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Deal

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[45] **Oct. 9, 1973**

[54] **CATHODE-RAY-TUBE-YOKE COMBINATION WITH AT LEAST TWO SPACED BODIES OF ORANGIC THERMOPLASTIC MATERIAL THEREBETWEEN AND A METHOD OF MAKING SAID COMBINATION**

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[52] **U.S. Cl.** **178/7.8,** 156/294, 264/262, 335/210
[51] **Int. Cl.** **H04n 5/64**
[58] **Field of Search** 178/7.8, 7.9; 335/210; 264/262; 156/294

[56] **References Cited**

UNITED STATES PATENTS

3,663,751	5/1972	Oberg	178/7.8
3,566,321	2/1971	Brown	335/210

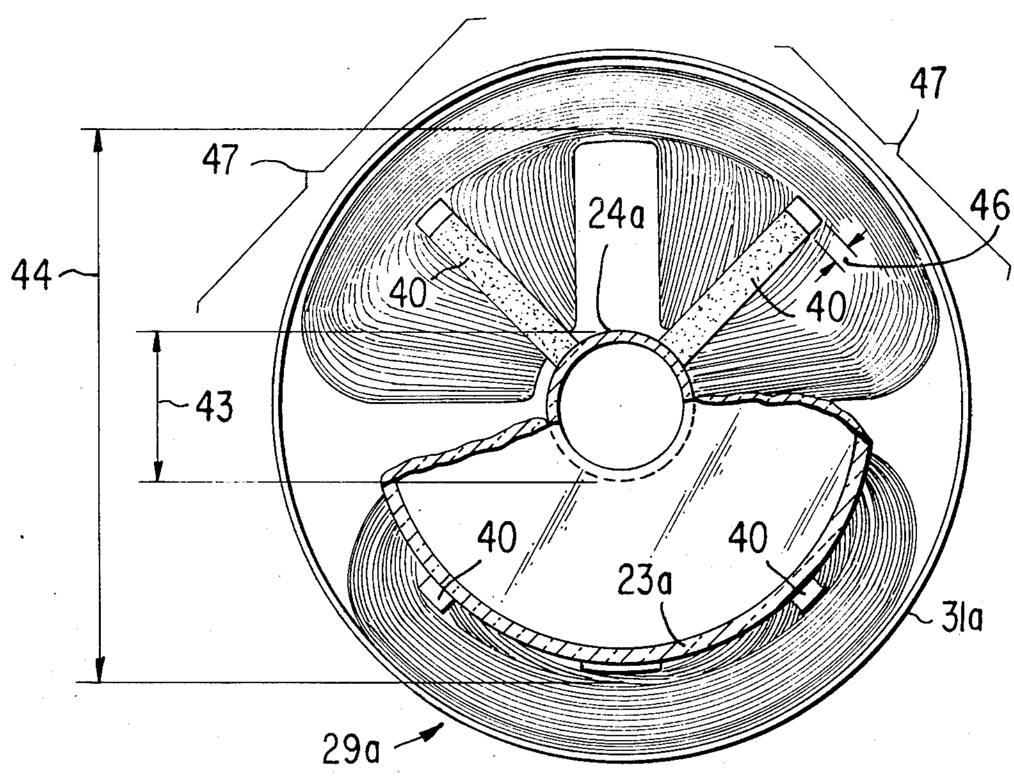
Primary Examiner—Howard W. Britton
Attorney—Glenn H. Bruestle et al.

[57] **ABSTRACT**

Combination comprises a cathode-ray tube, a magnetic deflection yoke in operative releationship with the tube and at least two spaced bodies of organic thermoplastic material positioned between the yoke and the tube, the bodies filling less than 20 percent of the total volume in the space between the tube and the yoke.

Method comprises placing a yoke in a predetermined spaced position with respect to a tube to provide a desired operative relationship therebetween. At least two substantially closed volumes are then defined between the yoke and the tube, the volumes enclosing less than 20 percent of the total volume in the spaced between the tube and the yoke. The defined volumes are substantially filled with heated liquid thermoplastic material, while the yoke and the tube are maintained at a temperature below about 50°C. The thermoplastic material is then permitted to cool and harden to a solid, which occurs at about 100°C.

9 Claims, 5 Drawing Figures



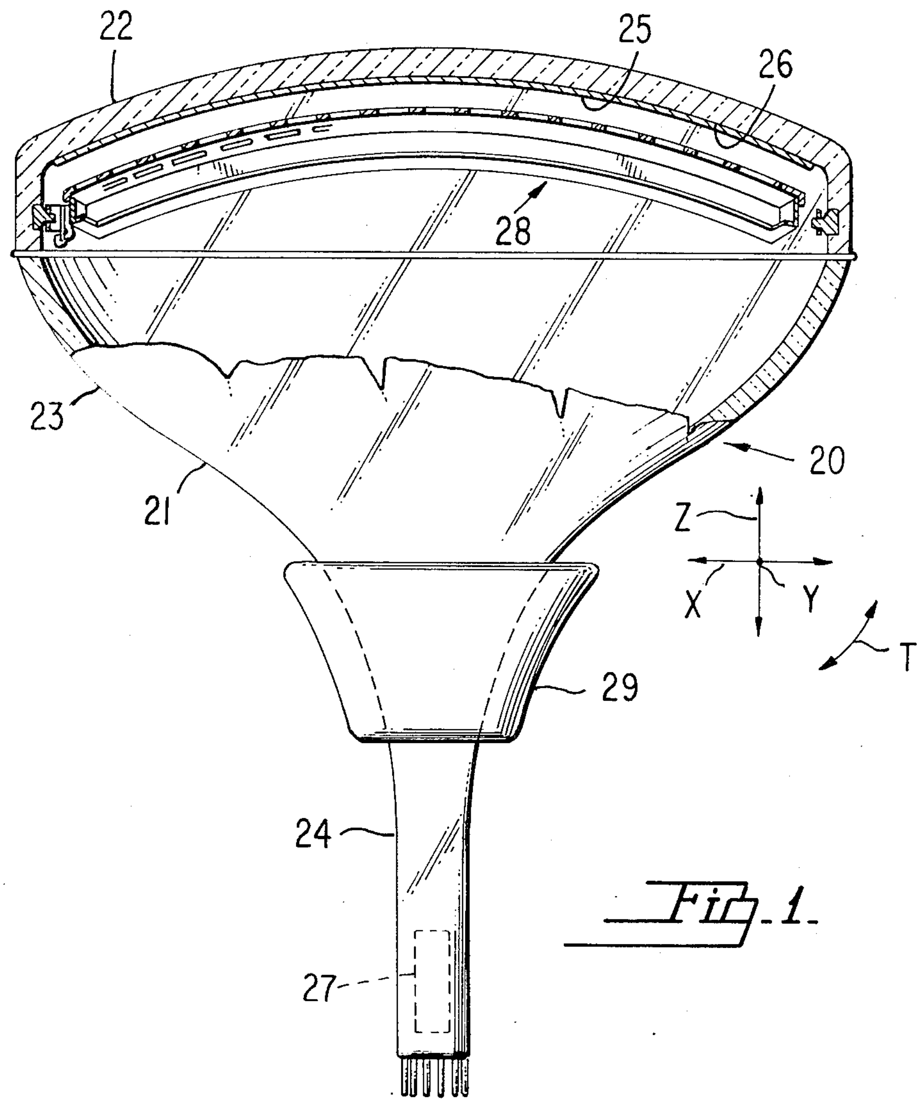


Fig. 1.

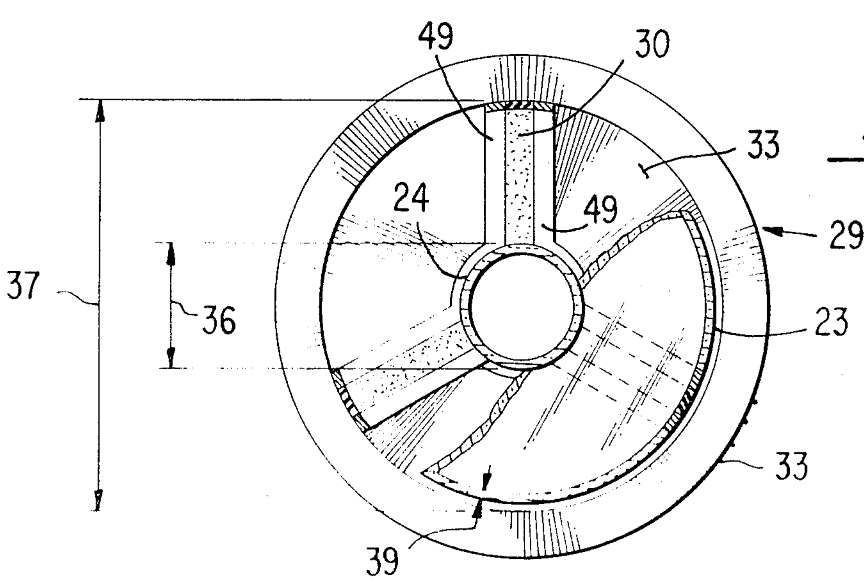


Fig. 2.

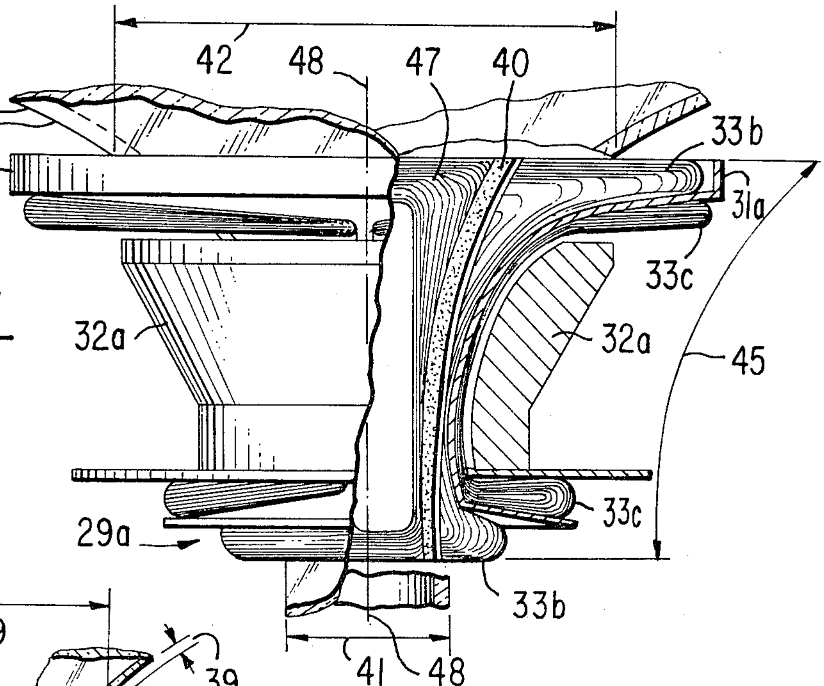


Fig. 4

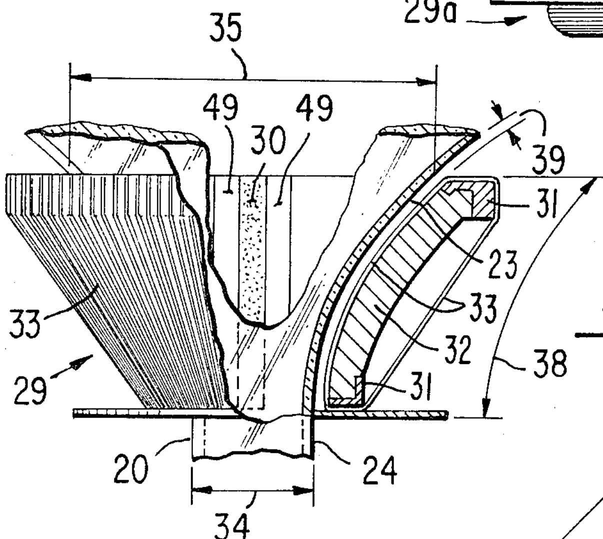


Fig. 3

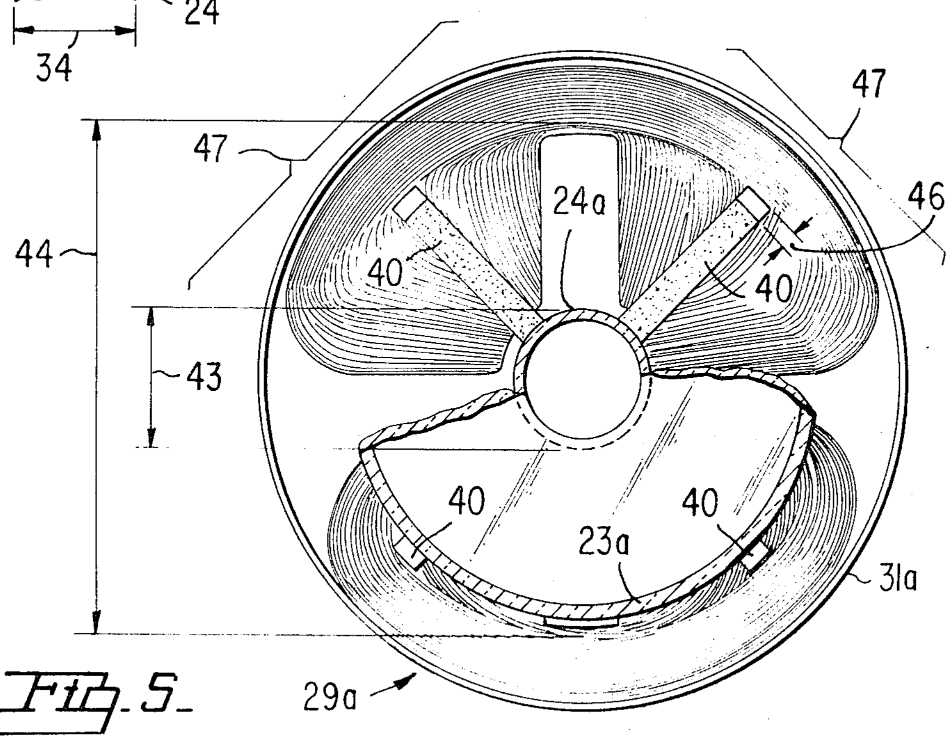


Fig. 5

CATHODE-RAY-TUBE-YOKE COMBINATION WITH AT LEAST TWO SPACED BODIES OF ORANGIC THERMOPLASTIC MATERIAL THEREBETWEEN AND A METHOD OF MAKING SAID COMBINATION

BACKGROUND OF THE INVENTION

This invention relates to a novel cathode-ray-tube-yoke combination wherein the yoke is attached on the tube with at least two spaced bodies of organic thermoplastic material, and to a novel method of making the combination.

A cathode-ray tube may use a magnetic deflection yoke mounted thereon to deflect the electron beams to scan a raster over the viewing-screen structure. The yoke may be attached on the neck of a cathode-ray tube with a body of cured polymeric material filling the volume between the yoke and tube, as described in U.S. Pat. No. 3,566,321 to M. G. Brown, Jr. Completely filling the volume 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 combination and consequently a shorter operating life. Also, the filled volume provides an extremely rigid combination which may result in breakage of the yoke or tube, particularly under extreme environmental conditions such as low temperature. In addition, where the filled volume is large, an uneconomical amount of material may be required.

In one prior method of making a yoke-tube combination, a polymeric material is poured into the space between a positioned, operative yoke and tube and allowed to cure. Since, during the curing of the polymeric material, the yoke may move from the desired operative position on the tube, a retest after curing is desirable. Because a long curing time of about 48 hours is required, the combination must be removed from the test set to allow curing. Then after the curing is complete the tube must be repositioned in the test set for retesting. This may result in an uneconomical method when processing large quantities of yoke-tube combinations.

SUMMARY OF THE INVENTION

The novel combination comprises a cathode-ray tube, a magnetic deflection yoke in operative relationship with the tube and at least two spaced bodies of organic thermoplastic material positioned between the yoke and the tube, the bodies filling less than 20 percent of the total volume in the space between the tube and the yoke. The spaced bodies of thermoplastic material, instead of eliminating air circulation between the yoke and the tube, permit air circulation between portions of the yoke and the tube, resulting in a cooler, more reliable operation of the combination. Also, the spaced bodies provide some flexibility in the combination permitting sufficient movement between the yoke and the tube to substantially eliminate breakage of the yoke or the tube when the combination is exposed to extreme environmental conditions such as low temperature.

The novel method comprises placing a yoke in a predetermined spaced position with respect to the tube to provide a desired operative relationship therebetween. At least two substantially closed volumes are then defined between the tube and the yoke, the volumes enclosing less than 20 percent of the total volume in the space between the tube and the yoke. An organic thermoplastic material is heated to form a liquid thereof, and the defined volumes between the yoke and the tube are substantially filled with the heated thermoplastic material, while the tube and the yoke are maintained at a temperature below about 50°C. The thermoplastic material is then permitted to cool and harden to a solid, which occurs at about 100°C. Since the heated thermoplastic material solidifies within 60 seconds and no curing is involved, the combination does not require retesting. The novel process permits economical mass processing of large quantities of combinations. The novel method is particularly adapted for preparing the novel combination described above.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial broken-away elevational view of a yoke-tube combination.

FIG. **2** is an enlarged broken-away sectional view of a portion of the yoke and tube shown in FIG. **1.**

FIG. **3** is a sectional view of the yoke-tube combination of FIG. **1.**

FIG. **4** is an enlarged broken-away sectional view of a portion of a further alternate yoke-tube combination.

FIG. **5** is a sectional view of the yoke-tube combination shown in FIG. **4.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **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 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 adjacent the envelope **21** near the intersection of the funnel **23** and neck **24.** The surface of the yoke **29** adjacent the surface of the tube **20** is defined to be the confronting surface of the yoke **29,** and similarly the complementary surface of the tube **20** adjacent the yoke **29** is defined to be the confronting surface of the tube **20.** The space **39** between the yoke-confronting surface and the tube-confronting surface is defined to contain the total volume between the yoke and the tube. The yoke **29** is fixed in place on the tube **20** by spaced bodies of solid organic thermoplastic material, which will be described in the specific examples. The yoke **29** may also include an auxiliary electromagnet or permanent magnet means such as a convergence or purity device (not shown) and terminal connection means (not shown).

EXAMPLE 1

FIGS. **2** and **3** illustrate a yoke **29,** catalog No. XD–4503–A distributed by RCA Corp., Indianapolis, Ind., attached on 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 bodies **30** of solid organic thermoplastic material. The preferred thermoplastic material is an organic hot-melt thermoplastic adhesive material. Suitable materials and melting temperatures are described in Table I.

The bodies 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 occurs at about 150°C, to permit economical salvage of component parts. Where the bodies **30** seal directly to the confronting surface (winding) of the yoke **20**, it is preferred that the bodies **30** remain solid at about 125°C. The bodies **30** after hardening must also have good adhesion to the glass tube **20** and the yoke **29**.

The tube **20** has a neck outside diameter **34** of about 0.937 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 **36** 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 difference between the inside diameter of the yoke **29** and the outside diameter of the tube **20** provides a space **39** of about 0.050 to 0.150 inch between the tube **20** and the yoke **29** with the yoke and tube in a concentric position. A minimum space **39** of about 0.045 inch is required to permit X and Y translation of the yoke **29** on the tube **20** as shown in FIG. **1** during establishment of the desired operative relationship.

The bodies **30** of organic thermoplastic material are in the space between the yoke **29** and the tube **20**. In one form, the bodies **30** comprise three strips of thermoplastic material substantially parallel to the axis of the tube and substantially equally spaced on the periphery of the tube. It is preferred that three bodies are used for the catalog No. XD–4503A toroidal yoke **29** previously described. Table II gives the physical dimensions of each body 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 bodies 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 bodies **30** of thermoplastic material may be of a second size as given in Table II. With three bodies **30** of the second size, about 16 percent of the total volume in the space **39** is filled.

EXAMPLE 3

FIGS. **4** and **5** illustrate a saddle-type yoke **29***a*, catalog No. XD3696–H5 marketed by RCA Corp., Indianapolis, Ind., attached on an RCA 25XP22 color television picture tube **20***a* with four spaced bodies **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. 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 **20***a*.

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

FIG. **5** illustrates the position of the four spaced bodies **40** of solid thermoplastic material. The size of each of the bodies **40** is given in Table I. The catalog No. XD3696–H5 saddle yoke includes a horizontal winding adjacent the tube **29**a. 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 **29***a*. The groups **47** are connected in pairs at the front and rear of the yoke **29***a* to form the horizontal windings. It is preferred that each of the four spaced bodies **40** of thermoplastic material is positioned between the yoke **29***a* and the tube **20***a* substantially centered on each of the four wire groups **47** as shown in FIG. **5**. This provides for uniform movement of the yoke **29***a* 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 novel method of attaching the yoke on the tube comprises placing the yoke **29** in a predetermined spaced position with respect to the tube **20** to provide a desired operative relationship therebetween. Operative relationship is defined to mean the position of the yoke relative to the tube that is required for the operation of the combination of a particular tube and a matching yoke in a television receiver.

The operative relationship may be established by generally positioning the yoke **29** adjacent the tube **20** and spaced within a desired tolerance. This operative relationship is generally used where the operation of the tube and yoke is adjustable by dynamic convergence circuitry. The operative relationship may also be established by temporarily positioning the yoke **29** on the tube **20**, operating the tube **20** and yoke **29**, and 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 adjusting the combination, the yoke **29** can be moved axially in the direction Z, moved traversely in the directions X and Y, rotated in the direction R, or tilted in the direction T with respect to the axis of the tube as shown by the directional arrows in FIG. **1**. This operative relationship is generally used where no dynamic convergence, or simplified dynamic convergence, circuitry is used.

After the operative relationship of the yoke **29** and tube **20** is established, at least two substantially closed volumes are defined in the space **39** between the yoke and the tube, the defined volumes enclosing less than 20 percent of the total volume in the space **39.** The size of the preferred volumes is equal to the sizes of the bodies given in Table II.

In the preferred method, the volumes are defined by positioning six pieces of foam silicone rubber strips **49** (shown in FIG. **2**) on the inside surface of the yoke **29** or on the outside surface of the tube **20.** The strips **49** are positioned substantially parallel to the longitudinal axis of the tube **20** and are equally spaced in pairs around 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 bodies **33** given in Examples 1 and 2. Since the foam strips **49** are compressible, they satisfactorily fill the space **39** between the yoke and tube at all times; and, since they are sufficiently flexible, they permit adjustment of the yoke and tube within the described adjustment range. The foam strips **49** are selected to be of an uncompressed thickness equal to the maximum possible spacing obtainable within the described adjustment range. It is preferred that the strips are ¼-inch wide, ½-inch thick, equal to the length of the yoke and compressible to a thickness of about one-sixteenth inch.

The strips **49** may be removed or retained in place after the bodies **30** of thermoplastic material have solidified. Since the strips **49** are of foam silicone rubber, they do not adhere to the bodies **30** of thermoplastic material and may be removed. If it is desired to remove the strips, it is preferred that the strips **49** are left longer than required with the longer ends temporarily attached to the yoke. For easy removal, the strips **49** may also be formed with end tabs. When the means for defining the volumes is retained with the combination for the life of the combination, adhesive-backed polyurethane foam tape may be used in place of the silicone foam strips. The adhesive backing permits 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 bodies are formed.

A thermoplastic material, as previously described in Examples 1 and 2, is heated to a temperature in the range of about 375° to 425° F to form a liquid thereof. With the tube in the desired operative relationship, the defined volumes are substantially filled with the heated liquid thermoplastic material. During the filling step, the tube and the yoke are maintained at a temperature below about 50°C. In a preferred method of filling the defined volumes, a plurality of masses of the heated liquid thermoplastic material are injected into the space **39** between the positioned yoke **29** and the tube **20** with the masses contacting less than **20** percent of the total confronting surfaces between the yoke **29** and the tube **20** and filling less than 20 percent of the total volume in the space between the yoke **29** and the tube **20.**

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

The masses of liquid thermoplastic are permitted to solidify by allowing heat to be conducted to the positioned yoke and tube, the masses of the material cooling and hardening to a solid to form spaced bodies **30** between the yoke **29** and the tube **20.** During the hardening, 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.

The cooling and hardening of the masses of thermoplastic material to form bodies **30** thereof 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-in-jected 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 matching yoke and tube combination such that the first-injected thermoplastic material hardens at about 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.** Of course, adhesive-backed foam tape could be easily positioned at one end of each of the body channels to fully define the end position of the bodies **30** prior to filling the volumes.

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 is about 50° C and the tube temperature is about 30° 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 FIGS. **2** and **3.**

The novel method of making Example **3** is the same as that used in making Examples **1** and **2** except that there are four bodies **40,** and the size of each of the bodies 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 volumes centered on the four wire groups **47.** The defined volumes are equal to the sizes of the bodies given in Table II.

General Considerations and Alternatives

The spaced bodies of thermoplastic material must leave sufficient volume in the space between the tube and the yoke unfilled to permit air circulation between the yoke and the tube. In addition, the bodies 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. At a spacing range of 0.0625 to 0.250 inch, the minimum width of each strip 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.

The liquid thermoplastic may be injected into the space **39,** without means to define the volumes, in the form of a bead directed to flow and harden in bodies **30** of width substantially as described in Example 1. This is difficult to accomplish consistently, and it is preferred that either temporary or permanent means be provided to define the volume of the bodies **30** of thermoplastic material.

The means used to define the volumes must be flexible (compressible and expandable) to permit ease of movement of the yoke **29** with respect to the tube **20**, as previously described. The means must expand and contract to continually define the volumes during the establishment of the operative relationship described. For example, when the yoke **29** is moved in the direction Y (shown in FIG. **1**), the means used to define the volumes must expand on one side of the tube **20** and contract on the opposite side of the tube **20** to fill the space **39** between the yoke **29** and the tube **20** on both sides of the tube **20**. Generally, the expansion required is from about 0.062 to 0.500 inch.

Although the fixturing means for defining the sidewalls for each of the bodies 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." The tubing is available in 3/16 OD × 1/16 wall thickness, ¼ OD by 1/16 wall thickness, and ⅛ OD by 1/32 wall thickness. In using the rubber tubing to define the volumes, 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.

Although the spaced bodies of thermoplastic material are described to be strips 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 a 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**.

When the yoke **29** includes a housing on the inside surface, the housing can include thin flexible members over the length of the housing to substitute for the tape strips **49** described. These members could be accordioned or folded to permit movement of the yoke **29** on the tube **29** within the range described, while continuously providing defined volumes for the casting of each of the spaced bodies **30** or **40**. This would eliminate the separate strips **49**, providing for further economy in the novel method.

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° C is directed to flow through the unfilled portion between the combination. Forced cooling reduces hardening time in the order of about 2:1 or 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
Versalon 1138	General Mills Chemical Co., Minneapolis, Minn.	125°C
Versalon 1165	"	134°C

TABLE II

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

I claim:

1. In combination,

a. a cathode-ray tube,

b. a magnetic deflection yoke in operative relationship with said tube

c. and at least two spaced solid bodies of organic thermoplastic material positioned between said yoke and said tube, said bodies filling less than 20 percent of the total volume in the space between said yoke and said tube.

2. The combination defined in claim **1** wherein each of said bodies is about 0.20 to 0.500 inch wide by 0.650 to 0.375 inch thick by 2.500 to 4.250 inches long.

3. The combination defined in claim **1** wherein said yoke includes four groups of wires substantially parallel to the longitudinal axis of said tube, said bodies comprising a strip of material positioned between each of said groups and said tube.

4. The combination defined in claim **1** including

d. means between said yoke and said tube defining the position of each of said bodies.

5. The combination defined in claim **1** wherein said organic thermoplastic material is a hot-melt adhesive which is solid at a temperature of about 100°C and melts at about 150°C.

6. The combination defined in claim **5** wherein said spaced bodies of organic material provide movement of said yoke with respect to said tube during temperature variations.

7. A method of fixedly attaching a yoke in a predetermined, spaced position on a cathode-ray tube comprising the steps of

a. placing said yoke in said predetermined, spaced position with respect to said tube to provide a desired operative relationship therebetween,

b. defining at least two substantially closed volumes between said yoke and said tube, said volumes enclosing less than 20 percent of the total volume in the space between said yoke and said tube,

c. heating an organic thermoplastic material to form a liquid thereof,

d. substantially filling said defined volumes with heated liquid thermoplastic material,

e. during step (d) maintaining said yoke and tube at a temperature below about 50°C

f. and then permitting said thermoplastic material to cool and harden to a solid which occurs at about 100°C.

8. The method defined in claim **7** wherein step (f) includes hardening by directing cooling air between said yoke and said tube, said hardening occurring in less than 30 seconds.

9. The method defined in claim **7** wherein said organic thermoplastic material is a hot-melt adhesive which is solid at a temperature of about 100°C and melts at about 150°C.

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