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METHOD OF PROVIDING AN ANTI-IMPLOSION CLAMPING BAND AROUND THE ENVELOPE OF A PICTURE TUBE

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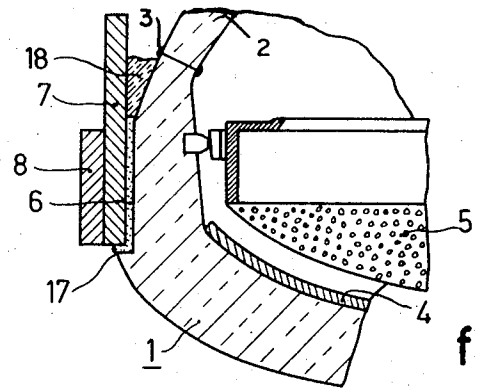

fig.1

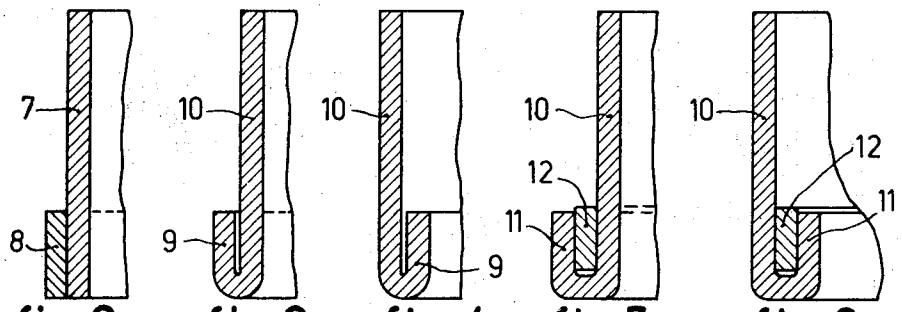

fig.2 fig.3 fig.4 fig.5 fig.6

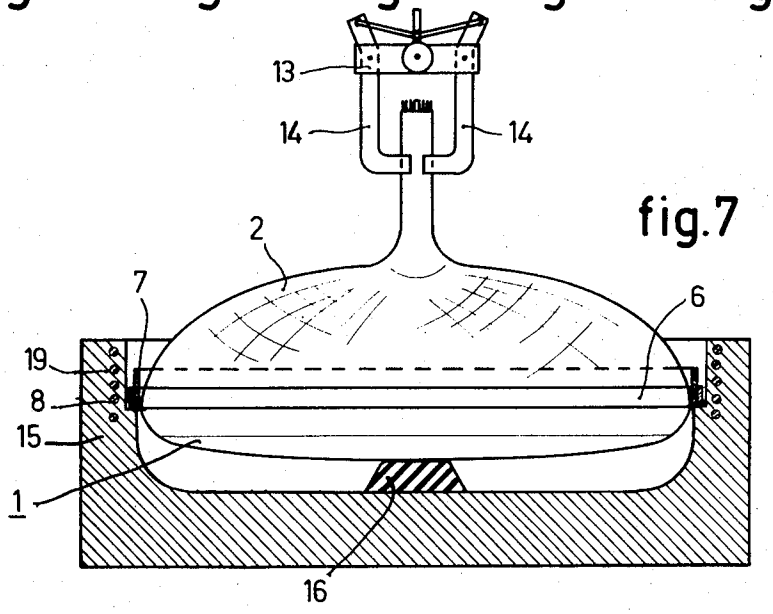

fig.7

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METHOD OF PROVIDING AN ANTI-IMPLOSION CLAMPING BAND AROUND THE ENVELOPE OF A PICTURE TUBE

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ABSTRACT OF THE DISCLOSURE

A method for providing an anti-implosion clamping band around the envelope of a television picture tube. The band comprising a frame having an aperture shaped in accordance with but smaller than the cross-sectional area of the envelope is heated without simultaneously heating the envelope to a temperature elongating the frame and enlarging the aperture of the frame to a value greater than the cross-sectional area of the envelope. In order to prevent cracking when the heated frame is positioned on the cold envelope, the surface of the tube to be clamped is covered with a heat insulating layer for example, of polyvinyl acetate or an epoxy resin. After the heated frame is positioned on the tube over the heat insulating layer and allowed to cool in this position to stress the material of the frame beyond its yield point, the space existing between the band and the envelope is filled with an adhesive.

The invention relates to a method of providing an anti-implosion clamping band around the envelope of a television picture tube. The invention relates particularly to a method in which a band frame, the aperture of which is formed in accordance with the cross-section of the region situated between the plane of the picture screen and the sealing seam of picture screen and cone, is provided around the envelope in a direction along the longitudinal axis of the tube. The invention furthermore relates to a picture tube provided with such a clamping band.

A method is known from British Pat. 977,654 in which an oversize frame is positioned around an envelope of a picture tube, the intermediate space being then filled with a filler. This method has the advantage that the tolerances of the envelope and the frame do not influence the provision of the frame or the anti-implosion effect. However, the comparatively large quantity of filler, in general a synthetic resin, is expensive while said method is restricted to a frame which borders the face-plate of the envelope. Since no noteworthy pressure is exerted on the envelope, said safeguarding is insufficient in the case in which it is desirable that the part of the wall situated between the mould match line and the face-plate of the window portion projects outside the frame.

Another anti-implosion protection is obtained by providing a clamping band around the widest part of the envelope. When the clamping band is tightened with a force exceeding 700 kg., the said restriction is not present. However, an uneven pressure over the circumference of the envelope may be set up in tightening the clamping band as a result of the friction which the band experiences particularly at the corners of a rectangular screen.

This may be avoided by heating an annular band or band frame and shrinking it onto the envelope, as has already been described in the U.S. Pat. 2,785,820.

A drawback is that, as a result of the tolerances of the envelope and frame, large deviations occur in the resulting tensile force in the band. Moreover, it will generally be necessary to preheat the envelope so as to avoid the possibility of cracking when the hot band is laid on the glass. If, however, a sufficient tensile force in the frame is to be obtained also with the most unfavourable combination of the tolerances of envelope and frame, the heating of the frame will have to take place above 400° C. In that case it is certainly necessary to preheat the envelope when the frame as such is arranged around the envelope. Moreover, the danger still exists that the band, after cooling, may burst off the envelope.

In German pat. 1,171,092 pressure is generated in an oversize band frame, by using an expanding filler. Although in this case also the influence of the tolerances of envelope and frame do not play a part, the pressure may only be very slight as a result of the low thickness of the layer of filler, and can in no case produce a large tensile force in the frame. So for this method, the above-mentioned restriction also holds that the frame must extend up to the picture plane.

This restriction does not apply to the method according to the published Netherlands patent application 6615277 in which a cold steel frame of smaller dimensions than that of the part of the envelope to be covered is forced over the envelope according to the longitudinal axis of the tube, the material of the frame being stretched beyond the yield point. Although as a result of this a large tensile force in the frame can be obtained which is independent of the tolerances of envelope and frame, while it is not necessary to heat the envelope, there exists a great danger of damaging the glass as has been proved in practice, since, as a result of the large pressure with which the steel frame rubs on the glass, any lubricant which may be provided is forced away at least locally so that the metal scours directly on the glass surface.

While maintaining the advantages, the said drawbacks can be fully avoided by a method of providing an anti-implosion clamping band in which a band frame, the aperture of which is formed in accordance with but smaller than the cross-section of the region of the envelope situated between the picture screen plane and the sealing seam of picture screen and cone, is provided around the envelope in a direction along the longitudinal axis of the tube, if, according to the invention, at least the part of the envelope which contacts the frame is covered with a heat insulating layer, the frame is heated, prior to being provided on the envelope, to such a temperature that upon cooling the frame on the envelope, the material of the frame is elongated at least to the yield point, after which the space remaining between the envelope and the frame is filled at least partly with an adhesive. The insulating layer may consist, for example, of a synthetic material, for example, polyvinyl acetate, or of a hardening synthetic material, for example, epoxy resin. If the heat insulating layer consists of an epoxy resin, the hot band is preferably provided prior to the hardening of the resin. The insulating layer protects the cold envelope from direct contact with the hot frame, so that also in the most unfavorable combination of tolerances no cracks occur upon cooling the frame on the envelope notwithstanding the fact that the frame has to be heated to 400 to 450° C. to reach the yield point of the material of the frame. The adhering material with which the space remaining between the frame and the envelope is filled may consist of an epoxy resin, but other known adhering materials, for example, polyester, urea, sulphur and the like, may also be used. The frame is preferably made so wide that it extends partly over the welding seam. This part is free from the surface of the glass, as a result of the particular shape of the envelope. This free edge of the frame is fully or partly filled with adhering material.

Since the filling is only approximately 100 gms., as against 700 gms. in an embodiment according to the above-mentioned British Pat. 977,654 the use of more expensive epoxy resin is not objectionable in this case. This resin has advantage with respect to polyester when the tube is exposed to very low temperaures.

In the case in which the frame is entirely provided on the cone-side of the mould match line, a tensile force of at least 500 to 700 kgms. must be present in the frame. This is obtained by reinforcing the edge of the frame situated near the mould match line by means of a separate steel band or by folding said edge in two. In that case the cross-section of the frame must be at least 16 to 22 sq. mm. when the yield point lies at approximately 33 kgms./sq. mm. In a frame consisting of carbon steel with a yield point of 33 kgms./sq. mm. and a cross-section of 20 sq. mm. pressing on the envelope, the tensile force in the frame hence is 660 kgms. independent of the tolerances. An extra band of 10 x 0.8 mm. cross-section across the frame at the side of the mould match line already increases the tensile force to $(20+8).33=924$ kgms.

In order that the invention may be readily carried into effect, it will now be described in greater detail, by way of example with reference to the accompanying drawing, in which

FIG. 1 is a cross-sectional view of an envelope of a color television tube, while

FIGS. 2, 3, 4, 5 and 6 are cross-sectional views of various embodiments of band frames, and

FIG. 7 diagrammatically shows an arrangement for providing a hot band frame around a picture tube, which is otherwise fully finished.

Referring now to FIG. 1, a glass window for a color picture tube is welded to a cone **2** by means of a layer of glaze **3**. A phosphor screen **4** and a shadow mask **5** are provided in the window portion **1**.

At the place of the envelope between the mould match line **17** and the welding seam **3**, a heat insulating layer **6** is provided consisting of polyvinyl acetate or epoxy resin, on which the clamping frame **7** is provided. Around the edge of the frame near the mould match line **17**, an extra reinforcing band **8** is provided. The remaining space between the frame and the envelope is filled with an adhering material **18** up to the welding seam **3**. The glaze welding seam **3** is preferably not covered with adhering material so as to avoid damage to the seam due to the difference in coefficients of expansion of adhering material and glass. In the case of a direct glass seal of the cone **2** to the window **1**, such as in black-and-white picture tubes, the adhering material **18** can be fully provided up to the upper edge of the frame **7**.

The cross-section of the frame **7** may have different shapes as is shown in FIGS. 2 to 6. In FIG. 2, a reinforcing band **8** is provided around the frame. In FIG. 3, the edge of the frame **10** is folded outwards, in FIG. 4 inwards to form a band **9**. In FIG. 5, a clamping band **12** is arranged in the pleat of the frame **10** so that the band **12** is clamped by the folded edge **11**. In FIG. 6 a similar construction is used, this time on the inside of the frame **10**. The cross-sections of the frames of these figures are, for example, 50 mms. high 0.8 mm. wide, a height of 25 mms. engaging the envelope and being hence mainly decisive of the pressure exerted on the envelope by the frame **7, 10**. The cross-section of the band **8, 12** is, for example, 10 x 0.8 mms.

According to the invention, for example, a steel band frame **7** with steel band **8, 9** is heated in an oven **15** by means of a filament **19** at 450° C. The cold picture tube which is otherwise fully finished, is taken, with its picture plane of the window **1** downwards, by a gripping device **13** shown diagrammatically and comprising arms **14**. The tube is then lowered in the position shown, according to the longitudinal axis of the tube into the hot frame **7** with band **8**. The envelope is previously provided with an epoxy-

heat-insulating layer **6**. The frame **7** with band **8**, hence slides around the envelope over the epoxy layer **6**, which preferably is not yet hardened, until the window portion **1** engages a stud **16** which may consist, for example, of rubber. This presents no difficulties because the heated frame always is a little wider than the envelope. Heating is then switched off. As a result of the heat, the material of the insulating layer **6** softens and even burns partly. It is found, however, that said layer has such a heat insulating effect that the temperature shock which the envelope experiences during providing the hot band is sufficiently damped to prevent cracking of the glass. The remaining parts of the insulating layer solidify after cooling or harden by the heat of the frame **7**, and prevent the frame **7** from bursting off the envelope before the adhering material **18** poured in the space between the envelope and the frame has hardened. The inside of the frame is preferably roughened to improve the adhesion.

Since sliding the hot frame over the envelope is effected without pressure, the hot frame being always larger than the largest cross-section of the cold envelope, danger of scratching the glass is not present.

For reaching the yield point of the steel of the frame **7** and the band **8** it is necessary for the band to shrink at least 3 mms. with an inner circumference of approximately 1600 mms., which must hence be the case in the most unfavourable combination of the tolerances, i.e. the smallest envelope with the widest frame. In the cold condition the frame, with the normal tolerances, has an inner circumference which with the said dimension for a picture screen with a diagonal of 53 cms., (=21") is 3.5 to 6.5 mms. shorter than the circumference of the envelope near the mould match line. The tolerance for the circumference of the envelope is ±0.5 mm., so totally 1 mm. and for the frame totally only 0.33 mm. When the coefficient of thermal expansion of the steel of the frame is 14.3×10^{-6}, the inner circumference increases by approximately 9.8 mms. upon heating from room temperature (20° C.) to 450° C. so that also in the case of the most unfavourable combination of the smallest envelope and the largest frame the elongation of the frame upon cooling is always more than 3 mms.

Although only a few embodiments of frames which are suitable for the method according to the invention have been described, the frame may also have different cross-sections and, if desired, also have the shape of a narrow thick annular band.

What is claimed is:

1. A method for providing an anti-implosion clamping band around the envelope of a television picture tube comprising, forming from material having a positive temperature coefficient of expansion a clamping frame having an aperture shaped in accordance with the cross-sectional area of said envelope, said frame being sufficiently smaller than the cross-sectional area of said envelope that expansion of the frame to the size of the envelope stresses the material of the frame beyond its yield point, heating said frame without simultaneously heating said envelope to a temperature of 400° C. to about 450° C., for elongating said frame thereby to enlarge said aperture thereof to a value greater than the cross-sectional areas of said envelope, covering outer glass surfaces of said envelope to be clamped with a layer of material, placing said envelope through the aperture of said heated frame to position said frame over said layer of material and cause said layer of material to melt and thereby function as a heat-insulating and lubricating layer, cooling said frame positioned upon said envelope to stress said frame material beyond said yield point, and filling spaces between said envelope and said frame with an adhesive.

2. A method as claimed in claim **1** wherein said layer of heat insulating material consists of a synthetic material.

3. A method as claimed in claim 1 wherein said layer of heat insulating material further consists of a hardening synthetic material which has not yet hardened.

4. A method as claimed in claim 1 wherein said layer of heat insulating material further consists of an epoxy resin.

5. A method as claimed in claim 1 wherein said layer of heat insulating material further consists of polyvinyl acetate.

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