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Color television system

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SUMMARY:

The present invention relates to electric systerns, and more particularly to television-receiving systems that, while having more general fields of usefulness, are especially adapted for use in color television.

In the prior art, color television has been accomplished by allowing a color disc to rotate in front of the iconoscope or other common type of television-transmitting tube. The optical field produced on the iconoscope mosaic has been i o scanned by the electron stream of the iconoscope while each color disc was in front of the tube. A similar disc, at the receiving station, has been synchronized with the disc at the transmitter so that; as the electron stream of the display-oathode-ray tube at the receiver reproduced the fields scanned at the transmitter, the appropriate color disc was in front of the receiver-oscilloscope.

The successive color scans occurred at such a rate of speed that they appeared as a single image in its true colors.

An object of this invention is to provide a new and improved color-television-receiving system.

rther object is to provide a novel color- ,, put of the detector levision system that shall eliminate the need 25 quency amplifier for bulky moving parts, such as color filters.

A further object is to provide a complete colorimage-producing system contained in a cathoderay tube, with no external parts other than the , synchronizing and impulse circuitry associated So in quantities dependent upon the signal strength with the receiving system.

It has been proposed to print lines or strips of differently colored luminescent material on a screen, thereby forming a mosaic of interlaced luminescent strips positioned inside the cathoderay tube. This process calls for coating the luminescent material on a supporting screen.

The inherent overlapping of the luminescent material, coated as thus proposed, and the sympathetic luminescence of adjacent strip coatings render these proposals disadvantageous.

It has also been proposed to provide a series of sets of metal strips coated with luminescent material and electrically charged in synchronism with the transmitter color disc to cause the scan of a particular set of strips. Such a construction and scanning procedure is intricate and complicated.

A further object of the present invention, therefore, is to overcome these complexities by so advantages of such a construction are the obusing a new and simple type of mosaic, ruled to provide a grating, the rulings of which are filled with luminescent material. As will be later pointed out, such a system permits the screen to be actually the cathode-ray-tube face itself, thus lending itself to present manufacturing methods, insures against sympathetic luminescence of adjacent rulings, and adapts itself to extremely simple scanning procedures.

r, Still a further object is to provide simple methods of making these grated mosaics.

Other and further objects will be explained hereinafter, and will be particularly set forth in the appended claims.</

ENGLISH-CLAIMS:
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claims.

The invention will now be more fully explained in connection with the accompanying drawings, in which Fig. 1 is a diagrammatic view of circuits and apparatus embodying the invention as incorporated in a common color-television-receiving system; Figs. 2 to 10 represent explanatory diagrams and wave forms; and Fig. 11 is a view of a cathode-ray-tube screen illustrating a feature of the present invention.

An antenna 22 receiving the radio-frequency transmission from :a sending station (not shown)

feeds a radio-frequency amplifier 24 which, in turn, feeds into a detector 28 that is superheterodyned by a local oscillator 2

6. Part of the outis fed to the video-frewhich controls the voltage between the cathode 5 and the control grid 1 of the display cathode-ray oscilloscope 4

2. Thus, electrons emitted from the cathode 5, in response to the energizing of the control grid 7, will pass transmitted during a particular scan of the iconoscope mosaic at the transmitter. The detector 28 also feeds a synchronizing signal-separator 21 that separates out the triggering pulses for the horizontal-sweep circuit 17, the vertical-sweep circuit 19, the backstroke blanking circuit 35, and the motor 32, which, in most color-television circults, is used to revolve a color filter. The horizontal-sweep circuit feeds the deflector coils 13, and produces periodically the "line-scan," while the vertical-sweep circuit ! 9 periodically energizes the coils and 25 to effect the "field-.

scan." All this is according to well-known television techniques. . .

The screen face 48 of the cathode-ray tube 12 is of unique construction. It involves the providing of depressions in

the face of the screen within the cathode-ray tube for holding the phosphorescent luminescent material. Among the viating of overlapping and consequent edgeluminescing, effects between adjacent portions of a pattern of luminescent material on the screen, since the luminescent material is confined to the depressions; the resulting clarity and sharpness of luminescent indication provided by the electron stream impinging upon the luminescent material confined to the depression; the rendering more difficult the dislodging and burning-off of the luminescent material by the electron stream; and the adaptability for accurate mass-production of particular luminescent-material patterns as a result of the use of easily reproducible depressions. While this feature of the present invention, therefore, is of generalise for cathoderay-tube screens and the like wherever the above advantages and others are sought, it is particularly adapted for use in the above-described illustration of color television.

Thus, in Pig. 1, for the color-television use, a pattern of depressions is provided in the cathoderay-tube screen that constitutes .a grating, ruled in the face itself, v/ith successive substantially equally spaced lines of the grating filled with various types of phosphors. The depth of the grating or grooved,-area,may,berafeout 0.002 millimeter. The width-of -each .-ruling, however, should preferably be -justTSlightly larger, than the width of the electron stream in the rcathoderray tube ;42 in order-that, among other;reasons, ;the degree of accuracy required of .the hereinafter described biasing and .scanning -system be .-not too great. The anodes-9 and-II maj be adjusted to produce an extremely finer-stream,-about,onefourth the width of the customary television electron stream. If every four gratings/from-the .top, such as 2, 8, 14, 20, etc are filled with, say/zinc orthosilicate.thenr.a green phosphorescent screen has,been created.andan:eleetron-stream striking any .layer 2, 8, 14, 20, etc will;produce a green color on the-scope face 40. Similarly,:gratings 4. 1,0, 16, etc might be .filled or .embedded with zinc oxide so that an electron stream striking any of these layers would produce :a.blue lumineseenee on the-scope face. And, a red or yellow or any :desired color phosphor,may occupy the remaining set of rulings 6, 12, 18, etc;; for example, zinc beryllium silicate.

A plurality of like sets of areas including a first area -2, 4, 6 and a last area, not shown, are thus provided on the screen 40 on which the electron stream impinges, each set having a plurality of like sub-areas or layers all extending in the same direction, which may be?assumed to be horizontal. The first set of areas as-provided with the successively disposed sub-areas: or layers 2, 4 and 6 equally spaced :along a ,direction perpendicular to the first-named direction, which may therefore be .vertical. The seeond,set of areas is provided with successively disposed sub-areas ,or layers 8, I0, and 12, similarly equally spaced vertically. The third, set-of areas: is; provided with successively disposed sub-rareas or layers 14,, 16, and 18, also -equally spaced vertically.

The fourth: set :of areas is .provided with suecessively disposed sub-areas or layers 20, etc likewise .equally spaced vertically, and so on. The subrareasJOT layers 2, J, .1.4, 20, etcof the sets.of areas are similar, corresponding,togreen. They spaced .alongthe .ver- OB the negative pulses applied to the grid tical direction between the-first .green layerZin the first area 2, 4, 6 and a last, green.layer in the equally spaced vertically between the first blue layer 4 in the first -area 2, 4, 6 and a lasf:blue layer in the last area, not-shown: The sub-areas or layers 6, 12, 18, etc of the-sets of areas are likewise similar, but corresponding to red. The red layers are also equally spaced vertically between the first red layer 6 in the first area 2, 4, 6 and a last red layer in the last area, not shown.

The sub-areas or layers of each area are thus colored in sequence to correspond to the sequence of colors of the filter at the transmitter.

Three sets of gratings have been provided, and an electron stream hitting any set will give luminescence of a color depending on the type of phosphor in that-set. The three primary colors may easily be used as mentioned above, so that the set 2, 8, 14, 20, etc gives green luminescence, the set 4, 10, 16, etc blue; and the set 6, 12, 18, etc,, red.

Each groove or ruling is separated from its adjacent-rulings by the non-phosphor material 70 .of -the,face.40. Since the luminescent material is embedded in the grooves of the face 40, the non-luminescent material is in the same plane as the top of the luminescent material so that the face.material 70 -effectively prevents-sympathetic ;luminescence .of adjacent grooves.

It is desired -to cause - the electron .stream ,to successively scan ;each set of rulings. .For exampie, the stream will scan the ruling,2, then the ruling ,5, then the-ruling 1.4, thenthe ruling-20, etc until .all the .layers of this:green.set .have been scanned. Then it. is -.desired ;to cause the electron stream-to scan :ruling 4, then.jruling 1,0, then ruling-16, etc until the second or blue.set has been scanned. The.stream should then st&rt scanning layer 6,,then 12, then 18, etc until the third or .redset has beenscanned. At such a time, it is desired to , start, all over with the first or green ,set.

If -we :assumethat there ris .sufficient voltage in the vertical,deflector coils 15, 25, to cause-the electron:stream; to impinge on the layer 2, and that the .horizontal-sweep circuit quickly scans the layer ,2, -then it is only necessary that, atthe end of this scan, the electron stream be blanked out until such a.time as the vertical-sweep voltage would be. sufficient to .cause the stream to impinge on the layer 8, the next layer of the same phosphor. If this is repeated throughout the whole of one scanning process, then we could accomplish a complete scan of one phosphor-grating.

To make this so, all that is needed is to adjust the time constants of the recovery circuit of the periodic horizontal-sweep circuit 17, to such-a value that, in the corresponding period of time, the vertical-sweep circuit shall have produced a sufficient voltage change to cause the next horizontal scan to .occur atthe proper lever of operationon the: scope face on the next similar phosphor layer.

In.Hg 2, the .synchronizing pulses that trigger the :horizontal sweep circuit 17 are shown. Fig.

shows -the .charging and discharging sweeps pf the .horizontal-sweep .circuit 17, Assume .that the scan: of any,layer by the .electron rstream takes place :during the discharge period-shown as rCiBs,-and that the back-stroke, or recovery, of the stream occurs during CiRi. Fig! 3 shows of the cathoderray tube; 42 during this recovery period CiEL.s.o ttet during -such period no .electrons Clrcuit 9 has built UP volia e -increments shown as Vi, V2 and V3 which are sufficiently large-to cause the next horizontal scan.CiR2 to ccur.-pn the-proper layer. Thus, as shown in;Fig. 6; the first scan takes place on layer 2, the next on layer 8, the following on layer 14, . . . layer 20, etc.

Thus the condition of scanning only one complete set of similar phosphor layers Z, 8, 14, 20, etc has been accomplished, and, say, a green image is produced on the screen 40.

It remains to produce a means of causing the next set of blue phosphor layers 4, 10, 16, etc to be scanned during the following vertical sweep. In accordance with the present invention, the electron beam or stream is biased by pre-set biasing voltages applied at the time of the initiation of the next vertical sweep voltage and hence prior to the commencement of the next vertical sweep, thereby to insure that the stream will commence the next vertical scanning with the top color layer of the next color in this case, the top blue layer

4. While the said biasing may obviously be effected in well-known ways, the drawings illustrate a convenient technique in accordance with which the vertical sweep is caused to produce an initial voltage at the commencement of the next vertical sweep that will start the first horizontal sweep on layer instead of layer 2. Then the set corresponding to layer 4, or the blue grating, will be scanned. This is accomplished by a switching mechanism 50, as follows.

The motor 32, which is commonly used to drive a color disc, identical with that at the transmitter, can drive a switch which successively connects with contactors 53, 52 and 51, at the time the red, blue and green filters are respectively in front of the transmitter iconoscope to present these respective colors in sequence to the transmitter. Contactors 5!, 52 and 53 allow different biasing voltages, as produced by batteries ! 5!, 152 and 153, respectively, to be applied to the electron-stream position-biasing device, in this case, to the vertical deflection coils 15, produce the proper color selection on the display tube. The voltage values of the biasing batteries 151. 152 and 153 increase in sequence to correspond to the spacing between the first layer and the other layers of each area. The increase in voltage of the battery 152 over that of the battery 151 thus corresponds to the spacing between the layers 2 and 4, 8 and ID, (4 and 16, and so on, and the increase in voltage of the battery 153 over that of the battery 151 corresponds to the spacing between the layers 2 and 6, 8 and 12, 14 and !8, and so on. If it be assumed that the top grating 2 is p. green phosphor, and every fourth grating is identical, then, while contactor makes with contactor 51, the green filter disc at the transmitter is

scanning the iconoscope. The vertical-sweep voltage will feed through the slip ring and contactor 50 and contactor 51 and biasing battery 15!, to the vertical deflection coils 15, 25, and will cause the electron stream in flO charges of the vertical-sweep, voltage, as illusthe cathode-ray tube 42 to scan each green ruling as previously described. Thus a picture of the televised object viewed by the iconoscope through a green filter appears as a green image on the receiver cathode-ray tube 42 on the scanning sequence.

grating of green phosphor. Definition will be good particularly if the width of the iconoscope electron stream is at least three to four times the width of the very fine stream preferable in the This restriction is rather essential since TO by adjusting the anodes the intensity gradations produced in the scanning of the iconoscope are reproduced at the receiver on a screen, only selected parts of which will produce luminescence during any particular scan.

After the green phosphor has been scanned and an image produced corresponding to the green object televised by the iconoscope, the color filter at the transmitter revolves so that, say, the blue filter next comes into play. Switch 50, by virtue of its synchronization with the transmitter color disc, then makes contact with the contactor 52, which causes a greater biasing voltage from the battery 152, corresponding to the separation or spacing between a blue and green layer, to be applied to the vertical deflection coils 15, 2

5. The first horizontal scan will therefore not take place along the layer 2, as previously, but, due to the additional bias voltage from the battery ! 52, will take place along the layer 4, the first blue layer. Thus will a scan of the blue phosphor be produced. If distance d/3 represents the separation or spacing of the green from the blue rulings, then the biasing battery !52 must produce a corresponding bias voltage that will deflect the stream a vertical distance d/3.

Similarly, when the red color disc is scanning the transmitter, contactor 53 at the receiver will cause the battery !53 to produce sufficient bias so that the first horizontal scan takes place on the layer 6, the first of the red phosphors.

It is well known that color has a diffusing effect upon the human eye, so that fewer scanning lines may be usually needed to produce a good definition color image than to produce a corresponding black and white image. This means that there can be wider separations between successive horizontal scans in producing a color image.

The distance d. between successive similar phosphor layers should be so arranged, accordingly, that this diffusing effect produces a complete and well-defined image on the color phosphor gratings.

to 0 Mg. 7 illustrates the synchronizing pulses triggering the vertical-sweep circuit 19, once to each scan of the iconoscope transmitter. Pig. 8 shows the position of the color filter at the transmitter during such scans. Pig. 9 shows how contactors 51. 52 and 53 put in enough additional voltage during respective scans at the receiver cathoderay tube 42 to cause the scans to occur first of the green layers, then of the blue, and then of the red.

The bias voltage represented by a in Fig. 9 is produced by battery 152 and is sufficient to cause the new set of horizontal scans to occur a displacement d/3 below the first level of operation on the layer 2; i. e on layer 4. Similarly, the voltage b shows the additional d/3 bias voltage put on by the battery 153, to cause a.scan initiating with the top red phosphor 6. The switch 50.

in between successive connections to the contactors 51, 52 and 53, during the back-stroke or distrated in Pig. 9, disconnects the vertical-sweep circuit 19 from the vertical deflection coils 15, 25. thereby providing convenient backstroke blanking. Fig. 10 shows the color phosphor The observer thus sees three successive different-colored images, slightly displaced from one another. If this displacement is small enough, and it can be made so by using fine gratings and and 9 to produce an extremely fine electron stream to fill the gratings, the observer will not be able to detect the slight displacement of the three scans, and will see but one image in its true colors.

A simple method of constructing the novel 2,615;087 cathodesray-ituhe screens 30f ethe -present invention will now:be described, ;applied.to:the complete .oscilloscope grating illustration. Rule , an independent grating on-each:of :three thin transparent sheets 44, 46, 48,:such as :fine glass. Suppnse the "separation: of the ruling is d. Moisten each,

sheet, and :then dry :off the sheet. The rulings will remain damp. The application of a powdered :phosphor ;to the :sheet, and the subsequent:dusting:off of:the sheet, will leave.the gratings full .of phosphor. These same moistening, drying and luminescentrmateriai-filling steps, of course, are equally applicable to other types of depression patterns,:too. Thus,:in the above illustration, three separate rphosphor gratings have been.made. Each;sheet, of reourse, is a useful eathode-ray-tube .screen. Where it is desired to obtain a:eomposite assembly of interlaced screens, as:f or.multi-:color-purposes, ;it merely remains to position theisheets.-sovas to stagger:the gratings so that:a complete.interlaced three-color grating is produced. If the top grating of the second thinvsheet ;be:placed:.a distance d/3 from, the top grating-of: the first sheet:and the, top grating of the-third sheet is-placed W3 below the top grating of:the;second;sheet,-.then gratings two and one, and .three :and two, .-respectively, can be joined, : if desired, at the outer edges with glass cement, producing :B three-color grating.

Ttother -modifications-will occur to persons skilled in;-the ;art/and all :such are considered to fall within the spirit -and scope of the invention, as defined in the appended claims.

What :is. claimed :is:.

3, A. transparent -screen -.for :incorporation at the-"front:of a .cathode-ray :tube having an electron -stream, the .screen .being:-provided on its f ace: adapted1 to be disposed-inside-the tube facing the electron stream with a plurality of depressions each containing luminescent material of "width larger than :the width of the electron stream.

2. Amosaic;that comprises several thin sheets each"rule d io provide a grating, the ruling of each grating being filled with luminescent mat rials, : and the sheets of gratings being joined with the1: rulings of the respective .sheets staggered to interlace :them.

3. A cathode-ray tube having a screen provided with a face disposed inside the tube Tuled with a series of-grooves to provide a grating, the grooves containing multi-colored luminescing materials, and means for producing an electron stream to scan the materials in order to cause them to luminesce, the luminescing materials b ing disposed in scanning paths along areas of width larger than : the -width . of the electron stream.

4. A color-television-receiver having a screen provided with .a plurality of like sets of areas including a:first area and. a last area each having a-plurality of .like layers extending in a first direction,constituted :of material that luminesces in: response -to :the action-thereon of an electron stream, the luminescent material.of the layers of each area;luminescingincolors in sequence, similarly luminescing -color layers.of the successively disposed areas being substantially equally spaced along a second direction between a first similarly luminescing ;Color .-layer .in the first area and a:last--similarly luminescing color layer in-the last area, means .for producing an electron stream for-impinging .on the -screen, a -pluraUlty of voltage sources having predetermined voltage values increasing in/sequence to correspond tortheispacing between theffirst layer .and-the,other Ilayers of each area, a first deflection means for deflectrng the electromstream- periodically ;to :cause.the electron stream -to, scan: the layers: successively .in the first direction, a-second deflection means, .a sweep circuitffor producing a periodic sweep voltage, ;means. connecting the sweep circuit to the second deflection means to ocause the second deflection means, during each-:sweep of the periodic sweep voltage, tordeflect the: electron stream upon the conclusion:of;the scanning of each layer from each scanned :layer: of each color to the next adjacently disposed layer of similar luminescing color until all of the similarly luminescing color layers:fromcthe first saidrsimilarly luminescing color layer:to:the:last;said similarly luminescing color layer have :been scanned, and means operable upon ihescompletion of the:scanning of the last layers -and -prior to : the -commencement of: each next following,sweep :o.f the-periodic sweep voltagetoradd the1 voltages i of the .plurality of voltage sources in the order of their increase in sequence -to :the .periodic sweep voltage of the sweep circuit in order to umpinge the electron stream upon .the tfirst; layer of the color next in sequence to ;the-said.first:similarly luminescing color layer.

5. A color-television receiver having a screen provided.with a-plurality of like sets of areas ineluding a:first :area.and:a last area;each having a plurality of like layers extending in a first directionconstituted-of:material: that

luminesces in response to the .action thereon of an electron stream,:the luminescent-material of the layers.oof each area luminescing in colors in sequence, similarly.vluminescing color layers of the:successively disposed .areas beingi-substantially equally spaced along: a secondi direction .between a: first similarly luminescing color layer in the first area and a .1 last similarly luminescing color layer in the last area, means .for producing an electron.stream for impinging on the screen, a plurality of voltage sources having predetermined voltage values increasing in.sequence-to-correspond to the spacr> ing :between the first .layer: and the other layers of each area, a first deflection means for defleeting.the electron stream .-periodically to cause the electron stream to scan:the layers successively in the first direction, a second deflection means, a sweep circuit for producing a periodic sweep voltage, means connecting the sweep circuit to the second deflection means to cause the second deflection-means, during each sweep of the periodic sweep-voltage, to deflect the electron stream BS upon the conclusion of the scanning of each layer from each scanned layer of each color to the next -adjacently disposed layer of similar luminescing color .until all- of the -similarly luminescing color layers from-the first said similarly luminescing color layer to the last said similarly luminescing color layer have been scanned means operable upon the completion of the scanning Of the last layers and priorto the commencement of fi h t followlng sweep of the periodic sweep lt to add the voltages .of the plurality of in the.order of their increase in =pmpnpp to tho npriorifp SWPPH vnlta nf th sequence to the periodic sweep voltage of the sf-eeP circuit un order to impinge the electron stream.upon the firstlayer .of the.color next :m.

sequence to .the .said first -similarly .luminescing color layer, and means for,disconnecting the periodic sweep voltage from .the .second deflection means during ,the .period .between the completion of the scanning of the last layers and the commencement of the next following sweep of the periodic sweep voltage.

6. A color television receiver having a screen provided with a plurality of like sets of areas including a first area and a last area each ha ing a plurality of like horizontally-extending layers constituted of material that luminesces in response to the action thereon of an electron stream, the luminescent material of the layers of each area luminescing in colors in sequence, similarly luminescing color layers of the suecessively disposed areas being substantially equally spaced vertically between a first similarly luminescing color layer in the first area and a last: similarly luminescing color layer in the last area, means for producing an electron stream for impinging on the screen, a plurality of voltage sources having predetermined voltage values increasing in sequence to correspond to the vertical spacing between the first layer and the other layers of each area, a first deflection means for deflecting the electron stream periodically to cause the electron stream successively to scan the layers horizontally, a second deflection means, a vertical-sweep circuit for producing a periodic vertical-sweep voltage, means connecting the vertical-sweep circuit to the second deflection means to cause the second deflection means, during each sweep of the periodic vertical-sweep voltage, to deflect the electron stream upon the conclusion of each horizontal scan from each scanned layer of each color vertically to the next adjacently disposed layer of similar luminescing color until all of the similarly luminescing color layers from the first said similarly luminescing color layer to the last said similarly luminescing color layer have been scanned, and means operable upon the completion of the scanning of the last layers and prior to the commencement of each next following sweep of the periodic vertical-sweep voltage to add the voltages of the plurality of voltage sources in the order of their increase in sequence to the periodic verticalsweep voltage of the vertical-sweep circuit in order to impinge the electron stream upon the first layer of the next color in sequence to the said first similarly luminescing color layer.

7. A color television receiving system having, in combination, a receiver having a screen provided with a plurality of like sets of grooved areas including a first area and a last area each having a plurality of like grooves extending in a first direction and filled with material that luminesces in response to the action thereon of an electron stream, the luminescent material in the grooves of each area luminescing in colors in sequence, the grooves containing the similarly luminescing color luminescent material of the successively disposed areas being substantially equally spaced along a second direction between a first groove containing similarly luminescing color luminescent material in the first area and a last groove containing similarly lumineseing color luminescent material in the last area, means for producing an electron stream for impinging on the screen, a plurality of voltage sources having predetermined voltage values increasing in sequence to correspond to the spacing between the first groove and the other grooves of each area, a first deflection means for deflecting the electron stream periodically to cause the electron stream to scan the grooves

successively in the first direction, a second deflection means, a sweep circuit for producing a periodic sweep voltage, means connecting the sweep circuit to the second deflection means to cause the second deflection means, during each sweep of the periodic sweep voltage, first to deflect the electron stream upon the conclusion of the scang nmg of each groove from each scanned groove containing luminescent material of each luminescing color to the next adjacently disposed groove containing luminescent material of similar luminescing color until all of the grooves containing the similarly luminescing color luminescent material from the first said groove containing the similarly luminescing color luminescent material :to the last said groove containing the similarly luminescing color luminescent material have been scanned, and means operable upon the completion of the scanning of the last grooves and prior to the commencement of each next following sweep of the periodic sweep voltage to add the voltages of the plurality of voltage sources in the order of their increase in sequence to the periodic sweep voltage of the sweep circuit in order to impinge the electron stream upon the first groove containing luminescent material of the color next in sequence to the said first groove containing the similarly luminescing color luminescent material.

8. A color television receiving system having, in combination, a receiver having a screen provided with a plurality of like sets of areas including a first area and a last area each having a plurality of like layers extending in a first direction constituted of material that luminesces in response to the action thereon of an electron stream, the luminescent material of the layers of each area luminescing in colors in sequence, similarly luminescing color layers of the successively disposed areas being substantially equally spaced along a second direction between a first similarly luminescing color layer in the first area and a last similarly luminescing color layer in the last area, means for producing an electron stream for impinging on the screen, a first deflection means for deflecting the electron stream periodically to cause the electron stream to scan the layers successively in the first direction, a second deflection means, a sweep circuit for producing a periodic sweep voltage, means connecting the sweep circuit to the second deflection means to cause the second deflection means, during each sweep of the periodic sweep voltage, first to deflect the electron stream upon the conclusion of the scanning of each layer from each scanned layer of each color to the next adjacently disposed layer of similar luminescing color until all of the similarly luminescing color layers from the first said similarly luminescing color layer to the last said similarly luminescing color layer have been scanned, and means operable upon the completion of the scanning of the last layers and prior to the commencement of each next following periodic sweep voltage. for biasing the position of the electron stream in order to impinge the electron stream upon the first layer of the color next in sequence to the said first similarly luminescing color layer.

9. A color television receiving system having, in combination, a receiver having a screen provided with a plurality of like sets of areas including a first area and a last area each having a plurality Of like layers extending in a first direction constituted of material that luminesces in response to the action thereon of an electron stream, the luminescent material of the layers of each area luminescing in colors in sequence, similarly luminescing color layers of the successively disposed : areas .being substantially equally spaced iatong a second direction .between & .first .similarly: luminescing oolor layer in the first area and a last similarly luminescing, color layer in -the last .area, means lor producing an: electron. stream ;for impinging on -the. screen a; plurality, of voltage sources having predetermined voltage values increasing in sequence to correspond to the spacing .between.the first: layer, .and the-.other layers of each area, a first deflection means .for .deflecting the electron stream periodically to cause the electron stream to scan, the layers successively in the first direction,, a second deflection means; a sweep circuit for producing a periodic sweep voltage,:-means connectingthe .sweep circuit to -the15: +/-he-.:corresponding-primary colors of the: object.

second deflection, means to cause the second deflection means, during each sweep x>f the periodic sweep voltage, first to deflect :the; .electron stream upon the conclusion, of the scanning: of each layer from each scanned layer of each color to the next adjacently disposed layer of similar lumineseing color until all of the similarly:luminescing color layers from the first .said similarly luminescing color layer to the last said similarly luminescing color layer have been scanned, and:

motor-driven contactor means operable upon the completion of the scanning of the.last layers and prior to the commencement of each next following sweep of the periodic sweep voltage :to add the voltages of the plurality of voltage sources in the order of their increase in sequence to the periodic sweep voltage of the sweep circuit in order to

impinge the electron stream upon the first layer of the color .next in sequence to the said first similarly luminescing color layer.

10. A system for producing a likeness of an object in the original colors of the object having, in combination, means for receiving signals corresponding to the object in its primary colors,: a cathode-ray tube having a screen provided with a plurality of like sets of areas including a first area and a last area each, having; a. plurality of like, layers extending in a first direction constituted of material that luminesces in response, to the action thereon of an electron stream, the luminescent material of the layers of each area luminescing in the primary colors,in sequence to correspond to the primary colors of the object, similarly luminescing primary-color layers of the successively disposed areas being substantially equally :spaced along a second direction between a first similarly luminescing primary-color layer in the first area and a last similarly luminescing primary-color layer in the last area, means for producing an electron stream for impinging on the screen, a plurality of voltage sources having predetermined voltage values increasing in sequence to correspond to the spacing between the first layer and the other layers of each area, a first deflection means for deflecting the electron stream periodically to cause the electron stream to scan the layers successively in the:.first: direction, a second deflection means, a sweep: circuit for producing a periodic sweep voltage, means connecting the sweep circuit to the second deflection means to causei the second deflection means, during each sweep of the-periodic sweep voltage, to deflect the electron stream upon the conclusion of the scanning; of. each layer from each scanned layer of. each primary color to the next adjacently disposed layer of similar luminescing primary colon until all of the similarly luminescing primary color layers from the first said similarly luminescing primary-color layer to the last said similarly luminescing primary:-color. layer , .havebeen.scanned.means operable upon the cornpletion of the scanning .of the last layers sand prior to the commencement of each-next following sweep .of: the periodic sweep voltage to add the voltages of-the plurality of voltage-sources in the order of their increase in sequence to the periodic sweep voltage of the sweep circuit; in order to impinge: the electron stream upon the first-layer of .the primary-color next in sequence .to.ithe said first .similarly luminescing primarycolor layer, and means responsive to the.receiving means for :modulating. the electron stream as it scans the;.similarly luminescing:, primary color layers with the received .signals corresponding, to 1

1. A; .system :f or. producing a likeness .of an object in the original: colors of the object having, in combination, Mneans for r-eeeiving signals corresponding to. the objecfcin its three primary colors;; a cathode-jay-tube having a screen provided "with: a.plurality of like sets .of areas-ineluding, a first area.and a last area each .having three like-layers -extending in a first direction constituted:, of material that, luminesces ,ln--re-

sponse to .the:.actipn thereon of an electron stream, .the luminescent material of the; three layers of each, area .luminescing in the primary colors In: sequence .to correspond to the. three primary colors of the object, similarly -luminescing, primary-color layers of-the successively disposed areas, being substantially equally spaced along a second: direction between, a first similarly luminescing primary-color: layer in the: first area and a:last: similarly luminescing: primarycolor layer in the last;area,:Tneans: for: producing an electron stream Jor impinging on the screen, three voltage sources having: predetermined voltage values increasing in sequence to correspond to the spacing between, the first layer and the other layers of each:area, a first, deflection means for deflecting the electron stream: periodically to cause the electron stream to scan the layers suecessively in the first; direction, a: second deflection means; a :sweep: circuit for: producing a. periodic-sweep voltage, means connecting the.sweep circuit to the second, deflection means to cause the second deflection:means, during each sweep of the periodic sweep voltage, to deflect the electron stream upon the conclusion of the scanning of each layer .from each scanned layer: of. each primary color to the next adjacently disposed layer of similar, primary luminescing color until all of the: similarly luminescing .primary-color layers from the first said.similarly luminescing primary-color layer to the last, said similarly luminescing .primary-color layer have been scanned, means operable upon the completion of the scanning.of the last layers, and prior to .the commencement of each, next following: sweep-of the periodic sweep voltage to: add the voltages ?f: tne three voltage sources in- the order of their increase in; sequence to the periodic sweep vdltage of the sweep circuit in order to impinge-the electron stream upon the first layer of the primary color next in sequence to the said first similarly luminescing primary-color, layer, and means: responsive to the receiving means for modulating the electron stream as it

scans the similarly luminescing primary-color layers with the received signals corresponding to the corresponding primary colors of the object.

12. A method of constructing: a luminescent screen that comprises ruling grooves in the iace of the screen to provide a grating,, moistening the screen;, drying the face, of the screen, and inserting luminescent material in the moistened grooves of the screen.

13. A method of constructing a luminescent screen that comprises ruling grooves in the face of the screen to produce a grating, moistening the screen, drying the face of the screen, applying powdered luminescent material to the screen, and dusting the powdered luminescent material off the face of the screen in order to leave the moistened grooves of the screen containing luminescent material.

14. A method of constructing a luminescent screen that comprises ruling several independent gratings on each of several thin transparent sheets, filling the rulings on each sheet with luminescent materials, positioning the sheets to stagger the gratings and joining the positioned sheets to maintain the gratings stagg.ered.

15. A method of constructing a multi-colored luminescent screen that comprises ruling several independent gratings on each of several thin sheets,-filling the rulings on each sheet with a particular - color luminescing material, positioning the sheets to stagger the gratings and joining the positioned sheets of gratings such that the assembly of joined sheets shall provide a screen of interlaced multi-color luminescing rulings.

16. A multi-colored luminescent screen that comprises several thin sheets ruled to provide gratings, the rulings of each sheet being filled with a particular-color luminescing material, and the sheets being joined with the rulings of the respective sheets staggered such that the assembly of joined sheets shall provide a screen of interlaced multi-color luminescing rulings.

17. A color-television receiving system for receiving color-television signals having, in combination, a display-cathode-ray tube having a screen provided with a face ruled with a series of grooves to provide a grating, the grooves being filled with luminescent materials that luminesce in various colors in response to the action thereon of an electron stream, means for producing an electron stream for impinging on the screen, means for deflecting the electron stream in one direction, means for deflecting the electron stream in a second direction at an angle to the said one direction, and means including a motor for connecting successively larger biasing voltages in series circuit with the last-named defleeting means for energizing the last-named deflecting means to cause the electron stream successively to scan luminescent materials that luminesce in similar colors.

18. A system for producing a likeness of -an producing on the screen a likeness of the object object in the original colors of the object having, in combination, means for receiving signals corresponding to differently .colored portions of the object, a cathode-ray tube having a screen provided with a face and means for producing an electron stream impinging on the face, the face being provided with a series of grooved areas filled with phosphors that luminesce in different colors in response to the action thereon of the electron stream to provide differently colored luminescent areas, means for causing the electron stream to scan the face along the luminescent areas, contactor means operated in synchronism with the received signals for connecting bias voltages into circuit with the scanning means to cause the electron stream successively to scan luminescent areas that luminesce in similar colors, and means controlled in accordance with the respective signals received by the receiving means for producing on the screen a likeness of the object, the luminescent areas being caused to luminesce during the scanning in response to the respective signals received by the receiving means to represent the colors of the corresponding portions of the object.

19. A system for producing a likeness of an object in the original colors of the object having, in combination, means for receiving signals corresponding to differently colored portions of the object, a cathode-ray tube having a screen provided with a face and means for producing an electron stream impinging on the face, the face being provided with a series of grooved areas filled with different luminescent materials, means for causing the electron stream to scan

the face, the different luminescent areas of the face being adapted to respond in different colors to the action of the electron stream, contactor means operated in synchronism with the received signals for connecting bias voltages into circuit with the scanning means to cause the electron stream successively to scan luminescent areas that luminesce in similar colors, and means controlled by the signals received by the receiving means for producing on the screen a likeness of the object, the response of different areas of the face to the action of the electron stream being controlled in accordance with the respective received signals to produce upon different portions of the likeness colors corresponding to the colors of the corresponding portions of the object.

20. A system for producing a likeness of an object in the original colors of the object having, in combination, means for receiving signals corresponding to differently colored portions of the object, a cathode-ray tube having a screen provided with a face grooved to provide a grating and means for producing an electron stream impinging on the face, means for causing the electron stream to scan the face along the grooved areas, the face being provided with a plurality of like sets of grooved areas, each set having a plurality of like sub-areas filled with color-responding material, corresponding subareas of the faces being adapted to respond with the same color to the action of the electron stream, contactor means operated in synchronism with the received signals for connecting bias voltages into circuit with the scanning means to cause the electron stream successively to scan sub-areas that respond with the same color, and means controlled in accordance with 5g tne signals received by the receiving means for and for modifying the action of the electron stream upon the sub-areas to cause different portions of the likeness to be colored with the colors of corresponding portions of the object.

21. A system for producing a likeness of an object in the original colors of the object having, in combination, means for receiving signals corresponding to differently colored portions of the object, a cathode-ray tube having a screen and means for producing an electron stream impinging on the screen, means for causing the electron stream to scan the screen, the screen having a face ruled to provide a plurality of like sets of grooved areas, each set having a plurality of like sub-areas filled with color-responding material, corresponding sub-areas of the screen being adapted to respond with the same color to the action of the electron stream, the colprs corresponding to the respective sub areas being: arranged in the.same sequence:in the;sets of areas, means including a: motor-driven .contactor. for connecting-/ bias : voltages inton circuit with:.the scanning, means:for:causing.the /scanning-means: to scan each .corresponding: sub-area of the sets of sub-areas in sequence, and.means controlled in accordance-with-the signals received by-the receiving-means for. producing uponothe sub-areas portions . of a.:, likeness - corresponding to the differently colored: portions .of:the object and:for modifying the action of the: electron stream upon the sub-areas to cause the: said portions of the likeness to be -colored.with the colors of the corresponding.portions.of the.object; 22. A system for producing: a:likeness of an:object in-the-original .colors: of the -object::having, in: combination, means for receiving .-signals cor responding io the1.object in its "primary colors, a cathode-ray display tube having; a luminescent screen- and means for producing: an-electron stream impinging on the.screen,, means f6r:caus ing the electron -stream to scan-the screen,: the screen having.-a face.ruledJto:provide a--plurality of "like sets of .grooved areas, each :set .having- a plurality of like primary color-responsive subareas filled with luminescent material that luminesce:in primary colors; corresponding subareas of the screen being adapted to respond with thesame primary.color to the;actibn of theielectron stream, the primary -colors corresponding t6 the respective .sub-areas .being. arranged In the same sequence in :the sets; of: areas, means "including a motor-driven contactor for connecting-bias voltages into circuit with the scanning-means for causing-the scanning:.means to scan-each correspending .sub-area of the sets of sub-areas in sequence/means for preventing-the scanning means from scanning other sub-areas of the sets .of areas during the-scanning-of particular sub-areas of the sets of areas, and means controlled in-accordance with the signals received by the-reeeiving means for producing upon the -sub-area-portions of the screen superposed likenesses of corresponding portions of the object in their different primary colors.

23. A system .for producing a likeness of an object in the original colors of the object having; in combination, means for receiving signals corresponding-to the object in its -primary colors, a .-cathode-ray display tube having a-luminescent [lowbar][lowbar] object in-the original colors tif the Object having, screen having a face ruled to provide a-gratihg; the. rulings: being filled with luminescent material; and means for producing, an electron-stream 1mpinging,

.on the screen, means for causing- the electron stream to scan the grating, means/co trolled in accordance with the signals received by the receiving means and: comprising a horizontal-sweep-circuit for producing-upon the-screen superposed likenesses: of portions of ;the object in their different primary colors, means compri ing a. vertical-sweep-circuit, for causing the -producing means to produce superposed.likenesses-of the remaining portions of the object in their dif-" ferent primary colors, and motor-driven contactor means operated in. synchronism with the received signals for connecting bias:voltages" into circuit with the vertical-sweep-circuit-to, cause the .electron stream, to produce successive complete superposed likenesses of the object upon the grating in.their different: primary colors,-, 24. A .cathode-ray :,tube- having, a;screen ithat comprises several independent - sets of grooves ruled on :each of several thinr.transparent sheets; the grooves :on : each sheet:itoeing: filled with lumineac:ent. materials :: and, the-sheets being j& sweeps by the horizontal-s eep-cifcaltSUfficieEtjdinedaw.ith-theigj?oovescoflthe=;reiSpective:;sheetS

stagger, and means for producing van" electron stfeam< -for- impingiHgron :"the screens 25. A cathode-rayytube -havinga.a screen-that comprises : several; independent <sets--of grooves ruled on .each::of several -thin- sheets,: the --grooves on: each: sheet beings; filled."- with: --.a-"- particular color-rlumineseing:luminesdeHti"material :arid.-tfte sheetscbeing joinedawith-; the :grdoves;Eof the re specti:ve>:heetsGstaggered such:that:the: assembly of joined sheets provides aisCreen ioff-iaterlafeed malti>-c61or-luffiinescing-grooves,-an dimeans!-Tor produ cing an electron stream-fof-im"i>ingiag"6n the-screen.26. As .cathode-ray tube-shaving asscfeen-tftat comprisesc several independent: sets?of; gtooves ruledSoni reach of::several"thinnsheets, the grooves on each::sheet being"filled.with aJpa-r-ticulaF-colofluminescirigduminescent-material. aiad-the-stieets being: joined with" the grooves: of -the-reSiJeetlve sheet staggered", such that the::assembly;of;goin6d sheets provides a screen: of interlaced.ffiUlti-corbtluminescing grooves, - means for producing an.

electron:.stream;for impinging?on the screen?,1 and means for:causing: the;electron;streaiS3 to -scan successively theMike-colOredfrgfoovesi oS each?.set of:grooves.:

27. A color-television receiving system hiving; intcombination; a::display-cathode-ray;tube .havihg."aiiscreen provided with-" a face rnled witn:"-a series of :.grooves toiprovide afgrating;:the grooves being;, filled with- v luminescent i materials that luminesce in":various .:cordrs;in;.response 46 tBe actioir.;thereon of; an: electron ::stfeani, means ifdr producingan::electron stream.-f6r;impingirigf:on tha:soreen, means.-.for-per-iodically-deflectihg-tlie electron; stream" in one direction, means -for defleeting the electron stream in a:second directibh at an:angle-to the. said.one direction, and=means for connecting successively larger biasing -voltages in :series circuit ".with- the -last-named deflecting means, said: last-named deflecting-means being ad justed: to "deflectthe electronstreani in:-tKe said second;direction during the periods bfetweensuccessive deflections "toy the "first-named deflecting means sufficiently, to: cause the electron stream successively, to scan luminescent material that luminesces in a similar color.

28. A: system for producing a likeness of !ati" in.combinati on; means :for receiving-signals cor responding to ;the object in its primary colors; a;cathode-ray display tube having-a luminescent screen: having! a. faceiruled1 to provide a grating.

the rulings of which are :filled"with luminescent materials that luminesce : in various colors in response to the action of an electron stream1 and means for producing an electron stream imping-ing on the :screen;: means for causing ithe elec-6Q tron stream to scan the grating,means controlled in: accordance with- the--signals received by the receiving - means and comprising: a horizo ntalsweep-circuit for periodically producing upon the screen superposed likenesses of portions -of "the object in their different primary colors, means comprising a vertical-sweep-circuit "for causingthe producing means to produce superposed likenesses of the remaining.:portions of the-objectin their different primary colors, and means operated in synchronism with the received signals-for connecting bias voltages into -circuit with, the vertical-sweep-circuit, the vertical-sweep-circuit being adjusted to deflect the electron stream vertically during the periods between successive ly to cause the electron stream to produce suecessive complete superposed likenesses of the object upon the grating in their different primary col rs- . . . , 4. v. 4. -

29. A mosaic comprising a plurality of sheets 5 1;969)573 each provided with a set of like layers of luminescent

materials, the sheets being disposed in parallel planes with the layers of the respective sheets staggered to interlace them. [lowbar]

30. A method of constructing a luminescent 10 2,287,415 screen that comprises ruling a grating on each of a plurality of sheets, inserting luminescent materials in the rulings on each sheet, and positurning the sheets to stagger the gratings, thereby to interlace them .

31. A multi-colored luminescent screen comprising a plurality of sheets respectively proyided with sets of like layers comprising respectively differently luminescing color luminescent materials, the differently luminescing color lay- 20 2,389,039 ers of the respective sheets being staggered to.

interlace them.

2,415,059 Zworykin [lowbar][lowbar][lowbar][lowbar][lowbar][lowbar][lowbar][lowbar][lowbar][lowbar] Jan. 28, 1947 ituiSJiiti HAK.VJLY KiJNiijb. 2,416,056

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