphragm to conform to the slightly different contour of the rigid face plate. The contact of seal 46 with the face plate by way of the frit layer forms an evacuation space within the seal outline and between the diaphram and the face plate. Channels 50 communicate with each other and with channel 52, which in turn communicates with ports 56 and conduit means 54. Application of vacuum by vacuum source 58 withdraws air from the evacuation space and the resulting differential pressure yieldingly urges diaphram 36 toward the face plate and insures that all of the projections 48 contact their respective areas of the frit layer.

The tacky material 62 penetrates the thin layer of frit immediately below each projection 48 causing the particles in the area to adhere to the projection. After a short dwell the vacuum is released and the stamp is withdrawn, and the adhering particles of frit are removed with it, leaving clear areas on the face plate corresponding in size, shape, and location to the projections. The black frit remaining on the face plate and corresponding to the channels 50 of the stamp, now has the desired final grid pattern 66 as seen in FIGURE 7. One advantage of the method and apparatus just described is that, if it is found on inspection that nay frit particles remain in the areas which are intended to be clear, it is not necessary to clean off and re-coat the face plate and repeat the entire operaiton. All that is needed is to wipe the stamp clean, re-coat it with tacky material and repeat the removal operation. Because of the accurate guide means, the stamp will register exactly as before, and the remaining particles will be readily removed.

After the removal operation has been completed, the lines of frit 66 appear as seen in FIGURE 8. They are now subject to a heating operation, in an oven, by radiant heat, or by firing. When the frit melts, it assumes the general cross section of the final lines 28 shown in FIGURE 9. These lines of light absorbing material have a

final thickness of about .0002 inch or less and have a knife edge which is highly desirable in the functioning of the finished filter.

Next, a layer of clear frit **68** is coated onto the face plate wall **24** and the grid pattern **28**, as seen in FIGURE 10, over the entire area originally covered by the black frit layer **60**. It is then subjected to heat and fused into a homogeonus clear layer **70**, FIGURE 11. The frit layer **68** is made thick enough so that the fused layer **70** will be about .002 inch thick, corresponding to the width of lines **28**. The geometry of the filter calls for a one to one relation, and if the line width is varied in particular designs, the thickness of layer **70** will be varied correspondingly.

Another feature of the method is that it has been determined that if the operation is carried out with sufficient care, the clear frit can be deposited directly on the face plate and the black frit grid without an intermediate fusing step. The two types of frit can then be heated at the same time and fused substantially simultaneously.

A complete filter is built up by repeating the entire cycle described above as many times as necessary to build up the desired number of layers and grid patterns. The same stamp is used each time and registered by the same guide means. Therefore all of the grid patterns will be in registry and will be separated depthwise by the thickness of the intervening layers of fused clear frit.

In the modification of the stamp shown in FIGURE 12, a cover plate **72** is secured to peripheral wall **74** to define an enclosure sealingly secured to the margin of diaphragm **76**. A source of fluid pressure **78** is connected by conduit means **80** to the interior of the enclosure. Cover plate **72** is secured to the ram **82** of a press, not shown, and the entire stamp is raised and lowered by the ram. The other features of the stamp are similar to those described above. The stamp is lowered into juxtaposition with the face plate and the ram is then held stationary. Pressure is supplied to the enclosure from source **78** and yieldingly forces diaphragm **76** to conform to the shape of the face plate in the same manner as described above. After a short dwell, the pressure is released and the stamp is raised by the ram to complete the removal operation.

Another modification of the stamp is shown in FIGURE 13. Here the diaphragm **84** is provided with a peripheral wall **86**, although the latter is not essential. Within wall **86** is a mass of elastomeric material **88**, such as rubber, which is bonded to the rear wall of the diaphragm. A load transfer member **90** is secured to the lower end of a ram **92** carried by a press, not shown, and contacts the rear wall of the elastomeric mass. It may be bonded thereto if it is desired to use the ram to raise and lower the stamp. However, it may be free and the stamp may be place in position by hand. The other features of the stamp are similar to those of the stamp which has been described in detail above. In any event, when the stamp is placed in operative position, the ram is lowered to cause the load transfer member to apply pressure to the mass **88**. Since the mass is soft and resilient it will apply pressure to all parts of the diaphram and yieldingly urge it into conformity with the face plate, insuring contact of all of the projections with the underlying black frit layer. The ram is then raised and the stamp is withdrawn to complete the removal operation.

While the invention has been described in connection with building up an integral filter directly on the inner wall of a face plate, it will be obvious that it can be utilized in the same way to produce a separate filter, the first glass layer being one of the parts of the filter body. The filter body can be used in flat form or it can be curved for any desired purpose. It is also obvious that the process can be used to build up a filter directly on the convex outer surface of a cathode ray tube if desired.

The thickness and other dimensions of various elements have been shown in greatly exaggerated form for facility of illustration and it is to be understood that the proportions as shown are not to be taken as limiting in any way.

It will be apparent to those skilled in the art that various changes and modifications may be made in the features as disclosed 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.

We claim:

1. A method of producing an integral, permanent filter element of a space lattice type ambient light trapping filter, comprising: providing a laterally extensive transparent layer of glass; depositing on one face thereof a uniform layer of substantially opaque black frit; removing selected portions of said frit layer to produce a desired grid pattern of alternating opaque and clear areas; and fusing the remaining black frit to said face to produce an integral, permanent black grid pattern thereon.

2. A method of producing an integral, permanent filter element of a space lattice type ambient light trapping filter, comprising: providing a laterally extensive transparent layer of glass; depositing on one face thereof a uniform layer of a mixture of substantially opaque black frit and an evaporable liquid carrier; evaporating said carrier to leave a substantially dry powdery layer of substantially pure frit; providing a stamp with a plurality of laterally spaced projections of selected planform and arranged to present a negative of a desired final grid pattern; coating the faces of said projections with a tacky material; moving said stamp into juxtaposition with the glass layer, with the coated faces of said projections in contact with respective areas of the frit layer; penetrating the frit layer in said areas with said tacky material and causing the corresponding portions of the frit to adhere to the projections; removing said stamp to leave clear areas in said frit layer in a desired pattern; and fusing the remaining frit to the face of said glass layer to produce an integral, permanent black grid pattern thereon.

3. A method of producing a permanent, protected, filter grid pattern on a transparent base member, comprising: providing a laterally extensive transparent layer of glass; depositing on one face thereof substantially opaque black frit in a grid pattern of alternating opaque and clear areas; depositing on said layer of glass and said black frit a uniform layer of clear frit; and fusing said black frit and said clear frit substantially simultaneously to make them integral with said glass layer with the black frit bonded between said glass layer and said layer of fused clear frit.

4. 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 face plate of transparent glass having a convex outer face and a concave inner face; depositing a uniform layer of substantially opaque black frit on the concave inner face; removing selected portions of said layer to produce a desired grid pattern of alternating opaque and clear areas; fusing the remaining black frit to said face to produce a unitary black grid pattern thereon; depositing on the combined face plate and grid a 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 a uniform layer of substantially opaque black frit; removing selected portions of said last mentioned layer to produce 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; fusing said last mentioned black frit to make it integral with 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 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; depositing on the inner surface of the combined filter and face plate a phosphor image screen; and uniting said face plate to the body of a cathode ray tube.

5. 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 face plate of transparent glass having a convex outer face and a concave inner face; depositing a uniform layer of substantially opaque black frit on the concave inner face; removing selected portions of said layer to produce a desired grid pattern of alternating opaque and clear areas; depositing on said face plate and said remaining black frit a uniform thin layer of clear frit; fusing said black frit and said clear frit substantially simultaneously to make them integral with said face plate; depositing on the new exposed concave face a uniform layer of substantially opaque black frit; removing selected portions of said last mentioned layer to produce 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; depositing on the fused layer of clear frit and the remaining black frit a second layer of clear frit; fusing said black frit and said clear frit substantially simultaneously to make them integral with the previous layer of fused 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; depositing on the inner surface of the combined filter and face plate a phosphor image screen; and fusing said face plate to the body of a cathode ray tube.

6. 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 a uniform layer of substantially opaque black frit on one face thereof; removing selected portions of said frit layer to produce a desired grid pattern of alternating opaque and clear areas; fusing the remaining black frit to said face to produce a unitary black grid pattern thereon; depositing on said face and grid pattern a uniform thin layer of clear frit; fusing said layer of clear frit to make it integral with said glass layer and to bond the grid pattern between them; depositing on the new exposed face of the fused layer of clear frit a second uniform layer of substantially opaque black frit; removing selected portions of said second layer to produce 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; fusing the remaining black frit of said second layer to said new exposed face to unite it thereto; 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 relation to each other.

7. A method as claimed in claim 6; the final step consisting in fusing a final grid pattern of black frit to be exposed at the surface of the filter.

8. A method as claimed in claim 6; in which said first transparent layer is the face plate of a cathode ray tube.

9. A method as claimed in claim 6; in which each grid pattern of black frit is fused substantially simultaneously with the fusing of the succeeding layer of clear frit.

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