

PATENT SPECIFICATION

(11) 1438774

1438774

- (21) Application No. 38706/73 (22) Filed 16 Aug. 1973
 (31) Convention Application No. 282272 (32) Filed 21 Aug. 1972 in
 (33) United States of America (US)
 (44) Complete Specification published 9 June 1976
 (51) INT CL² H01J 29/76
 (52) Index at acceptance

H1D 4A4 4A7 4B3A 4B3B 4B3Y 4B4 4C1 4C2B 4C2X
 4CY 4K4 4K7D 4K7Y 4K8



(54) CATHODE-RAY-TUBE YOKE COMBINATION

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cathode-ray tube and a magnetic deflection yoke mounted on the tube in operative relationship with the tube.

An electromagnetic deflection yoke for deflecting an electron beam over the viewing-screen structure may be adhesively attached to the neck of a cathode-ray tube with a body of cured polymeric material filling the space between the yoke and tube, as described in U.S. Patent No. 3,566,321 to M. G. Brown, Jr. Completely filling the space between the tube and the yoke eliminates air circulation between the yoke and the tube and may result in a higher operating temperature of the device and consequently a shorter operating life. Also, the filled space provides an extremely rigid combination, which may result in breakage of the yoke or tube, particularly under extreme environmental conditions, such as low temperatures. In addition, where the filled space is large, an uneconomical amount of polymeric material may be required.

Some polymeric materials require a period of time for curing. During the curing of the polymeric material, the yoke may move from the precise operative position relative to the tube which requires retesting after curing. Because a long curing time of about 48 hours is required for the polymeric materials used, the combination may have to be removed from the test set to allow curing. Then after the curing is completed the tube must be positioned in the test set for retesting. This may result in an uneconomical loss of time and extra handling, when processing large quantities of yoke-tube combinations.

The foregoing problems are minimized by the invention which in one aspect comprises

at least two spaced solid bodies of adhesive organic thermoplastic material between the yoke and the tube. The solid bodies are bonded directly to the windings of said yoke and directly to said tube and fill less than 20 percent of the total volume of the space between said yoke and said tube and rigidly join the yoke and tube together.

A further aspect of the invention comprises a method of fixedly attaching the magnetic deflection yoke on the cathode-ray tube by placing the yoke in a predetermined, spaced position with respect to said tube to provide a desired operative relationship therebetween. A plurality of closed spaces are formed between the yoke and the tube, the spaces being less than 20 percent of the total space between the yoke and tube. The closed space are filled with a heated organic thermoplastic material in liquid form, to form by casting a plurality of mounting strips adhesively fixing the yoke to the tube so that the windings of said yoke are bonded directly to said tube. And then the heated thermoplastic material is cooled to a solid form.

In the drawings:

Figure 1 is a partial broken-away elevational view of a yoke-tube combination, in accordance with an embodiment of the invention;

Figure 2 is an enlarged broken-away view in different cross-sections of a portion of the yoke and tube shown in Figure 1;

Figure 3 is a partial longitudinal view partly in section of the yoke-tube combination of Figure 1;

Figure 4 is a partial longitudinal view partly in section of a yoke-tube combination, in accordance with another embodiment of the invention; and

Figure 5 is a broken away view in different cross-sections of the yoke-tube combination shown in Figure 4.

Figure 1 illustrates an apertured-mask color television picture tube 20 comprising an evacuated glass envelope 21. The envelope 21 includes a faceplate panel 22, a funnel 23, and a neck 24. A three-color-phosphor-viewing-screen structure 25 is supported on

50

55

60

65

70

75

80

85

90

95

the inner surface 26 of the faceplate panel 22. An electron-gun assembly 27 positioned in the neck 24 includes three electron guns (not shown), one for each of the three color phosphors on the viewing-screen structure 25. An apertured mask 28 is positioned in the envelope 21 adjacent the viewing-screen structure 25. The electron-gun assembly 27 is adapted to project three electron beams through the apertured mask 28 to strike the viewing-screen structure 25.

A magnetic deflection yoke 29 is positioned on the envelope 21 near the intersection of the funnel 23 and neck 24. The surface of the yoke 29 adjacent to the surface of the tube 20 is defined as the confronting surface of the yoke 29, and similarly, the complementary surface of the tube 20 adjacent to the yoke 29 is defined as the confronting surface of the tube 20. The space between the yoke-confronting surface and the tube-confronting surface represents the total volume between the yoke and the tube. The yoke 29 is fixed in place on the tube 20 by spaced adhesive, mounting strips of solid organic thermoplastic material, which will tightly bond the windings of the yoke directly to the tube. The yoke 29 may also include an auxiliary electromagnet or permanent magnet means such as if required a convergence or purity device (not shown) and terminal connection means (not shown).

Example 1

Figures 2 and 3 illustrate a yoke 29, catalog No. XD-4503-A, distributed by the RCA Corporation, Indianapolis, Indiana, attached to an RCA C76072 color television picture tube 20. The yoke 29 comprises a housing 31, a core 32, and windings 33. The yoke 29 is fixed on the tube by three spaced adhesive mounting strips 30 of solid adhesive organic thermoplastic material, which is hot-melt, thermoplastic material. Suitable materials and melting temperatures are described in Table I.

The mounting strips of organic thermoplastic material must remain solid at a yoke-operating temperature of about 100°C and must melt below the temperature, at which damage to the yoke 29 or tube 20 would result, which may occur in some cases at about 150°C, to permit economical salvage of component parts. Since the strips 30 seal directly to the confronting surface (winding) of the yoke 29, it is preferred that the strips 30 remain solid at about 125°C. The strips 30, after hardening, must have good adhesion directly to both the glass tube 20 and the windings of the yoke 29.

The particular tube 20 shown, has a neck outside diameter 34 of about 0.937 inches and a funnel outside diameter 35 at the position of the large end of the yoke 29 of about 4.187 inches. The yoke 29 has an inside

diameter of about 1.187 inches at the small end and an inside diameter 37 of about 4.437 inches at the large end. The length 38 of the yoke is about 2.5 inches measured along the confronting surface of the yoke 20. The spacing between the confronting surfaces of the yoke 29 and the tube provides a space 39, which can vary between 0.050 to 0.150 inch between the tube and the yoke when they are positioned coaxially with each other. A minimum spacing of about 0.045 inch is required to permit X and Y translation of the yoke 29 on the tube 20 as shown in Figure 1, during establishment of the desired precise operative relationship.

The strips 30 of organic thermoplastic material are formed within the space between the yoke 29 and the tube 20. In one form, they comprise three strips 30 of thermoplastic material, parallel to the axis of the tube and equally spaced on the periphery of the tube. It is preferred that three strips be used for the toroidal yoke 29, catalog No. XD-4503A, previously described. Table II gives the physical dimensions of each strip of material. The confronting surface of the yoke 29 is empirically determined to be about 15 square inches. Since the confronting surface of the yoke 29 is complementary to that of the tube 20, the confronting surface of the tube is also about 15 square inches. With three strips of thermoplastic material, of the size given in Table II, about 10 percent of the total volume in the space 39 between the yoke 29 and tube 20 is filled. This leaves about 90 percent of the total volume in the space 39 unfilled and provides for air circulation between portions of the tube 20 and the yoke 29, which results in a cooler operation of the yoke and the tube.

Example 2

This Example is the same as Example 1 except that the strips 30 of thermoplastic material may be of a second size as given in Table II. With three strips 30 of the second size, about 16 percent of the total volume in the space 39 is filled.

Example 3

Figures 4 and 5 illustrate a saddle-type yoke 29a, catalog No. XD3696-H5, marketed by the RCA Corporation, Indianapolis, Indiana, attached to an RCA 25XP22 color television picture tube 20a with four spaced mounting strips 40 of thermoplastic material. Important differences between Examples 1 and 3 are in the size of the yoke and tube and in the use of a saddle-type yoke. Parts of the structure of Figures 4 and 5 corresponding to identified parts of the structure of Figures 2 and 3 are indicated with the same reference numbers followed by the letter a. The embodiment of Examples 1 and 2 is known as a small-neck tube 20, and the

embodiment of Example 3 is known as a large-neck tube 20a.

The tube 20a has a neck 24a with an outside diameter 41 of about 1.625 inches and a funnel 23a having an outside diameter 42, at its large end of about 6.500 inches. The yoke 29a has an inside diameter 43 of about 1.875 inches at its small end and an inside diameter 44 of about 7.000 inches at its large end. The length 45 of the yoke 29a is about 4.250 inches measured along the inside confronting surface. The space 46 between the yoke 29a and the tube 20a is substantially uniform. The actual spacing between the yoke 29a and the tube 20a, in an operative relationship, may range from about 0.150 to 0.350 inch, when measured with the tube 20a and yoke 29a mounted coaxially. The confronting surface of the yoke 29a is empirically determined to have an area of about 50.25 square inches.

Figure 5 illustrates the position of the four mounting strips 40 of solid thermoplastic material. The size of each of the strips 40 is given in Table II. The saddle yoke includes a horizontal winding adjacent the tube 29a. The horizontal winding includes four groups 47 of wires substantially parallel to the longitudinal axis of the tube and substantially conforming to the confronting surface of the yoke 29a. The groups 47 are connected in pairs at the front and rear of the yoke 29a to form the horizontal windings. Each of the four spaced mounting strips 40 of the thermoplastic material is positioned substantially centered on each of the four wire groups 47, as shown in Figure 5. This provides for uniform movement of the yoke 29a with respect to the tube to compensate for extreme temperature variations. With four strips of thermoplastic material of the dimensions given in Table II, about 14 percent of the total volume in the space 46 is filled. This leaves about 86 percent of the total volume in the space 46 unfilled providing increased heat radiation from the combination to air in the unfilled space.

The method of attaching the yoke on the tube comprises fixing the yoke 29 in a position spaced from the tube 20, at which position a desired, and precise operative relationship exists between the tube and yoke. Operative relationship is defined as the position of the yoke relative to the tube that is required for the optimum operation of the combination in a television receiver.

After the operative relationship of the yoke 29 and tube 20 is established, at least two and preferably three or more mounting strips are formed between the yoke and the tube. These strips occupy less than 20 percent of the total volume of the spacing between the tube and yoke and may conform substantially to the sizes of the strips given in Table II.

The mounting strips 30 are formed by a casting technique, wherein six strips 49 of foam silicone rubber (shown in Figure 2) are positioned on the inside surface of the yoke 29, or on the outside surface of the tube 20 to provide confined spaces into which the thermoplastic material is cast. This is done prior to establishing the precise operative relationship between the yoke and tube, described above. The strips 49 are positioned substantially parallel to the longitudinal axis of the tube 20 or yoke and are equally spaced in pairs around either the periphery of the outside of the tube 20, or the inside of the yoke 29. The pairs of strips 49 are spaced a distance apart equal to the desired width of the mounting strips 30 or 40. The foam strips 49 are of a size to be snugly compressed between the yoke and tube to permit adjustment of the yoke to the tube. In the examples described, foam strips 49 have been used, which are 1/4-inch wide, 1/2-inch thick, and compressible to a thickness of about 1/16-inch.

Normally the operative relationship between the yoke and tube may then be established by positioning the yoke 29 on the tube 20 and spaced precisely within a desired tolerance. This operative relationship is generally used where the operation of the tube and yoke is controllable by dynamic convergence circuitry. In this determined position, the foam strips 49 are compressed between the yoke and tube.

The operative relationship may also be established by positioning the yoke 29 on the tube 20, operating the tube 20 and yoke 29, and then adjusting the position of the yoke 29 relative to the tube 20, while continuing to operate the combination until the desired operative relationship is established. In this method, the foam strips 49 are also compressed between the tube and yoke, but allow the yoke to be moved axially in the direction Z, transversely in the directions X and Y, rotated, or tilted in the direction T, with respect to the axis of the tube, as shown by the directional arrows in Figure 1. This operative relationship is generally used where no dynamic convergence, or simplified dynamic convergence, circuitry is used.

The thermoplastic material, previously described in Examples 1 and 2 is heated to a temperature in the range of about 375 to 425 degrees F to form a liquid thereof. With the tube and yoke fixed in the desired operative relationship, the mounting strips 30 or 40 are cast by filling the spaces between the pairs of foam strips 49 with the heated liquid thermoplastic material. During the filling step, the tube and the yoke are maintained at a temperature below about 50°C. With the spacing between the tube 20 and the yoke 29 in the range of about 0.062 to 0.250 inch, it is preferred to inject the liquid thermo-

plastic material at a rate of about 1 to 1.75 cubic inches per second.

5 The liquid thermoplastic material solidifies by cooling and hardening to a solid to form the mounting strips 30, which firmly bond yoke 29 and the tube 20 together. During the cooling and hardening of the thermoplastic material, the yoke and tube are maintained at a temperature below 50°C. The thermoplastic material hardens by physical change only, and no curing takes place.

10 The cooling and hardening of the thermoplastic material to form the mounting strips 30 occur at least in part during the filling of the defined volumes with liquid thermoplastic material. The first-injected liquid thermoplastic material cools and hardens first, and the later injected thermoplastic material progressively cools and hardens after the first-injected material has hardened. In practice, the temperature of the liquid thermoplastic material can be controlled for a particular machining yoke and tube combination such that the first-injected thermoplastic material hardens at the opposite end of the yoke from the injection position. This eliminates the need to provide means to prevent the material from flowing beyond the end of the yoke 29.

25 The cooling of the thermoplastic material substantially occurs by conduction to the tube 20 and the yoke 29. After the operative relationship of yoke 29 and tube 20 is established, the yoke temperature does not exceed 50 degrees C and the tube temperature is about 30 degrees C. With the yoke 29 and tube 20 at these temperatures, the total hardening time is about 30 to 60 seconds for the embodiment described in Example 1 and shown in Figures 2 and 3.

40 The strips 49 may be removed or retained in place after the strips 30 of thermoplastic material have solidified. Since the strips 49 are of foam silicone rubber, they do not adhere to the strips 30 of thermoplastic material. If it is desired to remove the strips 49 it is preferred that the strips 49 be longer than the length of the yoke each with one end temporarily attached to the yoke. For easy removal, the strips 49 may also be formed with end tabs. If the foam strips are to be retained permanently in place, adhesive-backed polyurethane foam tape may be used, in place of the silicone foam strips. The adhesive backing assures retention of the foam tape in the desired position. But, since the thermoplastic material adheres to this tape, it is very difficult to remove after the mounting strips 30 or 40 are formed.

50 The method of fixing the yoke to the tube of Example 3 is the same as that used in assembling the structures of Examples 1 and 2, except that there are four mounting strips 40, and the size of each of the strips is larger, as required for support of the larger yoke 29a. For the combination of Example 3, four

pairs of foam tape (not shown) define confined spaces each centered respectively on one of the four wired groups 47. The confined spaces are equal to the sizes of the mounting strips formed therein.

70 The spaced strips 30 and 40 of thermoplastic material must leave sufficient space between the tube and the yoke to permit air circulation between the yoke and the tube. In addition, the mounting strips must also have a minimum width-to-thickness ratio to provide sufficient rigidity of the yoke on the tube. In practice, it is preferred to attach the yoke with a spacing less than 0.25 inch. With a spacing range of 0.0625 to 0.250 inch, the minimum width of each strips is about 0.20 inch, and the maximum width of each strip is about 0.500 inch. It is preferred that the width of each strip be about double the strip thickness. For any given strip width, the uncovered percentage of the total confronting surfaces is substantially equal to the unfilled percentage of the total volume in the space between the yoke and the tube.

85 The means used to form the spaces to be filled with the thermoplastic adhesive must be flexible (compressible and expandable) to permit ease of movement of the yoke 29 with respect to the tube 20, as previously described.

90 Although the fixturing means for forming the strips 30, 40 of thermoplastic material is disclosed to be a silicone rubber tape or a polyurethane foam tape, a smooth finish, small rubber tubing of neoprene rubber, butyl rubber, or polyethylene may also be used. A preferred tubing is marketed by Arthur H. Thomas, Philadelphia, Pa., as "smooth finish, extruded, thin wall, black rubber tubing".

100 The tubing is available in 3/16 OD x 1/16 wall thickness, 1/4 OD by 1/16 wall thickness, and 1/8 OD by 1/32 wall thickness. In using the rubber tubing to form the mounting strips, rubber tubing (of a diameter greater than the space 39 or 46) is placed on the tube in the same position as previously described for the foam tape. The tubing is compressible and expands and compresses to fill the variable space between the yoke and tube. A preferred method of positioning the tubing is to extend the ends beyond the ends of the yoke and temporarily attach them to the yoke. The smooth finish of the tubing substantially prevents the thermoplastic material from adhering to the tubing. The extended ends permit the tubing to be pulled out after the bodies of thermoplastic material have hardened.

110 Although the strips 30, 40 of thermoplastic material are described to be strips of substantially parallel to the longitudinal axis of the tube, other body configurations are possible. For example, the strips can be segmented and staggered. Also, bodies of about

one half inch in diameter could be positioned between the yoke and tube in any convenient arrangement. One arrangement may be to position three one-half-inch-diameter bodies at each end of toroidal yoke substantially uniformly spaced around the periphery thereof. Whatever the arrangement selected, the bodies must be spaced and must fill less than twenty percent of the total volume in the space 39 or 46.

The hardening time for the bodies of

organic thermoplastic material can also be accelerated by forced cooling. In a preferred method of cooling, an air stream at a temperature of about 40 to 45 degrees C is directed to flow through the unfilled portion between the combination. Forced cooling reduces hardening time in the order of about 2:1 to 3:1 of that normally required. This permits hardening in about 20 to 30 seconds, permitting increased production rate and resulting in subsequent economies.

TABLE I

	Material	Marketed By	Melting Temperature
25	Versalon® 1138	General Mills Chemical Co., Minneapolis, Minn.	125°C
	Versalon® 1165	General Mills Chemical Co., Minneapolis, Minn.	134°C

TABLE II

	Example No.	Strip Width (Inches)	Strip Thickness (Inches)	Strip Length (Inches)	Strip Surface Area (Square Inches)
30					
35	Example 1	0.20	0.05	2.50	0.024
	Example 2	0.35	0.15	2.50	0.131
	Example 3	0.35	0.25	4.25	0.371

WHAT WE CLAIM IS:—

1. A cathode-ray tube and a magnetic deflection yoke mounted on said tube in operative relationship with the tube, by at least two spaced solid bodies of adhesive organic thermoplastic material between said yoke and said tube, said bodies being bonded directly to the windings of said yoke and directly to said tube and filling less than 20 percent of the total volume of the space between said yoke and said tube and rigidly joining the yoke and tube together.

2. A cathode-ray tube and yoke in accordance with Claim 1, wherein said organic thermoplastic material is a hot-melt adhesive which is solid at a temperature of about 100°C and melts below 150°C.

3. A cathode-ray tube and yoke in accordance with Claim 1, wherein said yoke includes four groups of wires substantially parallel to the longitudinal axis of said tube, said bodies each comprising a strip of material substantially centered on respective ones of said groups of wires and said tube.

4. A method of fixedly attaching a magnetic deflection yoke on a cathode-ray tube com-

prising the steps of placing said yoke in a predetermined, spaced position with respect to said tube to provide a desired operative relationship therebetween, forming a plurality of closed spaces between said yoke and said tube, said spaces being less than 20 percent of the total space between said yoke and said tube, filling said closed spaces with a heated organic thermoplastic material in liquid form to form by casting a plurality of mounting strips adhesively fixing the yoke to the tube, so that the windings of said yoke are bonded directly to said tube, and cooling the heated thermoplastic material to a solid form.

5. A cathode-ray tube and yoke substantially as hereinbefore described in conjunction with Example 1, 2 or 3, Figures 1, 2 and 3, or with Figures 4 and 5.

JOHN A. DOUGLAS,
Chartered Patent Agent,
50 Curzon Street,
London, W1Y 8EU.
Agent for the Applicant.



14

5

1,438,774

5

one half inch in diameter could be positioned between the yoke and tube in any convenient arrangement. One arrangement may be to position three one-half-inch-diameter bodies at each end of toroidal yoke substantially uniformly spaced around the periphery thereof. Whatever the arrangement selected, the bodies must be spaced and must fill less than twenty percent of the total volume in the space 39 or 46.

The hardening time for the bodies of

organic thermoplastic material can also be accelerated by forced cooling. In a preferred method of cooling, an air stream at a temperature of about 40 to 45 degrees C is directed to flow through the unfilled portion between the combination. Forced cooling reduces hardening time in the order of about 2:1 to 3:1 of that normally required. This permits hardening in about 20 to 30 seconds, permitting increased production rate and resulting in subsequent economies.

TABLE I

	Material	Marketed By	Melting Temperature
25	Versalon® 1138	General Mills Chemical Co., Minneapolis, Minn.	125°C
	Versalon® 1165	General Mills Chemical Co., Minneapolis, Minn.	134°C

TABLE II

	Example No.	Strip Width (Inches)	Strip Thickness (Inches)	Strip Length (Inches)	Strip Surface Area (Square Inches)
30					
35	Example 1	0.20	0.05	2.50	0.024
	Example 2	0.35	0.15	2.50	0.131
	Example 3	0.35	0.25	4.25	0.371

WHAT WE CLAIM IS:—

1. A cathode-ray tube and a magnetic deflection yoke mounted on said tube in operative relationship with the tube, by at least two spaced solid bodies of adhesive organic thermoplastic material between said yoke and said tube, said bodies being bonded directly to the windings of said yoke and directly to said tube and filling less than 20 percent of the total volume of the space between said yoke and said tube and rigidly joining the yoke and tube together.

2. A cathode-ray tube and yoke in accordance with Claim 1, wherein said organic thermoplastic material is a hot-melt adhesive which is solid at a temperature of about 100°C and melts below 150°C.

3. A cathode-ray tube and yoke in accordance with Claim 1, wherein said yoke includes four groups of wires substantially parallel to the longitudinal axis of said tube, said bodies each comprising a strip of material substantially centered on respective ones of said groups of wires and said tube.

4. A method of fixedly attaching a magnetic deflection yoke on a cathode-ray tube com-

prising the steps of placing said yoke in a predetermined, spaced position with respect to said tube to provide a desired operative relationship therebetween, forming a plurality of closed spaces between said yoke and said tube, said spaces being less than 20 percent of the total space between said yoke and said tube, filling said closed spaces with a heated organic thermoplastic material in liquid form to form by casting a plurality of mounting strips adhesively fixing the yoke to the tube, so that the windings of said yoke are bonded directly to said tube, and cooling the heated thermoplastic material to a solid form.

5. A cathode-ray tube and yoke substantially as hereinbefore described in conjunction with Example 1, 2 or 3, Figures 1, 2 and 3, or with Figures 4 and 5.

JOHN A. DOUGLAS,
Chartered Patent Agent,
50 Curzon Street,
London, W1Y 8EU.
Agent for the Applicant.