

United States Patent [19]

Takenaka et al.

[11] 3,860,850

[45] Jan. 14, 1975

- [54] COLOR CATHODE RAY TUBE WITH
COLOR RASTER DISPLACEMENT
CORRECTION
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Japan
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- [30] **Foreign Application Priority Data**
May 18, 1971 Japan..... 46-32975
- [52] U.S. Cl..... **313/428, 313/431**
- [51] Int. Cl..... **H01j 29/62, H01j 29/72**
- [58] Field of Search..... **313/79, 77**

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Primary Examiner—Robert Segal
Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**
In a color cathode ray tube including a triple electron gun assembly composed of three electron gun units arranged in the same plane, there is provided an electron beam control means disposed in the deflection field which is produced by a deflection device so as to properly shield the electron beams of the electron gun assembly from a deflection magnetic field and control the respective deflection angles of the electron beams.

9 Claims, 15 Drawing Figures

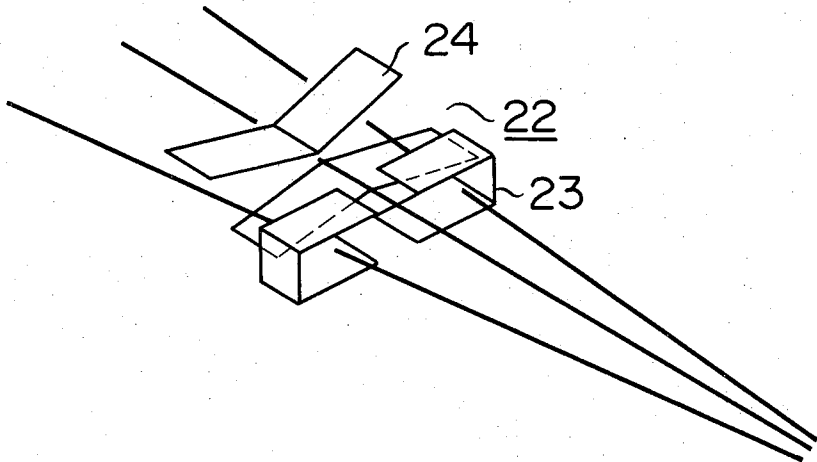


FIG. 1

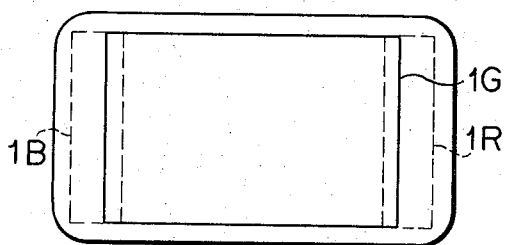


FIG. 2

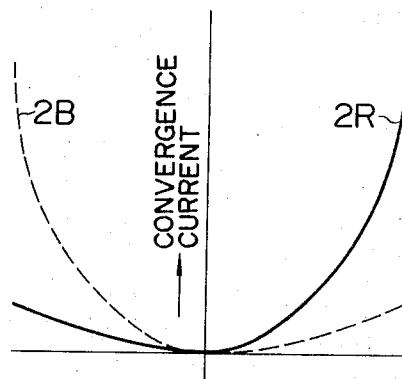


FIG. 3

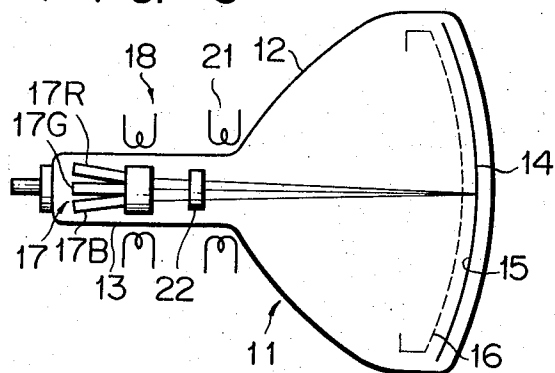
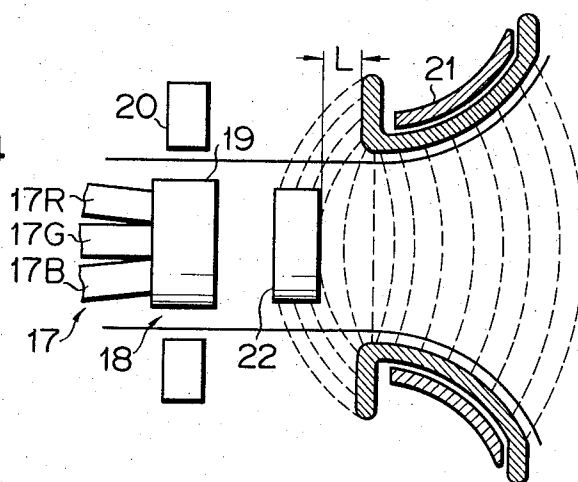


FIG. 4



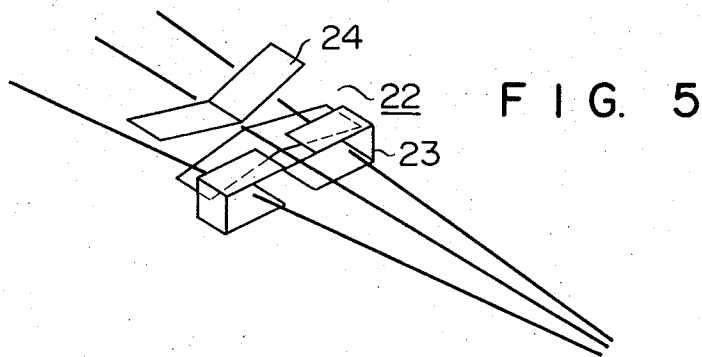


FIG. 5

FIG. 6A

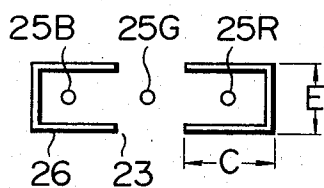


FIG. 7A

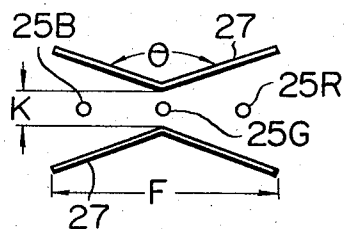


FIG. 6B

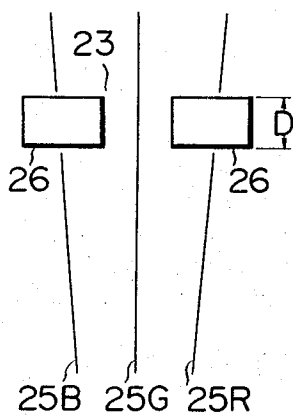
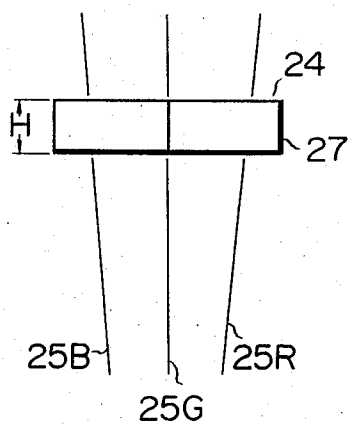


FIG. 7B



SHEET 3 OF 4

FIG. 8

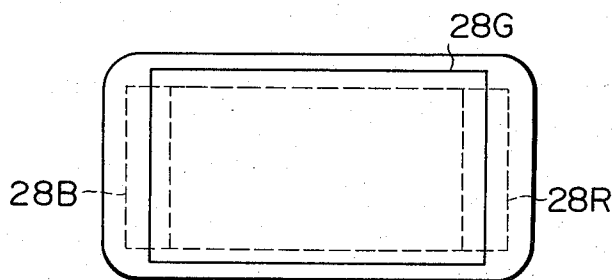


FIG. 9

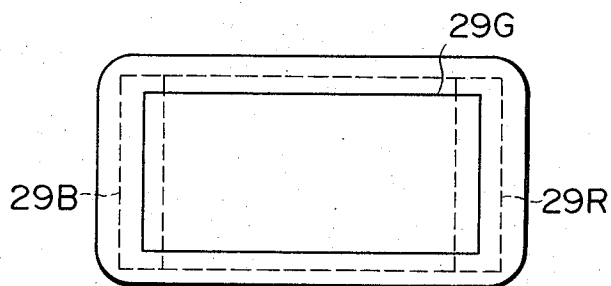


FIG. 10

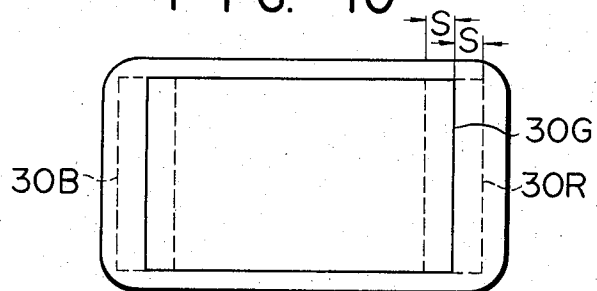


FIG. 11

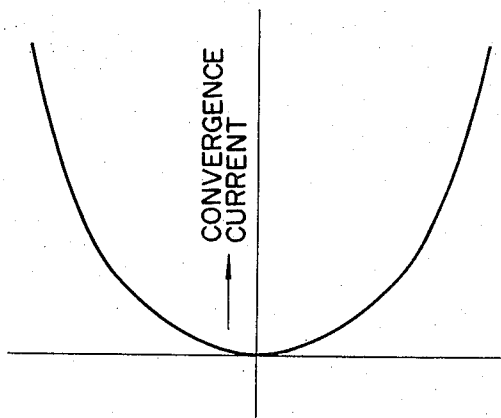


FIG. 12A

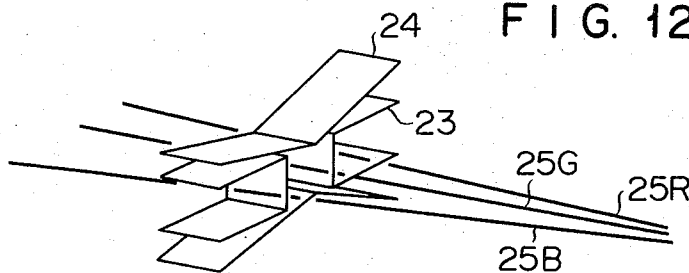
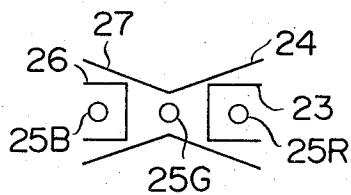


FIG. 12B



COLOR CATHODE RAY TUBE WITH COLOR RASTER DISPLACEMENT CORRECTION

This invention relates to a color cathode ray tube and more particularly to an in-line type color cathode ray tube. Such cathode ray tube comprises a funnel shaped envelope on the front side with a faceplate formed of a fluorescent screen; a triple electron gun assembly composed of three electron gun units arranged in the same plane and received in the neck section of the envelope; a deflection yoke for deflecting electron beams from the electron gun assembly so as to effectively scan the screen; and a convergence device fitted to the beam outlet of the electron gun assembly so as to register three rasters derived from scanning by three electron beams.

In the aforementioned color cathode ray tube, the vertical registration of rasters is effected by a deflection yoke for generating a regular pin cushion-shaped horizontal deflection magnetic field and a regular barrel-shaped vertical deflection field. The horizontal registration of rasters is attained by their dynamic convergence. Thus the rasters are fully registered all over the screen.

Where there is not applied dynamic convergence, there are formed on a screen 15 rasters 1B, 1G and 1R with the side rasters 1B and 1R unequally displaced, as shown in FIG. 1, from the central raster 1G in a horizontal plane on both sides of the screen 15. For proper registration of such rasters, there must be introduced through a convergence coil two extremely unbalanced convergence currents 2B and 2R in synchronization with a current for creating a horizontal magnetic field. Generation of such unbalanced currents unavoidably leads to a complicated circuit for obtaining said currents.

It is accordingly the object of this invention to provide a cathode ray tube comprising such an electron beam control means as enables the side rasters to be equally displaced from the central raster in a horizontal plane on both sides of the screen so as to simplify the arrangement of said convergence circuit.

SUMMARY OF THE INVENTION

A color cathode ray tube according to this invention comprises a funnel shaped envelope having neck and conical sections; a triple electron gun assembly received in the neck section; a faceplate coated with a color screen consisting of a plurality of groups of three fluorescent elements producing red, green and blue lights; and a shadow mask so disposed as to face the color screen. Said triple electron gun assembly is formed of three electron gun units arranged in the same plane. The convergence device has a convergence pole piece assembly mounted on the outlet portion of the electron gun assembly and a convergence coil assembly disposed around the section of the funnel shaped envelope. Around the periphery of the envelope is fitted a deflection yoke for deflecting electron beams from the electron guns. Within the deflection field from the deflection yoke is provided an electron beam control means. This control means comprises first control member for decreasing the horizontal deflection angles of the side electron beams from the side electron gun units as compared with the similar deflection angle of the central electron beam from the central control gun unit and second control member for reducing to a verti-

cal plane of the central electron beam as compared with the similar deflection angle of the side electron beams. Addition of said control means enables the side rasters formed on the screen through scanning by the side electron beams passing through said control means to be equally displaced from the central raster derived from the central electron beam. Such equal displacement of the side electron beams permits the introduction of convergence currents symmetrical with each other into the convergence device, thereby simplifying the arrangement of a circuit for generating said convergence currents.

The present invention can be more fully understood from the following detailed description when taken in connection with the accompanying drawings, in which:

FIG. 1 shows the arrangement of three rasters formed in a prior cathode ray tube where the electron beams are not subjected to dynamic convergence;

FIG. 2 illustrates the wave forms of convergence currents flowing through the convergence coil assembly of the prior art cathode ray tube;

FIG. 3 is a sectional view of a cathode ray tube according to an embodiment of this invention;

FIG. 4 is a sectional view enlarged in part of the cathode ray tube of FIG. 3;

FIG. 5 is a perspective view of an electron beam control means;

FIG. 6 indicates the first control member of the electron beam control means: FIG. 6A is a front view and FIG. 6B is a plan view;

FIG. 7 shows the second control member of the electron control means; FIG. 7A is a front view and FIG. 7B is a plan view;

FIG. 8 presents the arrangement of rasters formed by electron beams passing through the first control means;

FIG. 9 illustrates the arrangement of rasters formed by electron beams passing through the second control member;

FIG. 10 indicates the arrangement of rasters formed by electron beams conducted through both first and second control members;

FIG. 11 shows the wave form of convergence current introduced through the convergence coil assembly of the cathode ray tube of this invention; and

FIG. 12 illustrates an electron control means according to another embodiment of the invention: FIG. 12A is a perspective view and FIG. 12B is a front view.

Referring to FIGS. 3 and 4, the color cathode ray tube comprises a funnel shaped envelope 11 having a conical section 12 and a neck section 13; a faceplate 14 fitted to the front side of the envelope 11; a fluorescent color screen 15 formed of a plurality of groups of three fluorescent elements producing red, green and blue lights and coated on the inner wall of the faceplate 14; a shadow mask 16 disposed opposite to the screen 15; and an in-line type triple electron gun assembly 17 composed of three electron gun units 17R, 17G and 17B arranged in the same plane and received in the neck section 13. Referring to FIG. 4, the convergence device 18 includes a convergence pole piece assembly 19 mounted on the beam outlet portion of the electron gun assembly 17 and a convergence coil assembly 20 disposed around the periphery of the neck section 13 so as to surround the convergence pole piece assembly 19. Around the boundary between the neck section 13 and the conical section 14 is fitted a deflection yoke 21 so as to deflect electron beams from the electron gun

assembly 17. This deflection yoke 21 generates a regular pin cushion-shaped horizontal deflection magnetic field and a regular barrel-shaped vertical deflection magnetic field. Particularly a cathode ray tube according to this invention effectively acts on said deflection magnetic fields. There is further provided an electron beam control means 22 in an electron beam passageway defined between the electron gun assembly 17 and the deflection yoke 21, more particularly in the magnetic field created by the deflection yoke 21.

Referring to FIG. 5, the electron beam control means 22 includes first and second control members 23 and 24. The first control member 23 is formed of a pair of C-shaped (or U-shaped) elements 26 prepared from material of high magnetic permeability and, as shown in FIG. 6A, so disposed as to surround the side beams 25B and 25R, with the open sides of said C-shaped (or U-shaped) elements 26 disposed opposite to each other. The second control member 24 is composed of a pair of V-shaped elements 27 made of material of high magnetic permeability and, as shown in FIG. 7A, so disposed as to face each other with the electron beams 25B, 25G and 25R allowed to pass therebetween. The apices of the convex surfaces of said V-shaped elements 27 are positioned in the passageway of the central electron beam 25G.

There will now be described the aforementioned control means 22. The first control member 23 properly shields the side electron beams 25B and 25R from a horizontal deflection magnetic field, thereby decreasing the horizontal deflection angles of the side beams 25B and 25R from that of the central electron beam 25G. If the first control member 23 is formed with a suitable shape and size and properly positioned, then the side electron beams 25B and 25R will be desirably shielded from the horizontal magnetic field, thereby enabling the side rasters 28B and 28R (FIG. 8) resulting from scanning by the side beams 25B and 25R to be equally displaced on both sides of the screen from the central raster 28G derived from scanning by the central beam 25G. The first control member 23 slightly shields the side electron beams 25B and 25R from a vertical deflection magnetic field, so that the side rasters 28B and 28R are more reduced in vertical width than the central raster 28G, thus presenting such a raster pattern as shown in FIG. 8. The second control member 24 increases the horizontal deflection angle of the central beam 25G over those of the side electron beams 25B and 25R with respect to the horizontal deflection magnetic field, and decreases the vertical deflection angle of the central electron beam 25G from those of the side electron beams 25B and 25R, thus obtaining such a raster pattern as illustrated in FIG. 9. If the second control member 24 is formed with a suitable shape and size and properly positioned, then the side rasters 29B and 29R will be equally displaced from the central raster 29G in a horizontal plane, causing the vertical width of the central raster 29G to be reduced to an extent equal to the contraction of the vertical width of the side rasters 29B and 29R resulting from their passage through the first control member 23.

In practice, the length C, width D and depth E of the elements 26 of the first control member 23 of FIG. 6 and the length F, width H and interspace K of the elements 27 of the second control member 24 of FIG. 7 are experimentally so determined as to cause the rasters to contain the various components constituting the

raster pattern of FIG. 1 as well as those forming the raster pattern of FIG. 8 or 9. The position of the control means 22 with respect to the deflection yoke 21 is determined by computing from the following equations the distance L_{1x} between the deflection yoke 21 and the first control member 23 and the distance L_{2x} between the deflection yoke 21 and the second control member 24.

$$10 \quad \{M_1 - \Delta M_1(L_1 - L_{1x})\} + \{M_2 - \Delta M_2(L_2 - L_{2x})\} = S \quad (1)$$

$$N_1 - \Delta N_1(L_1 - L_{1x}) = N_2 - \Delta N_2(L_2 - L_{2x}) \quad (2)$$

In the above equations, M denotes increases in the horizontal displacements of the side rasters over that of the central raster. Said increase represents a difference between the horizontal displacements of the side rasters from the central raster where the electron beams do not pass through the beam control means 22, and the horizontal displacements of the side rasters from the central raster where the electron beams are conducted through the beam control means 22. N represents the increased or decreased vertical displacements of the side rasters with respect to the central raster when determined in the same manner as the horizontal displacements; ΔM and ΔN show the variation of M and N with a 1 millimeter change of the distance between the deflection yoke 21 and the control means 22; the suffixes 1 and 2 correspond to the first and second control members 23 and 24; and S indicates the horizontal displacements of the side rasters from the central raster.

If the shape, size and position of the first control member 23 are rigidly defined, it may be sufficient to attain equal horizontal displacements of the side rasters from the central raster. In fact, however, there take place the vertical displacements of the side rasters, so that provision of only the first control member 23 fails to obtain a desired raster pattern. Accordingly, there is additionally used the second control member 24 so as to correct the arrangement of rasters derived from the action of the first control member 23, thereby obtaining a desired raster pattern shown in FIG. 10. Such desired raster arrangement enables mutually symmetrical currents to be introduced through the convergence coil assembly intended for full registration of the rasters, thus simplifying the construction of a convergence current generating circuit.

There will now be described by reference to FIG. 12 another embodiment of this invention. The C-shaped (or U-shaped) first control elements 26 surround the side beams 25B and 25R respectively, with their closed end faces disposed opposite to each other. The V-shaped second control elements 27 are so arranged that said first control elements 26 are disposed between the convex surfaces. The apices of said convex surfaces are aligned with the passageway of the central beam 25G. According to the embodiment of FIG. 12, the first and second control members 23 and 24 are disposed equidistant from the deflection yoke 21, thereby reducing the space occupied by the control means 22 in the neck section of the funnel shaped envelope 11 and in consequence the length of a cathode ray tube. Since the deflection yoke 21 of the colour cathode ray tube is generally allowed to be shifted within the range of about

2 mm in the axial direction of the tube for adjustment of color purity, the aforesaid control means has to be so designed as to prevent the rasters from making prominent displacements even with said shifting of the deflection of yoke 21.

What we claim is:

1. A color cathode ray tube comprising:
an envelope including a neck portion, a conical portion and a face plate;
a fluorescent screen formed on the inner surface of said face plate;
a shadow mask disposed close to said fluorescent screen;

electron gun means for projecting a central electron beam and a pair of side electron beams, said beams being disposed in the same plane and being directed toward said fluorescent screen through horizontal and vertical deflection fields produced by an electromagnetic deflection yoke device; and

electron beam control means for equalizing the sizes of the rasters produced by said electron beams on the screen, said electron beam control means being disposed adjacent the path of said electron beams and in the region of the horizontal and vertical deflection field between said electron gun means and said deflection yoke so as to cooperate with said deflection yoke to modify the flux distributions, and including:

a first control member including a pair of similarly shaped control elements of high magnetic permeability around respective side beams along a given length of travel of the side beams, said control elements shielding the side beams from both horizontal and vertical deflection fields to reduce both horizontal and vertical deflection flux acting on the side beams as compared with that acting on the central beam; and

a second control member including a pair of control elements of high magnetic permeability and symmetrically located equidistantly above and below the plane of the beams and symmetrical with the first control elements, the elements of said second control member both being similarly shaped, said second control member being located to modify the flux distribution in the region of the central beam so as to enhance the horizontal deflection flux acting on the central beam as compared with that acting on the side beams and to modify the flux distribution in the region of the central beam so as to reduce the vertical deflection flux acting on the central beams as compared with that acting on the side beams.

2. The color cathode ray tube of claim 1 wherein said electron gun means has an outlet end for projecting said electron beam, said second control member is disposed near to the electron beam outlet end of the electron gun means and said first control member is separately juxtaposed to said second member on the side of said fluorescent screen.

3. The color cathode ray tube of claim 1 wherein said first and second control members are disposed at substantially the same position in the deflection field.

4. The color cathode ray tube of claim 1 wherein said first control member comprises a pair of generally U-shaped elements and said second control member comprises a pair of convex elements, the apices of said convex elements being aligned in a plane which is directed in the travelling direction of the central beam and which is perpendicular to the plane of the beams.

5. The color cathode ray tube of claim 4 wherein said convex elements are generally V-shaped elements.

6. The color cathode ray tube of claim 1 wherein said first control member comprises a pair of generally U-shaped elements respectively shielding said side beams with the open ends of said U-shaped elements mutually facing each other and with the upper and lower sides of said U-shaped elements terminating short of the central beam.

7. The color cathode ray tube of claim 6 wherein said second member comprises a pair of generally V-shaped elements facing each other with said beams passing therebetween, the apices of said V-shaped elements being directed toward each other and being positioned in the passageway of said central beam, the apices of said V-shaped elements being aligned in a plane which is directed in the travelling direction of the central beam and which is perpendicular to the plane of the beams.

8. The color cathode ray tube of claim 1 wherein said first control member comprises a pair of generally U-shaped elements respectively shielding said side beams, the open ends of said U-shaped elements being directed away from each other.

9. The color cathode ray tube of claim 8 wherein said second member comprises a pair of generally V-shaped elements facing each other with said beams passing therebetween, the apices of said V-shaped elements being directed toward each other and being positioned in the passageway of said central beam, the apices of said V-shaped elements being aligned in a plane which is directed in the travelling direction of the central beam and which is perpendicular to the plane of the beams.

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