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METHOD OF PRODUCING A RASTER SCREEN FOR A TELEVISION PICTURE TUBE

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This invention relates to a television picture tube adapted to reproduce images in natural color and more particularly to the method of preparing a layer of fluorescent material on a supporting element of such a tube. As used throughout the specification the terms "warp" and "weft" designate two sets of parallel threads in a fabric. The sets are perpendicular to one another and the "warp" threads correspond to the scanning lines in a television picture tube.

In the art of color television, it has been found desirable to utilize a single cathode-ray picture tube for the reproduction of color images rather than several tubes each of which is adapted to reproduce one of the color components of the composite color image. To accomplish this, and yet avoid the use of the well-known color disc, it has been suggested that a preselected color pattern of fluorescent material be disposed on a supporting element, usually the front face of the tube, thereby forming a color raster screen. In one prior arrangement this pattern includes a series of parallel lines of fluorescent material individually extending across the face of the tube and having a thickness, transverse to the direction of the lines, which is no greater than the maximum cross-sectional dimension of the scanning electron beam employed to excite the line material into fluorescence. Three varieties of line material are employed each emitting, in the presence of impinging electrons, visible light substantially within the respective spectral ranges of red, green and blue. The pattern of lines includes these materials recurring in a designated order or color sequence.

It is well recognized that the preparation of the fluorescent screen for a conventional picture tube, adapted for black and white reproduction, is a delicate process. Of particular importance is the requirement that the fluorescent material be disposed over the tube face with uniform thickness. The fabrication of a fluorescent screen featuring a repeating sequence of color components in accordance with prior arrangements poses additional problems, usually leading to complex, slow and costly steps.

It is an object of this invention, therefore, to provide an improved method for preparing a preselected color pattern of fluorescent material for a television picture tube.

Yet another object of the invention is to provide an economical method for preparing a preselected color pattern of fluorescent material for a television picture tube.

One prior method of constructing a color raster

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screen of the general type under consideration utilizes a fabric, the warp threads of which are composed of conductive wires or strips individually coated with fluorescent material. The coatings flouresce in different colors when excited by impinging electrons, thereby providing the desired color pattern. Adjacent warp threads are electrically insulated from one another but all threads to which the same color has been assigned are electrically connected at the sides of the screen. In using such a screen, a color-selective switch-in circuit causes each color group to be sequentially coupled into the electron beam circuit of the picture tube. This system may be efficient when arranged so that the reproduced image is viewed from the side of the raster screen on which the electrons impinge. However, if employed for viewing on the other side of the screen, it is apparent that the presence of the opaque conductive portions of the raster tend to reduce the light-efficiency of the tube. In a modified arrangement employing an insulating strip carrying the fluorescent material and coated with a transparent conductive material, this difficulty may be obviated but it is apparent that the complexity and high production costs of this arrangement cause it to be unattractive.

Thus, it is a further object of the invention to provide a method for preparing a more efficient raster screen for a picture tube to reproduce images in natural color.

The invention resides in the method of preparing a layer of fluorescent material on a supporting element of a television picture tube adapted to reproduce images. This method comprises the preparation of threads individually carrying fluorescent material which, in the presence of impinging electrons, emits light within the visible spectrum. A fabric is woven in which these threads constitute the warp. The fabric is disposed on the afore-mentioned supporting element of the television picture tube and treated to dissociate the fluorescent material and the threads and deposit the fluorescent material on the supporting element.

In a particular embodiment of the invention a preselected color pattern of fluorescent material is prepared for a television picture tube adapted to reproduce images in natural color. A plurality of threads are prepared which individually carry one of a group of fluorescent materials. Each fluorescent material, in the presence of impinging electrons, emits light within a predetermined one of a plurality of ranges in the visible spectrum. The fabric is woven

with these threads constituting the warp and occurring in a preselected color pattern.

In another specific embodiment of the invention the threads are of synthetic fiber and individually have suspended therein the fluorescent materials. After the fabric is disposed on the supporting element of the televison picture tube, the fiber portion of the fabric is removed to leave a residue of fluorescent material on the supporting element.

In accordance with still another embodiment of the invention the threads are of glass.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof my best be understood by reference to the following description.

Although the method of the invention is equally applicable to the preparation of monochrome, two-color or three-color raster screens, it is especially applicable to the production of the three color variety and will be described in that connection.

The initial step, for one embodiment of the invention, is the preparation of cellulose nitrate by the conversion of cotton linters or other suitable material by any well known method. The cellulose nitrate then is dissolved in a solvent such as a mixture of ether and alcohol, or other low-boiling solvent mixture, filtered to remove impurities and undissolved particles, and transferred to aging tanks in which air bubbles are released. This step is performed at a temperature in the range of from 60° F. to 65° F.

From the aging tanks the cellulose nitrate solution is transferred to four separate tanks. Into each of three of these solutions is intimately mixed by stirring, one of a group of fluorescent materials. Each of these materials, in the presence of impinging electrons, emits light within a predetermined one of a plurality of ranges in the visible spectrum including red, green and blue. The composition of these powders is generally well known and need not be set forth in detail.

While maintaining the three fluorescent materials in suspension, by stirring or agitation, fiber threads are formed from each of the four solutions which are maintained free of air, in the following manner: Each solution is extruded through spinnerets into a current of warm air which evaporates and carries off the solvents thus solidifying the filaments. The spinnerets are of such a size that the resulting thread formed from several filaments has a predetermined thickness to be pointed out hereinafter. The several filaments from the spinnerets are combined and wound upon a bobbin. After washing and drying, the several threads are wound upon respective bobbins.

The process just recited for forming synthetic fiber-threads is described in substance in the Handbook of Plastics by Simonds and Ellis, published by D. Van Nostrand Co., Inc., New York at p. 352 under the heading "Nitrocellulose process." It is to be understood that this particular method is presented merely by way of example and any other suitable process for producing synthetic fiber threads, which are volatilizable by combustion, may be successfully employed. Further, it is entirely within the scope of the invention to utilize a monofil thread, for example one made by extrusion.

After threads are formed in accordance with

the above-enumerated steps, a fabric of tight mesh is woven in which the three threads having the suspended fluorescent material constitute the warp and the remaining thread constitutes the weft. The warp threads are arranged to occur in a preselected color order wherein a recurring sequence of red, green and blue is effected.

It should be pointed out that the distance between successive warp threads and the thickness of these threads are dependent upon the physical size of the raster screen to be constructed. For example, in a picture tube having a 10 inch diameter reproducing screen adapted for a 525 line, 3-color system, the warp threads are spaced from one another by approximately 0.019 inch. Hence, the thickness of these threads should be no greater than 0.019 inch and inasmuch as some spacing between adjacent threads should be provided, threads of .015 inch diameter are employed. This dimension determines the size of the filaments which make up individual threads.

The distance between successive weft threads is less critical than that of the warp threads, since these merely serve to complete the fabric and have no relationship with respect to the required color pattern. For this illustrative example, the same dimensional relationships for both the warp and weft threads are utilized.

The supporting element or surface on which the raster screen is formed usually is the glass front face of a cathode-ray picture tube blank. Although it is entirely feasible to continue through the succeeding steps with the tube blank used in its entirety, i. e. the face, bulb and neck portions, it is generally an easier procedure to utilize only the face portion. A small portion of the bulb may be included with the face. The interior front surface (when assembled) of the glass face is coated with an adhesive material such as phosphoric acid, water glass or other suitable tacky material and a piece of the fabric, suitably cut to the dimensions of the tube face, is spread or otherwise disposed over the adhesive material thereby adhering the fabric thereto.

In the next step, the fabric is treated whereby the fluorescent material suspended therein is disposed on the face or supporting element. This is accomplished by heating the assembly of the supporting element and the fabric in an atmosphere including oxygen or in air to volatilize the fabric by combustion. The fabric thus is removed to leave a residue of fluorescent material embedded in the adhesive material on the tube face in accordance with the required pattern.

Finally, the face portion is welded to the bulb end of the picture tube and the beam forming system is assembled in known manner.

Thus it may be seen that the invention provides, a simple, speedy and economical method for producing a preselected color pattern of fluorescent material on a television picture tube adapted to reproduce images in natural color. Also, since it is possible to rid the raster screen of substantially all the fiber material, the picture tube is not subject to decreased light efficiency resulting from the presence of opaque material within the fluorescent material. Furthermore, by utilizing the tight mesh fabric, it is possible to dispose the various fluorescent materials according to the required standards, of line width and parallelness of lines, prescribed by the arrangement for color reproduction here under consideration. Finally, since the amount of fluorescent material throughout the threads may be held uniform and the threads may be formed with uniform diameter,

it is apparent that the resulting raster screen is of uniform thickness.

In constructing a monochrome raster screen both the warp and the weft threads carry a fluorescent material which has the required monochrome quality in the presence of impinging electrons. Aside from this deviation, the procedure outlined above is applicable.

According to another embodiment of the invention, the warp threads are composed of glass fibers, constructed in known manner, and are coated with or have suspended therein, the several fluorescent materials. The weft threads may be formed either of glass or of volatile fiber. After the fabric is disposed on the glass tube face, it is sintered thereto by heating. In the case of fiber weft threads, the sintering is carried on in an atmosphere including oxygen whereby the fiber threads are volatilized.

While particular embodiments of the present invention have been described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this 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 this invention.

I claim:

1. The method of preparing a preselected color pattern of fluorescent material on a supporting element of a television picture tube adapted to reproduce images in natural color, which comprises the steps of: preparing a single synthetic fiber thread; preparing a plurality of synthetic fiber threads individually having suspended therein one of a group of fluorescent materials each of which in the presence of impinging electrons emits light within a predetermined one of a plurality of ranges in the visible spectrum; weaving a fabric in which said single fiber thread constitutes the weft and said plurality of fiber threads constitute the warp and occur in a preselected color pattern; disposing said fabric on said supporting element of said television picture tube; and removing only said fiber portion of said fabric to leave a residue of said fluorescent material deposited on said supporting element in accordance with said pattern.

2. The method of preparing a preselected color pattern of fluorescent material on a supporting element of a television picture tube adapted to reproduce images in natural color, which comprises the steps of: preparing a single synthetic fiber thread; preparing a plurality of synthetic fiber threads individually having suspended therein one of a group of fluorescent materials each of which in the presence of impinging electrons emits light within a predetermined one of a plurality of ranges in the visible spectrum; weaving a fabric in which said single fiber thread constitutes the weft and said plurality of fiber threads constitute the warp and occur in a preselected color pattern; disposing an adhesive material on said supporting element of said television picture tube; spreading said fabric over said adhesive material thereby adhering said fabric to said supporting element; and removing only said fiber portion of said fabric to leave a residue of said fluorescent material deposited on said supporting element in accordance with said pattern.

3. The method of preparing a preselected color pattern of fluorescent material on a supporting element of a television picture tube adapted to reproduce images in natural color, which comprises the steps of: preparing a single synthetic fiber thread; preparing a plurality of synthetic fiber threads, which are volatilizable by combustion, individually having suspended therein one of a group of fluorescent materials each of which in the presence of impinging electrons emits light within a predetermined one of a plurality of ranges in the visible spectrum; weaving a fabric in which said single fiber thread constitutes the weft and said plurality of fiber threads constitute the warp and occur in a preselected color pattern; disposing said fabric on said supporting element of said television picture tube; and heating the assembly of said supporting element and said fabric in an atmosphere including oxygen to volatilize only said fiber portion of said fabric and thereby leave a residue of said fluorescent material deposited on said supporting element in accordance with said pattern.

4. The method of preparing a preselected color pattern of fluorescent material on a glass supporting element of a television picture tube adapted to reproduce images in natural color, which comprises the steps of: preparing a synthetic fiber thread which is volatilizable by combustion; preparing a plurality of glass threads individually carrying one of a group of fluorescent materials each of which in the presence of impinging electrons emits light within a predetermined one of a plurality of ranges in the visible spectrum; weaving a fabric in which said fiber thread constitutes the weft and said glass threads constitute the warp and occur in a preselected color pattern; disposing said fabric on said supporting element of said television picture tube; and sintering said fabric to said glass supporting element of said television picture tube, said sintering being carried on in an atmosphere including oxygen whereby said fiber thread is volatilized and said fluorescent material is disposed on said supporting element in accordance with said pattern.

5. The method of preparing a layer of fluorescent material on a supporting element of a television picture tube, which comprises the steps of: preparing a synthetic fiber thread which is volatilizable by combustion; preparing a plurality of threads individually carrying one of a group of fluorescent materials each of which in the presence of impinging electrons emits light within a predetermined one of a plurality of ranges in the visible spectrum; weaving a fabric in which said synthetic fiber thread constitutes the weft and said fluorescent-material-carrying threads constitute the warp; disposing said fabric on said supporting element of said television picture tube; and heating the assembly of said supporting element and said fabric in an atmosphere including oxygen to volatilize said fiber portion of said fabric.

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