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COLOR-KINESCOPES ETC

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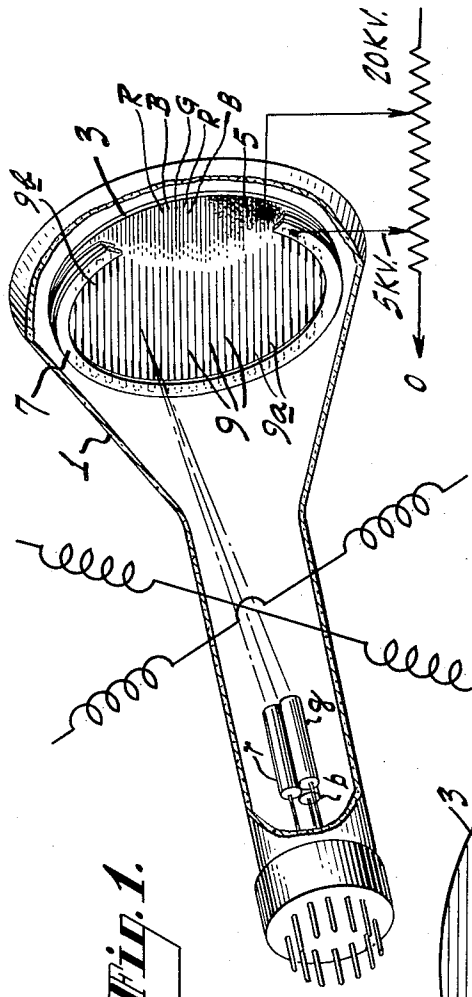


Fig. 1.

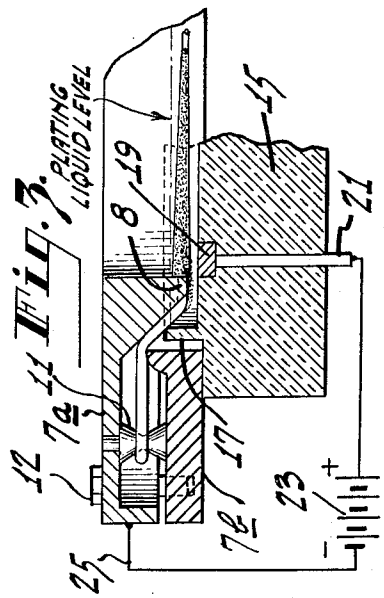


Fig. 3.

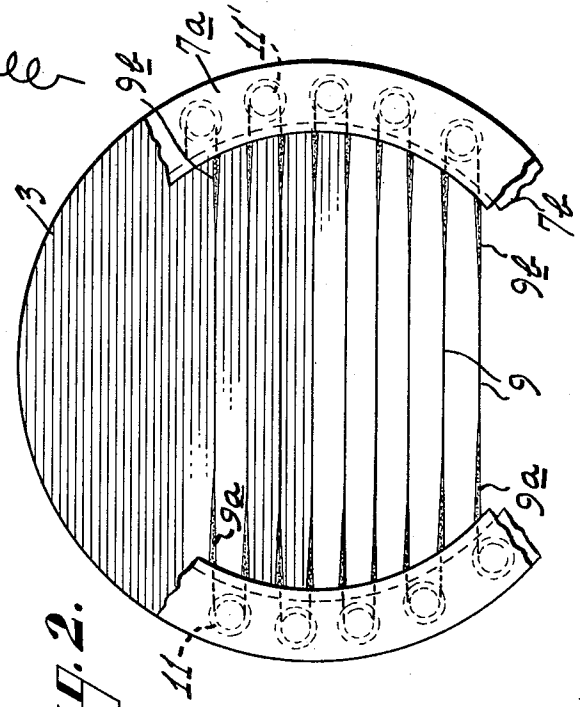


Fig. 2.

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COLOR-KINESCOPES ETC.

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7 Claims. (Cl. 313—80)

This invention relates to improvements in color-kinescopes, camera tubes and other cathode-ray (CR) tubes of the kind containing a screen-unit or "target assembly" comprising one or more parallel-wire grills through which beam electrons pass in their transit to a nearby screen.

The wire grills used in cathode-ray tubes of the general character described are often composed of very fine wire, for example .003" diameter, tautly strung upon a rigid frame. When, as is usually the case, the grill wires are used as cylindrical electron-lenses, any reinforcement interconnecting the wires (for purposes of preventing vibration) would upset the lens-field. Furthermore, such reinforcements cast their shadow upon the screen and mar the picture sketched on the screen by the moving pencil or beam of electrons. In a color-kinescope if the wires do vibrate, unwanted color changes appear on the screen because of the change in position of the electron-beam as a result of the instantaneous changes in position of the wires.

Observations of grill structures, in operation, both in sealed-off tubes and in demountable setups, indicate that vibrations may occur at frequencies that are harmonics of the vertical-scan frequency. Vibrations of large amplitude have been observed under conditions where there is resonance between the driving force and some natural harmonic of the wires. The driving force may be of any of several origins. For example; mechanical tremors of external origin; a ripple in the power supply feeding the voltage to the grills; small changes in force between the grills due to the IR drop in the wires in carrying away the intercepted beam current and, possibly, small stray fields present at the grills and derived from the scanning yoke.

A method for reducing exciting force of electrical origin (e. g., the force due to the IR drop in the thin-wire) has been disclosed by Harrison S. Allwine in copending application Serial No. 345,891, filed concurrently herewith. Allwine's method of minimizing wire-vibration involves lowering the electrical resistance of the grill as by applying a coating of copper or other highly conductive metal to the wire. The vibration-exciting forces of electrical origin are reduced in this way, nevertheless if the energy that is imparted to the wire by the beam or beams is more, per cycle, than that lost by the wires, per cycle, by damping, it is then still possible that the amplitude of vibration may build up to an objectionable value.

Accordingly, the principal object of the present invention is to provide a screen-unit having a parallel-wire grill which shall operate without the addition of auxiliary reinforcing bars or cross-wires to damp wire-vibration irrespective of its (electrical or mechanical) origin and substantially irrespective of its frequency and amplitude.

Stated generally, the foregoing and related objects are achieved, in accordance with the present invention, by the provision within a CR tube of a screen-unit including a fine-wire grill wherein the wire or wires taper off toward the center-line of the screen from the frame upon which said wire or wires are supported. The effect of the taper

is to promote absorption of the energy of vibration over a wide range of frequencies.

The invention is described in greater detail in connection with the accompanying single sheet of drawings, wherein:

Fig. 1 is a partly diagrammatic view in perspective of a 3-gun cathode-ray tube containing a screen-unit including a parallel-wire grill constructed in accordance with the principle of the invention;

Fig. 2 is a partly broken away elevational view of the grill of Fig. 1 showing the tapered contour of the grill wire;

Fig. 3 is a sectional view of a plating "tank" with the grill wire in position to receive its tapered deposit of copper or the like.

Fig. 1 shows the invention as applied to a color-kinescope 1 of the so-called "3-gun, line-screen" variety, first disclosed by Dr. Flechsig in French Patent 866,065 of 1941 (and its German equivalent, No. 736,575 of 1943). The three electron-guns, *r*, *b* and *g*, are individual to the different color-phosphor R (red) B (blue) and G (green) on the screen and are here shown arranged "delta (Δ) fashion," with common beam deflecting coils C^1C^2 in the manner claimed by Alfred C. Schroeder in U. S. Patent 2,595,548.

Here the screen-unit comprises a transparent screen plate 3 marked on its rear or target surface with a multiplicity of groups of lines R, B and G arranged in a repetitive pattern and constituted of phosphor materials of different color-response characteristics, such, for example, as red (R), blue (B) and green (G), respectively. The phosphor surface of the screen is covered all over with an electron-transparent, electrically continuous, conductive coating 5 constituted, for example, of evaporated aluminum of from, say 1000 to 10,000 angstrom units thick.

The grill with which the present invention is especially concerned, is mounted closely adjacent to the conductive target surface 5 of the color-screen. It comprises a metal frame 7 and, conveniently, a single wire 9 (see Fig. 2) wound back-and-forth tautly, on pins 11—11' parallel to the phosphor-lines R, B and G on the screen-plate, there being one grill aperture (i. e., two adjacent lengths of wire) for each group (R, B and G) of phosphor lines.

As shown in the drawing, each of the parallel parts of the wire 9 is provided, in accordance with the invention, with a pair of oppositely located tapered portions 9*a* and 9*b* which extend inwardly a short distance (say, an inch or so) from the inner periphery of the frame toward the center line of the grill. Each of these parallel parts of the wire is very tightly stretched on the frame 7 and, to this end, should comprise a metal of great tensile strength such, for example, as nichrome (nickel 80%, chromium 20%), stainless steel, steel, tungsten or equivalent metal or alloy. To ensure the requisite tautness of the wire its frame 7 may comprise two separable parts or rings 7*a*, 7*b* (see Fig. 3) one of which is provided with a rim 8 about its inner periphery, which exerts a stretching force on the wire when the rings are assembled, as by means of clamps or screws 12.

In carrying the invention into effect it is convenient to start with copper (or silver) plated nichrome (or similar) wire of the requisite fine gauge and tensile strength and to string and clamp the wire on its frame 7 prior to furnishing it with its tapered reinforcements 9*a*, 9*b*. The tapered portions 9*a*, 9*b* may be applied simultaneously to all of the parallel sections of the wire as by an electroplating operation, illustrated in Fig. 3.

The plating equipment shown in Fig. 3 comprises a base 15 constituted of insulating material and provided with a circular rim 17 of a diameter slightly larger than that

of the inner diameter of the frame member 7*a* over which the wire 9 extends. The rim 17 on the insulating base 15 serves as the wall of a tank for the acid of the plating bath. The copper, silver, or other preferably highly conductive metal 19 to be used in building up the tapers is contained in a groove provided for the purpose at the bottom of the tank.

The metal 19 to be applied to the wire 9 is the anode of the system and is connected as through a lead to the positive pole of a source of direct current, exemplified by the battery 23. The circuit is completed by connecting a negative lead 25 to part 7*a* of the frame.

It will be observed upon close inspection of Fig. 3 that the inner boundary of the frame 7 for the grill wire 9 lies substantially in register with the ring-shape anode 19 of plating metal. As a consequence when the plating current is turned on the maximum amount of metal is applied to the wire at the region where the wire is in contact with the inner periphery of the frame, and progressively smaller amounts are plated upon the wire at progressively greater distances from the metal anode 19. The thick end of the taper becomes integral with the frame. Here there is a gradual, not an abrupt, change in the flexibility of the system. Bonding the wire to the frame, by the plating operation, also serves to minimize the electrical resistance of the assembly. In the case of an .003" wire satisfactory performance is ensured when the maximum thickness of the tapered metal 9*a* and 9*b* is of the order of from 5 to 15 mils. Wire of heavier gauge (such as may be used if the grill is operated as a "shadow mask") ordinarily requires a proportionately thicker taper.

Grill wires tapered in accordance with the invention have been found many times more effective than non-tapered wires in damping vibrations. The damping action of the taper is effective over a wide range of amplitudes and frequencies. Without limiting the invention to any particular theory of operation it may be said that different parts of the taper may exert their damping action most effectively on different amplitudes and frequencies of wire vibration. Thus, in the case of large amplitude low-frequency vibrations (such as may be created by shocks and tremors of external origin), the thicker portion of the taper may provide the requisite damping action whereas in the case of low amplitude high-frequency vibrations (such as may be caused by internal electrical stresses) the thinner portion of the taper may do the damping.

The present invention is obviously not limited in its useful application to color-kinescopes of either the single or plural grill variety but can be employed to advantage

in color-cameras and indeed to any tube utilizing a parallel-wire grill.

What is claimed is:

1. A cathode-ray tube comprising an electron-gun and a screen-unit mounted in a position to be scanned by electrons from said gun, said screen-unit including a taut fine-wire grill through the openings in which electrons pass in their transit from said gun to a near-by electron-sensitive screen, the fine-wires of which said grill is comprised having oppositely located vibration-damping terminal portions of a larger diameter than that of their intermediate portions.

2. The invention as set forth in claim 1 and wherein said fine-wires comprise a core constituted of a metal of great tensile strength, and a coating of metal of low electrical resistance provided at said terminal portions with a superimposed metal-layer.

3. A cathode-ray tube comprising an electron-gun and a screen-unit mounted in a position to be scanned by a beam from said gun, said unit including a ray-sensitive screen, a fine-wire grill and a frame upon which said fine-wire is supported, said wire having a taper adjacent to the places at which it is supported.

4. The invention as set forth in claim 3 and wherein the taper on said wire comprises a deposit constituted of a highly conductive metal.

5. A cathode-ray tube comprising an electron-gun and a screen-unit mounted in a position to be scanned by a beam from said gun, said unit including a ray-sensitive screen, a fine-wire grill and a frame upon which said fine wire is tautly stretched along parallel lines extending across said screen, said wire having oppositely located inwardly directed tapered portions adjacent to said frame.

6. The invention as set forth in claim 5 and wherein the thick end of said tapered portions of said wire are integral with said frame.

7. The invention as set forth in claim 5 and wherein said fine-wire comprises a core of a diameter of about .003" and said tapered portions having a miximum diameter substantially no greater than .015".

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