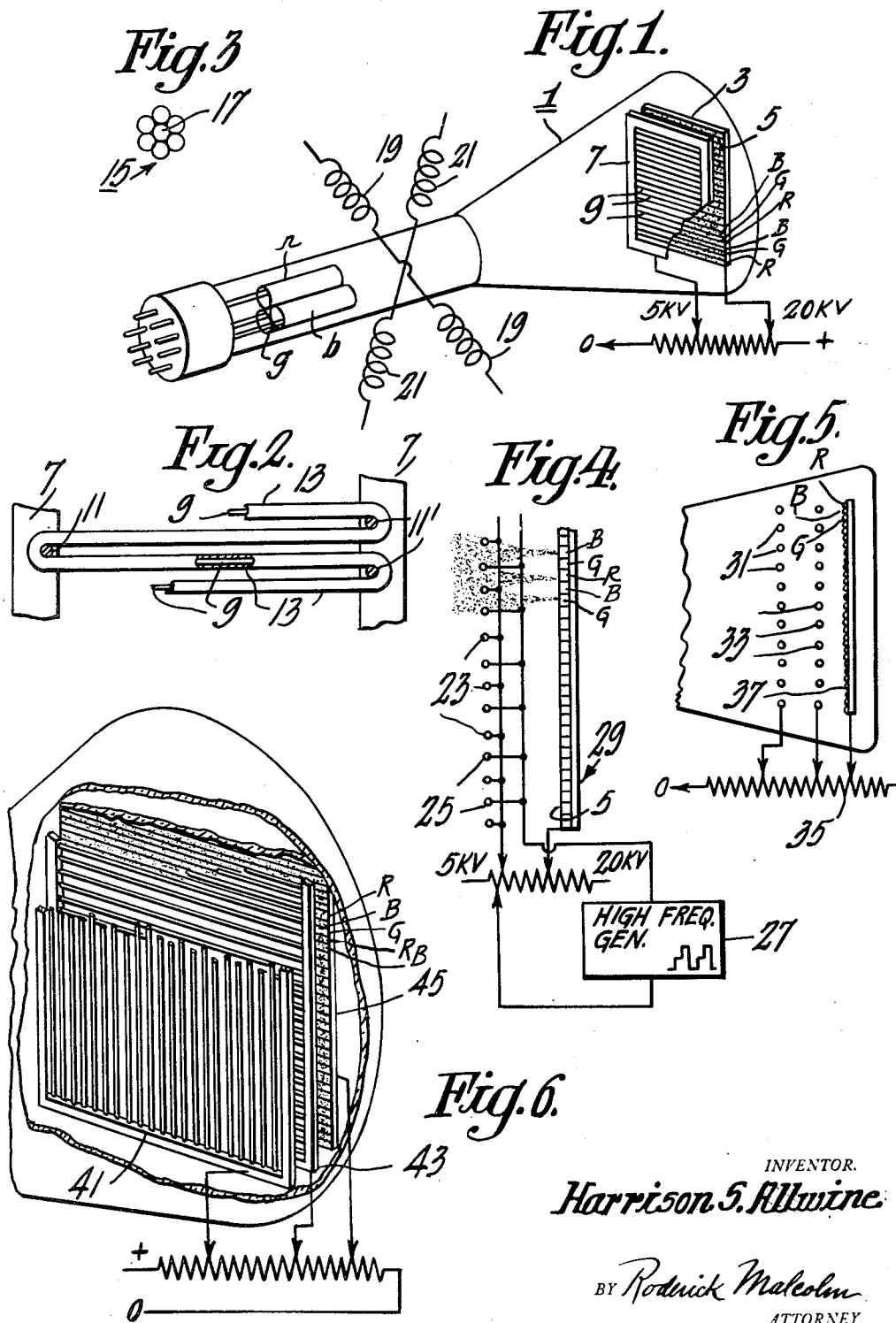


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COLOR-KINESCOPIES ETC
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COLOR-KINESCOPES, ETC.

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

The principal object of the invention is to reduce wire vibration and thus to reduce color-dilution, loss-of-contrast and other image-defects resulting from grill-wire vibration.

The problem of grill-wire vibration in CR tubes of the general character described has long been recognized and several ways of solving it have heretofore been proposed. By way of example; Dr. Flechsig in his 1941 French Patent 866,065 discloses a color line-screen unit including a grill comprising "a series of parallel metal wires whose spacing is maintained by several very fine wires positioned at right angles to the first wires." One very real objection to re-inforcing wires (however thin they may be) is that their shadow mars the image sketched on the screen by the moving pencil of electrons. Another proffered solution of the problem involves the use of relatively thick and strong reinforcing rods or "damping bars" and a number of auxiliary electron-lens elements for re-uniting the beam after it is split by said rods or bars. Still another proposal involves the use of a multiplicity of spring-like supports for damping the vibration of each length of wire. Irrespective of the efficacy of such proposals it may be said that they are far more complicated and expensive than is desirable in a "home instrument," or one which should be produced by mass-production methods.

Accordingly, another and important object of the present invention is to provide a vibration-free color-kinescope which, by reason of the simplicity and economy of its parts, lends itself readily to mass-production methods.

Stated generally, the foregoing and related objects are achieved in accordance with the invention by constructing the grill (or grills) of high tensile strength wire having an effective resistance many times lower than that exhibited by the taut wire grills of the prior art. The lower effective resistance of the grill wire lowers the voltage excitation caused by scanning and this in turn reduces the tendency of the wire to vibrate. Optimum freedom from vibration is achieved when the screen and other elements, if any, of the target assembly, to which the grill is capacitively coupled, also exhibit a very low value of resistance. The high tensile strength and low

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resistance of the grill, required by the invention, may be achieved either (a) by plating a wire having the requisite high tensile strength with a metal of low electrical resistance or (b) by using a twisted cable in which some of the strands are of high tensile strength material and the other or others consist, essentially, of copper or similar (e. g., silver or aluminum) substance of low electrical resistance.

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

Fig. 1 is a partly diagrammatic view in perspective of a 3-gun, single-grill color-kinescope embodying the invention;

Fig. 2 is a fragmentary view on an enlarged scale of a part of the grill-wire and frame of the screen-unit of Fig. 1;

Fig. 3 is an end view of a multi-strand cable which may be used in place of the plated wire of Fig. 2;

Fig. 4 shows the invention applied to a color-tube of the so-called "post-deflected" variety having a bi-part co-planar beam-deflecting grill, similar to the one shown in Schroeder 2,446,791;

Fig. 5 is a longitudinal sectional view of the viewing chamber of a color-kinescope containing a screen-unit including two plated wire grills arranged with their wires in register with each other to form the elements of a compound cylindrical lens; and

Fig. 6 is a view in perspective of a line-screen unit having two plated-wire grills arranged with the wires of one grill parallel to the color-lines and the wires of the other grill at right angles to the first grill, as taught by Edward G. Ramberg in copending application Serial No. 277,182.

When a wire grill is scanned in conventional television raster fashion, some of the beam current is intercepted by the grill wires and flows through them to the frame, causing a voltage drop because of the resistance of the wires. When, as is usually the case, the grill is mounted close to another "field electrode" (such as a metalized phosphor screen or another grill) there is an electrostatic force on each wire tending to bow it toward the other electrode. When the voltage on either is changed, the force on the wire changes also, being proportional to the square of the voltage difference existing between the wire and the other electrode.

Because of the nature of the scanning process, the current in any given wire is in the form of pulses, and normally contains components that

correspond to the horizontal and vertical scanning frequencies and their harmonics.

The resistance through which the beam current flows, while in the wire, is constantly changing, also, being a maximum when the beam strikes the middle of the wire, and practically zero when it strikes the end. This, together with the pulsed nature of the current, causes the voltage change to have strong components in the two scan-frequencies and their harmonics.

In addition, the point of impact, and therefore the point of maximum voltage change, is, for part of the time, near the middle of the wire, where a change in force has the maximum ability to cause fundamental frequency vibrations, and at other times near the end, where this ability approaches zero.

Because the tension may differ slightly from wire to wire, and differs in the same wire from time to time as changes in picture brightness cause changes in the wire temperature, the fundamental frequencies of vibration extend over a large range. It is inevitable, therefore, that at some time the resonant frequency of one or more wires will coincide with some harmonic of a scan frequency (generally of the vertical scan frequency).

When this happens, the tendency of the wire to vibrate is greatly increased and, if there is also some slackening of the wire due to heating from electron bombardment, the amplitude of vibration can readily cause enough shift in the shape or position of the cylindrical electrostatic lens to cause electrons to strike the wrong color phosphor strip.

When very thin wires are used, to allow high transmission and consequently bright pictures, the effect is aggravated because the thinner wires have higher resistance, causing the excitation to be increased. Also, having less mass, a given excitation can cause vibrations of greater amplitude.

Enlarging the screen-unit also adds to the difficulty, because the longer wires have more resistance, and also vibrate with greater amplitude for a given value of voltage swing.

In large tubes, wire having a tensile strength not less than that of Nichrome is usually required to reduce to a minimum the sag of the wires under the steady force of a strong field. But wires of such high tensile strength are, unfortunately, relatively poor conductors and their use aggravates the vibration problem by causing greater voltage swings when the grill is scanned.

In accordance with the present invention a very substantial reduction in the exciting force is obtained by the use of a relatively thin plating of a good conductor, such as copper or silver, on the wires. In this manner, a stainless steel wire 0.003" in diameter and 18" long, with a resistance of about 150 ohms, can easily have its resistance reduced by a factor of 10, by a plating of copper which brings its diameter up to about 0.0035". This reduces the excitation by a similar factor and so minimizes the possibility of vibration.

Fig. 1 shows the invention as applied to a color-kinescope 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). 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 at least one thousand 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. The wire, or each cross-piece thereof, is very tightly stretched on the frame 7 and, to this end, should be formed at least in part of a metal of great tensile strength such, for example, as Nichrome (nickel 80%, chromium 20%), stainless steel, steel, tungsten or the like. In order to achieve the low value of electrical resistance necessary to the practice of the invention the wire 9 may be provided with a coating 13 of copper or of silver or other highly conductive metal, as shown in Fig. 2, or it may be constructed in the form of a twisted cable, Fig. 3, made up of a number of strands some of which are constituted of steel or the like and at least one strand 17 of copper or similar (low resistance) metal.

As taught in the Flechsig foreign patents, the screen 5 and its grill 9 may be operated either at the same potential or with the screen at a potential higher than that of the grill. In the latter case, here illustrated, electrons passing between the parallel wires are subjected to the focusing action of a cylindrical electron-lens field which is set up in the grill-screen space by reason of the difference in potential between said parts of the screen-unit. In the instant case the "red," "blue" and "green" electron-guns (r, b and g, respectively) are arranged delta-fashion with common horizontal and vertical deflection coils 19 and 21, as taught in U. S. Patent 2,595,548 to Alfred C. Schroeder.

Figs. 4, 5 and 6 are included to show that the invention is not limited in its useful application to the single grill tubes of the Flechsig type, but may be applied to cathode-ray tubes of other varieties, including various types of plural-grill tubes. The color-screen unit shown in Fig. 4 is of the "switching-at-the-screen" variety described in U. S. Patent 2,446,791 to Alfred C. Schroeder. Here the grill is made up of alternate and intermediate sets of wires 23 and 25, respectively, to which color-switching voltages may be applied as by a square-wave (or sine-wave) generator 27. As described in the Schroeder patent the grills are co-planar and the color phosphor lines on the screen are in a sequence such as R G R B R G R (instead of R B G R B G). Here both parts of the bi-part grill will be understood to be constructed, in accordance with the present invention, of "composite wire," either of the "plated" type shown in Fig. 2 or the "twisted cable" type shown in Fig. 3. As in the Flechsig patents, the conductive screen plate 29 is maintained at a potential higher than that of the grill in order to establish a cylindrical lens-field in the grill-screen space.

Fig. 5 shows a color-screen unit similar to the

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one shown in Fig. 1 but having two parallel-wire grills 31 and 33 spaced apart in parallel planes with the wires in exact register with each other and connected to points of successively higher voltages on a voltage divider 35 to provide a "compound" cylindrical lens field. Here the number of wires in each of the grills 31 and 33 corresponds substantially to the number of groups of red (R) blue (B) and green (G) phosphor lines on the metalized screen 37. As shown in the drawing the screen 37 is maintained at a potential higher than that of either of the two composite-wire grills 31 and 33.

Fig. 6 shows the invention applied to a color-screen unit of the "post decelerated" type described by Edward G. Ramberg in co-pending application Serial No. 277,182. Here, two parallel-wire grills 41 and 43 are arranged at right angles to one another with the composite wires of one grill (in this case, grill 43) parallel to the phosphor lines R, B and G on the metalized screen 45. The grill (43) that lies next adjacent to the screen 45 has a voltage applied thereto which is equal to or greater than the voltage applied to the screen. As a consequence, there is no retarding field adjacent to the screen. Similarly, there is no field capable of accelerating low-velocity secondary-electrons (emitted by impact of beam-electrons upon the grills 41 and 43) toward the screen. Thus, the only parts of the screen that are activated at any given moment are those phosphor lines that lie directly in the path of the scanning beam or beams.

From the foregoing description it should now be apparent that the present invention provides an effective means for minimizing wire-vibration and consequent color-dilution, loss of contrast and other image-defects in cathode-ray tubes of the kind containing one or more parallel-wire grills through which beam-electrons pass in their transit to a nearby screen.

What is claimed is:

1. A cathode-ray tube comprising, an electron-gun, a screen-unit including a conductive element and a taut fine-wire grill mounted in closely spaced relation in a position to be scanned by an electron-beam from said gun whereby at least a part of said grill tends to vibrate when subjected to a varying potential resulting from the flow of beam-current through the electrical resistance of the fine-wire of which said grill is comprised, and a body of highly conductive metal contiguous said fine-wire throughout its length to reduce the effective resistance of said wire to the flow of said beam-current and thus to reduce said tendency of said grill to vibrate.

2. The invention as set forth in claim 1 wherein said grill wire comprises a core portion of high tensile-strength and said body of highly conductive metal surrounds said core.

3. The invention as set forth in claim 1 wherein said grill wire comprises a multi-strand cable and said body of highly conductive metal comprises at least one of the strands of said cable.

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4. The invention as set forth in claim 1 and wherein the conductive element with which said grill is closely associated comprises the target surface of a ray-sensitive screen-electrode.

5. The invention as set forth in claim 1 and wherein the conductive element with which said grill is closely associated comprises a second fine-wire grill.

6. A cathode-ray tube comprising; an electron-gun, a screen unit including a conductive element and a taut fine-wire grill mounted in closely-spaced relation in a position to be scanned by an electron-beam from said source, said grill wire comprising a core portion constituted of a material having a tensile strength substantially no less than that of Nichrome and a second portion in intimate contact with said core and constituted of a material that exhibits electrical resistance of a small fraction of the resistance of said core material.

7. The invention as set forth in claim 6 and wherein said second portion of said grill wire comprises an outer coating of copper on said core.

8. A cathode-ray tube comprising; an electron-gun, a screen-unit including first and second taut fine-wire grills mounted in capacitive relation in a position to be scanned by an electron-beam from said gun whereby at least a part of one of said grills tends to vibrate when subjected to a varying potential resulting from the flow of beam current through the electrical resistance of the fine-wire of which said grills are comprised, and a coating of highly conductive metal on said wire to minimize said tendency to vibrate.

9. The invention as set forth in claim 8 and wherein said first and said second coated fine-wire grills are mounted in a common plane.

10. The invention as set forth in claim 8 and wherein said first and second coated fine-wire grills are mounted in spaced-apart parallel planes.

11. The invention as set forth in claim 8 and wherein the wire of said second grill extends at right angles to the wire of said first grill.

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