METHOD AND APPARATUS FOR SECURING ELECTRODE-SUPPORTING STUDS ON THE ENVELOPE OF A COLOR CATHODE RAY TUBE

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Filed: Dec. 21, 1973

App. No.: 427,389

U.S. Cl. 156/60; 156/349; 156/539; 269/321 T; 313/85 R; 313/405; 313/406

Int. Cl. 269/321 T

Field of Search 313/476, 482, 405, 406, 313/85; 29/25.13; 269/321 T; 156/60, 290, 349, 320, 539

References Cited

UNITED STATES PATENTS
2,826,870 3/1958 Soubier
2,381,347 5/1968 Reinwall

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ABSTRACT

This disclosure depicts method and apparatus useful in the manufacture of color cathode ray tubes of the type having a color selection electrode supported in spaced relationship to a faceplate portion of the tube envelope. More particularly, this disclosure depicts method and apparatus for securing on the envelope studs employed in supporting the electrode. By the use of an alignment fixture, there is positioned and held on an inner surface of the envelope at the intended location of the studs, jigs which temporarily support the studs at the precise intended locations thereof. The jigs are temporarily secured to the envelope inner surface by the use of an air-hardenable, room temperature cement such that the studs are accurately and firmly held at the said precise locations. The alignment fixture is then removed and a cement of a type which cures at high temperature is located between the studs and the envelope inner surface. The faceplate with the jigs attached is baked to cure the high temperature cement and thereby permanently affix the studs to the envelope. Finally, the jigs are broken loose and removed from the envelope to leave the studs permanently cemented to the envelope. The jigs and alignment fixtures are disclosed in detail.

10 Claims, 11 Drawing Figures
METHOD AND APPARATUS FOR SECURING ELECTRODE-SUPPORTING STUDS ON THE ENVELOPE OF A COLOR CATHODE RAY TUBE

BACKGROUND OF THE INVENTION

It is well known that studs for supporting the color selection electrode of a color tube adjacent the faceplate thereof may be secured to the envelope inner surface by the use of a high temperature cement such as the devitrifying solder glass, commonly termed "frit". For example, see U.S. Pat. Nos. 2,727,172 and 2,846,608.

One of the drawbacks of this method of securing studs to a color tube envelope has involved the burdensome restraints imposed on the fixture used to position and hold the studs during the high temperature cementing operation. Due to the long bake cycle required to cure frit-type cements (typically 1–3 hours), the requirement that an alignment fixture be provided to hold the studs in place during the bake cycle means that a great many fixtures must be provided to satisfy the demands of a high volume production facility. For example, a color tube facility producing 10,000 tubes per day would require between 1,000 and 2,000 such fixtures, with attendant storage, handling and capital cost burdens.

Further, because the typical bake cycle is conducted at temperatures in the range of 400°–500°C, such a fixture must be capable of maintaining the required stud positioning tolerances (typically a few mils) while undergoing such extreme temperature cycles. It is well known that it is extremely difficult to maintain such high tolerances with a fixture subjected to extreme temperature cycling, and that to attempt to do so inevitably will result in high fixture maintenance and replacement costs.

OBJECTS OF THE INVENTION

It is a general object of this invention to provide improved method and apparatus for cementing electrode-supporting studs on the envelope of a color cathode ray tube.

More particularly, it is an object to provide such improved method and apparatus which does not require the temperature cycling of an alignment fixture used to position the studs on the tube envelope.

It is another object to provide improved method and apparatus for cementing electrode-supporting studs on the envelope of a color cathode ray tube which provides high positioning accuracy for the studs, and yet which result is achieved at a relatively modest cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view, partly broken away, of one corner of a color cathode ray tube, illustrating a color selection electrode and a suspension device thereof, which suspension device employs an electrode-supporting stud of the type with which this invention is most advantageously involved;

FIGS. 2–7 are views of a novel jig employed in a stud-cementing method according to this invention;

FIGS. 8–10 are plan, sectional, elevational and fragmentary perspective views illustrating an alignment fixture employed in the method of this invention; and

FIG. 11 is a view showing a portion of the FIGS. 2–7 jig as it would appear at one step in the method of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a fragmentary perspective view of one corner of a color cathode ray tube including a color selection electrode 10 supported by suspension devices (one of which is shown at 12) incorporating a stud of a type with which the principles of this invention are applicable. The stud 14 has a body portion 16 and a foot 18 which is adapted to be cemented to the inner surface 20 of a faceplate 22. The faceplate 22 is adapted to mate with a funnel 24 constituting the remaining portion of the tube envelope. The body portion 16 of the stud 14 has formed therein an opening 26 which is adapted to receive a spring-biased lug 28 carried on the distal end of a spring 30 held by a supporting bracket 32.

As is well known, the color selection electrode 10 must be supported adjacent the faceplate 22 at a critical distance from the inner surface 20 of the faceplate and also must be positioned in the plane perpendicular to the tube axis with a high degree of positional accuracy. Thus, the studs 14 must be located on the faceplate 22 with a high degree of accuracy, typically in the order of a few mils or less for conventional tubes, and in the case of tubes fabricated with interchangeable masks, to accuracies of a few tenths of a mil.

The suspension device 12 forms no part of this invention, but represents an invention described and claimed in the present invention. The illustrated color selection electrode 10 also constitutes no part of this invention but is disclosed and claimed in the application Ser. No. 395,334, filed Sept. 7, 1973, also assigned to the assignee of the present invention.

This invention is directed to an improved method and associated apparatus for cementing electrode-supporting studs, for example studs of the type shown at 14 in FIG. 1, upon the inner surface of a color cathode ray tube envelope. Whereas the principles of this invention are most advantageously employed to cement studs directly on the faceplate of a flangeless-type faceplate as shown in FIG. 1, the principles of this invention may also be applied to cement studs on the faceplate or flange portions of flanged front panels and on color tube envelopes of other types.

At the heart of this invention is the use of a jig 34, shown with particular clarity in FIGS. 2–7 which is adapted to be temporarily secured to the inner surface of the associated color tube envelope to accurately position and hold the stud during a high temperature cementing operation in which the stud is permanently cemented to the envelope. As will be described in detail below, the jig 34 is cemented to the envelope by the use of a room temperature, air-hardenable cement which
holds the stud during the high temperature cementing operation, thus obviating the use of a high accuracy alignment fixture to hold the studs during the high temperature cementing operation. As will be described in detail hereinafter, the jig 34 is positioned and held in an alignment fixture (shown at 36 in FIGS. 8–10) which places the jig on the faceplate with a high degree of dimensional accuracy. Before discussing the fixture 36 and associated stud cementing method, however, the jig 34 will be described in detail.

The jig 34 comprises stud holding means for releasably gripping the stud 14, guide means for slideably receiving the stud holding means and the stud, and means for urging the stud into firm engagement with the inner surface of the tube envelope. In the illustrated preferred embodiment, the means for urging the stud into firm engagement with the faceplate during the high temperature cementing operation (described in detail below) takes the form of an elongated body 38 having a predetermined mass by which a gravitational force is exerted on the stud. In the illustrated embodiment, the stud holding means is shown as taking the form of a clamp, comprising a clamping bar 40 through which a tightening screw 42 is passed for reception in a threaded bore in a base portion 44 of the body 38.

When the screw 42 is drawn tight, a head 46 on the clamping bar 40 makes frictional engagement with a flat surface 47 on the body 38 and a foot 48 on the clamping bar 40 makes frictional engagement with body portion 16 of the stud 14. The stud 14 is thus held in firm connection with the body 38.

In the illustrated preferred embodiment, the guide means is shown as taking the form of a sheet metal guide 50 having a circular opening 52 in a first leg 53 for slideably receiving the body 38 and a rectangular opening 54 in a second leg 56 axially spaced from the first leg 53 for slideably receiving the body portion 16 of the stud 14. It is thus seen that with the clamping bar 40 drawn tight to interconnect the body 38 and the stud 14, the coupled body-stud assembly is free to slide vertically in the guide 50.

The guide 50 is provided with a pedestal 58, here shown as comprising three legs 60, 62, 64 which are adapted to be temporarily cemented to the inner surface 20 of the faceplate 22 by means of an air-hardenable, room temperature cement. It is noted that the legs 60–64 are dimensioned, and the bottom surface of the foot 18 of the stud 14 is configured to follow the curvature of the inner surface 20 of the faceplate 22 such that the axis of the jig 34 is parallel to the tube axis.

As will be described in detail hereinafter, in accordance with the method of this invention, a high temperature cement, preferably of the so-called “frit”-type, is employed to permanently cement the stud 14 to the faceplate 22. In accordance with a preferred implementation of this invention, a measured quantity of frit cement, preferably in the form of a dry pellet 72, is inserted beneath the floating gravity-biased stud-body assembly after the jig 34 has been cemented to the faceplate 22.

As briefly discussed above, in accordance with this invention, a novel alignment fixture 36 is provided for positioning the jigs 34 (and thus the studs held thereby) with a high degree of accuracy at spaced points on the faceplate 22 while the jigs 34 are being cemented to the inner surface 20 of the faceplate 22. See FIGS. 8–10.

In the illustrated preferred embodiment, the alignment fixture 36 is shown as comprising a chassis, here shown as taking the form of a base plate 74, which acts to provide a rigid skeleton for the fixture and which serves to carry associated attachments and components. The fixture 36 includes means carried by the faceplate 22 for detachably engaging the outer peripheral edge 76 of the faceplate 22, acting as a reference edge, and for aligning the fixture 36 relative to the faceplate 22 in the X-Y plane perpendicular to the faceplate axis. The means for assuring alignment of the fixture relative to the faceplate in the said X-Y plane is shown as comprising three cylindrical locators 78, 80, and 82. The locators depend from the base plate 74 and make engagement with the faceplate 22 at three spaced points on the peripheral edge 76 of the faceplate. To draw the locators 78–82 into firm engagement with the peripheral edge 76 of the faceplate 22, there is provided two clamp assemblies 84, 86. Each of the clamp assemblies 84, 86 includes an “L” shaped support bar 88 which carries a spring-biased piston 90, on the operative end of which piston is located a bumper 92 making contact with a point on the peripheral edge 76 of the faceplate 22. When the piston 90 is released, by rotating it to the release position shown in FIGS. 8–9, the piston 90 is free to travel under the influence of the spring 93. The bumper 92 thus engages the faceplate peripheral edge 76 and draws the fixture locators 78–82 into firm engagement with the faceplate peripheral edge 76.

To locate the base plate 74 of the fixture 36 at a predetermined elevation from the faceplate 22, there is provided a plurality of feet (here shown as three in number) 94, 96, 98 which engage the inner surface 20 of the faceplate 22 and support the base plate 74 at a predetermined distance from the faceplate 22.

A plurality of jig-holding bars 100 are mounted on the base plate 74 and serve to releasably position and hold the jigs 34. Mounting bolts 102, 104 provide for detachment of the jig-holding bars 100 from the jigs 34 after the jigs 34 have been cemented to the inner surface of the faceplate.

The jig-holding bars include on one end thereof a pair of spaced fingers 106, 108, the separating space between which is contoured to conform to the cross-sectional configuration of the body 38. Because of the flats 110, 112 formed on the body 38, the body is not free to rotate between the fingers 106, 108. A set screw 109 passing through finger 106 and into the threaded bore 111 holds the jigs 34 firmly on the jig-holding bars 100.

As will be described in more detail below, by this arrangement, after the jigs 34 have been cemented to the faceplate 22, the jig-holding bars 100 can be loosened from the base plate 74 and slipped radially off the jigs 34, permitting the alignment fixture 36 to be removed.

A method for cementing electrode-supporting studs on the envelope of a color cathode ray tube following the principles of this invention will now be described in detail. The first step of a preferred method is to insert the studs 14 into four jigs 34 and to draw the screws 42 up to effect a tight clamping of the studs 34 against the bodies 38. The jigs 34 are then mounted on the jig-holding bars 100 which are in turn bolted onto the base plate 74.

The alignment fixture 36 with the jigs 34 held thereby is then placed on the concave inner surface of a face-
plate 22 and the clamp assemblies 84, 86 released to
draw the locators 78-82 into firm engagement with the
envelope peripheral edge 76. With the jigs 34 posi-
tioned at the intended location of the studs 14, the jigs
34 are adhered securely to the envelope inner surface
by the use of an air-hardenable room temperature ce-
ment. Satisfactory results have been obtained using a
cement of a soluble silicate binder base variety with an
inorganic particulate filler, e.g., Sauerusen No. 31 ce-
ment made by Sauerusen Cement Co., Pittsburgh,
Pennsylvania. Using a cement of the type described,
the cement may be permitted to dry at room tempera-
ture for the recommended drying time, typically 20-30
minutes, or, in the interest of hastening the drying pro-
cess, the cement may be irradiated with infra-red radia-
tion through the faceplate from the front side thereof.
It has been found that the cement-hardenning process
can be hastened from 20-30 minutes to 1-3 minutes by
the application of infra-red radiation as described.

With the jig now cemented on the faceplate with a
high degree of positional accuracy, the jig-holding bars
100 are loosened and slipped off the jigs 34, permitting
the alignment fixture 36 to be removed.

A measured quantity of frit, preferably in dry pellet
form as shown at 72, is inserted under the foot 18 of
each stud 14. It is noted at this point that the clamped
stud-body assembly is free to move against the force of
gravity in the guide 50. Thus, to insert the frit pellet 72
the stud-body assembly is merely lifted and the pellet
placed beneath.

The faceplate 22 with attached jigs 34 is then placed
in an oven and baked to cure the frit cement. By way
of example, using a frit cement of the devitrifying
solder glass type, the faceplate is preferably baked at a
temperature in the range of 400°-450° for approxi-
mately one hour. During the bake cycle, the frit pellet
72 liquefies. Because of the bias applied to the stud dur-
ing the baking operation, here shown as being accom-
plished by the use of a weight acted upon by the force
of gravity, the stud 14 is urged through the frit cement
into firm engagement with the inner surface 20 of the
faceplate 22.

The faceplate 22 with attached jigs 34 is then re-
moved from the oven and cooled to room temperature.
The clamping bars 40 are released and the body 38 re-
moved. The remaining portion of the jig 34, namely the
guide 50-pedestal 58, and the stud 14 then appear as
shown in Fig. 11. The guide-pedestal is then broken
loose and removed from the faceplate. Thus the studs
14 remain, permanently cemented to the faceplate with
a high degree of positional accuracy.

It is seen then that by this invention, a stud cementing
method and apparatus are provided by which the align-
ment fixture 36 performs its alignment functions always
at room temperature and does not have to go through
any thermal cycling. Further, because the alignment
fixture 36 is employed only for the length of time re-
quired to harden the air-hardenable cement used to ad-
here the jigs 34 to the faceplate 22, the alignment fix-
ure 36 has a relatively short duty cycle and can be used
hundreds of times during each working day. By the ob-
viating of any thermal cycling of the alignment fixture,
the alignment fixture maintains its high dimensional ac-
curacy substantially indefinitely, resulting in substantial
accuracies in the stud cementing operation.

The invention is not limited to the particular details of
construction of the embodiments depicted and other
modifications and applications are contemplated. For
example, whereas the above-described method and ap-
paratus have been depicted as applied to the cementing
of studs onto a flangeless-type face-plate, the principles
of this invention may be employed to cement studs
onto the inner surface of the flanges of a flanged-type
faceplate. For example, it is contemplated that the
principles of this invention may be implemented using
jigs of other constructions than shown and described
above. Jigs having other stud holding, guiding and bias-
ning structures may be employed. Spring bias rather
than gravitational bias may be used, for example.
Alignment fixtures other than the fixture 36 portrayed
above may be employed. The above-described stud-
cementing method is preferred, however modifications
of this method within the teachings of the invention,
and rearrangement of the steps in the above-described
method may be employed. Certain other changes may
be made in the above-described methods and apparatus
without departing from the true spirit and scope of the
invention herein involved and it is intended that the
subject matter in the above depiction shall be inter-
preted as illustrative and not in a limiting sense.

1. For use in the manufacture of color cathode ray
tubes of the type is having a color section electrode
supported in spaced relationship to a faceplate portion of
the cathode ray tube envelope, a method for securing on the
ten envelop studs

2. The apparatus defined by claim 1 wherein said
stud-holding means includes an elongated body having
a predetermined mass, said body constituting said
means for urging the stud, by the force of gravity acting
on said mass, into engagement with the envelope inner
surface.

3. The apparatus defined by claim 2 wherein said
stud-holding means includes a clamp for clamping said
body to the stud.

4. The apparatus defined by claim 3 wherein said
guide defines first and second openings spaced on a
slide axis for slideably receiving said body portion and
a shank portion of the stud.

5. The apparatus defined by claim 1 wherein said
support means comprises a plurality of feet which en-
geage the envelope inner surface and are adapted to be
individually cemented thereto.

6. In the manufacture of color cathode ray tubes of
the type having a color section electrode supported in
spaced relationship to a faceplate portion of the tube
envelope, a method for securing on the envelope studs
which are employed in supporting the electrode, comprising:
gripping the studs with respective jigs;
by the use of an alignment fixture, positioning and holding the jigs on an inner surface of the envelope
at the intended locations of the studs to temporarily support the studs at the precise intended locations thereof;
securely adhering the jigs to the envelope inner surface by the use of an air-hardenable, room temperature cement such that the studs are accurately and firmly held at said precise locations;
removing the alignment fixture;
locating between the studs and the envelope inner surface a cement of a type which cures at high temperature;
baking the faceplate with the jigs attached to cure the high temperature cement and thereby permanently affix the studs to the envelope; and
breaking loose and removing the jigs from the envelope to leave the studs permanently cemented to the envelope.

7. The method defined by claim 6 wherein the jigs each have a plurality of discrete feet which engage the envelope inner surface, and wherein said step of adhering comprises cementing the feet individually to the envelope.

8. The method defined by claim 6 wherein said method includes positively urging the stud through the high temperature cement during the baking operation and into intimate engagement with the envelope inner surface.

9. The method defined by claim 6 wherein the high temperature cement is a devitrifying solder glass which cures at temperatures above 400°F, and wherein the time and temperature of the baking operation are sufficiently long to cure said cement.

10. For use in the manufacture of color cathode ray tubes of the type having a color selection electrode supported in spaced relationship to a flangeless faceplate comprising part of the tube envelope, an alignment fixture for accurately positioning and firmly holding on the faceplate a plurality of jigs which are adapted to be temporarily secured to the inner surface of the faceplate and which act to accurately position and hold an electrode-supporting stud during a high temperature stud cementing operation, said alignment fixture comprising:
a chassis;
means carried by said chassis for detachably engaging the outer periphery of the faceplate which acts as a reference edge, and for aligning said fixture relative to the faceplate in a plane perpendicular to the faceplate axis;
a plurality of jig-holding means carried by said chassis for positioning and releasably holding a like plurality of jigs on the faceplate inner surface; and
means providing for detachment of said jig-holding means from said jigs before a faceplate baking operation, but after an operation in which the jigs are cemented temporarily to the inner surface of the faceplate.