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METHOD OF MANUFACTURING AN INSULATING
MEMBER AND APPARATUS THEREFOR

5 This invention relates to an electric insulator being
capable of insulating between high voltage stem pins, e.g.
in a cathode ray tube used for an electric equipment
provided with high voltage electrodes, which electric
equipment particularly includes color television picture
10 tubes and monitor of image screens and computers, and for
other electrodes being subjected to a high voltage, and
relates to an electric insulation device using thereof, and
further relates to a method of electrical insulation using
the electric insulator.

15 The cathode ray tube described above is a typical
example of the electric equipment provided with high
voltage electrodes. The high voltage inter-stem pin
electric insulator in a cathode ray tube of prior art and
the method for producing a cathode ray tube using the
20 insulator are described below referring to Fig. 1 and Fig.
2.

Fig. 1 illustrates the method of electric insulation
between stem pins including a high voltage stem pin of
prior art. Fig. 1A shows a stem base, and Fig. 1B shows a
25 neck of the cathode ray tube. Fig. 2 illustrates the neck

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of cathode ray tube structured in accordance with the method of electrical insulation illustrated in Fig. 1. Fig. 2A gives a view of the neck, and Fig. 2B gives the cross sectional view along A-A line in Fig. 2A.

5 In Fig. 1B, the reference number 1 designates the neck of a cathode ray tube which is installed in a color television picture tube or a monitor for image screen or computer. The neck accepts an electron gun being mounted on a stem 2, which is not shown, by inserting therein, and
10 the stem 2 is provided with more than one stud electrode, stem pins 3A, 3B, 3C, etc. The glass periphery of the stem 2 and the glass edge periphery of the neck 1 are welded together to integrate them. The assembled cathode is evacuated through the tip 4 of the exhaust pipe formed at
15 the center of the stem 2, then the tip 4 is sealed. The stem pins 3A, 3B, 3C, etc. are studded along a specified pin pitch circle.

 In Fig. 1A, the reference number 10 designates a stem base. The stem base 10 consists of a bottom disc plate 11,
20 a tip acceptor 12 which is formed at the center of the bottom disc plate 11 and protects the tip 4, an acceptor for high voltage stem pin 10 in a fan-shape to receive a high voltage stem pin 3B and acts also as a part of the side wall of the tip acceptor 12, a skirt 14 which covers
25 the edge periphery of the neck 1 formed at the periphery of



the bottom plate 11 and which prevents sagging of the paste electric insulator 5, and more than one throughhole, 15A, 15B, 15C, etc. aligning to the stem pins 3A, 3B, 3C, etc. formed at the periphery of the bottom plate 11.

5 A common material for the stem base 10 is a resin such as polycarbonate which has excellent insulation property. The dielectric breakdown voltage of polycarbonate resin is 30 KV/mm.

10 A conventional method to electrically insulate between the stem pins 3A, 3B, 3C, etc. being studded onto the stem 2 on the neck 1 of cathode ray tube is to evacuate the cathode ray tube, to seal the tip 4, then, as illustrated in Fig. 1B, to insert the nozzle of a tube 6 filled with paste electric insulator 5 between the stem
15 pins 3A, 3B, 3C, etc. of the stem 2, and to squeeze out to apply a small amount of the electric insulator 5 from the tube 6 using fingers 7.

 The stem base 10 shown in Fig. 1A is placed on the applied electric insulator 5 in a manner that
20 the tip acceptor 12 accepts the tip 4 and that the acceptor for high voltage stem pin 13 accepts the high voltage stem pin 3B and that each of the throughholes 15A, 15B, 15C, etc accepts corresponding stem pin 3A, 3B, 3C, etc. under a slight
25 compression. Then, the configuration becomes to the one



illustrated in Fig. 2. The structure assures the electric insulation between the stem pins, 3A, 3B, 3C, etc.

As realized in the present color television picture tubes and monitors for image screens and computers, the cathode ray tubes for these equipments are requested to have high brightness and high resolution. To cope with the ever increasing demand, a high voltage is applied not only to the anode of cathode ray tube but also to the electrode of electron gun in the cathode ray tube. In particular, a focus electrode is unavoidably applied with a high voltage for improving the focusing characteristic.

The outside diameter of the neck 1 receiving the electron gun has an upper limit from the standpoint for saving the deflection power of electron gun. Consequently, the area of stem 2 is limited. Since such a limited area of the stem 2 receives the stem pins 3A, 3B, 3C, etc., which receive various levels of voltage, the spacing of these stem pins 3A, 3B, 3C, etc. becomes narrow.

For example, a color cathode ray tube for monitoring a graphic display made by SONY CORP. has the pin pitch circle diameter of 15.24 mm, and the number of studded pins is 14 with the pin spacing of 3.42 mm.

Among these stem pins, 3A, 3B, 3C, etc., the stem pin 3A, for example, is called the G1 pin which is applied with a voltage of 0 to several volts, and the stem pin 3B is the



one for focus electrode which is applied with maximum 9800 volts, and the stem pin 3C is the one to supply voltage to the convergence electrode and is applied with 0 to 2000 volts.

Accordingly, there exists the difference of maximum 9800 volts between the stem pin 3A and the stem pin 3B, and the maximum 8750 volts between the stem pin 3B and the stem pin 3C. For a new cathode ray tube, or if the surface of the glass stem 2 is clean, the glass dielectric breakdown voltage (the lead along the stem glass surface) between the stem pins 3A and 3B and between the stem pins 3B and 3C has not problem. However, a temperature rise or deposition of dust or dirt caused by static charge degrades the dielectric breakdown voltage during operation, or an excess voltage over the dielectric breakdown voltage is often applied to the stem pins, so the dielectric breakdown voltage is not necessarily secured during operation.

To assure the necessary dielectric breakdown voltage, conventional technology uses a paste silicone resin of a room-temperature-curing type such as KE03490 made by Shin-Etsu Chemical Co. Ltd. and SE-9168 made by Toray Dow Corning Co., Ltd. That type of resin is hereinafter referred to simply as "RTV resin".

The RTV resin has basic electric characteristics, but it lacks flowability because of its paste property. As



illustrated in Fig. 1B, the RTV resin 5 is squeezed out from the tube 6 between the stem pins before mounting the stem base 10 to the stem 2, then the stem base 10 is attached. Usually, the application of RTV resin 5 is manually carried out.

However, the RTV resin raises several problems such that it likely includes bubbles during application work, and that a solvent existing in itself foams at a temperature range of from 80 to 120°C under the heat generated during the aging stage for activating the cathode of electron gun, and that bubbles occur during the insertion and withdrawal of connector of an instrument employed several times of inspection in the period from the application of RTV resin to the complete curing, (normally 7 days), which bubbles interfere the perfect functioning of electric characteristics of the resin and degrades the dielectric breakdown voltage and, in the worst case, discharge occurs between stem pins to damage the cathode ray tube.

The inventors solved these problems by providing the following invention.

1. The first aspect of the invention is an electric insulator as an electric insulator for inter-electrode such as inter-stem pin for high voltage service in a cathode ray tube, which



electric insulator comprises:

(1) An electric insulator comprising a clay-like silicone compound being formed to secure electrical insulation between stem pins or the like for high voltage service in a cathode ray tube.

(2) An electric insulator of (1), wherein the silicone compound has a volume resistivity ranging from 1×10^{12} to $1 \times 10^{15} \Omega \cdot \text{cm}$ and a dielectric breakdown strength ranging from 10 to 30 KV/mm.

(3) An electric insulator of (1), wherein the clay-like insulator has a degree of plasticity giving a deformation ranging from 4/10 to 7/10 under a compression of 19 Kg-f.

(4) An electric insulator of (3), wherein a thickness of the formed shape is in a range of from 0.8 to 2.0mm.

(5) An electric insulator of (1) through (4), wherein more than one throughhole are formed corresponding to at least a spacing of electrodes of an electric equipment and being acceptable of these electrodes penetrating therethrough.

(6) An electric insulator of (1) through (5), wherein throughholes corresponding to more than one stem pin including a high voltage stem pin in a cathode ray tube and to a tip of exhaust pipe of the cathode ray tube are



formed.

2. The second aspect of the invention is a stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip of exhaust pipe of the cathode ray tube, wherein the electric insulator is attached to the stem base while aligning these throughholes with the throughholes of the electric insulator described in (6) of 1.

3. The third aspect of the invention is an inter-stem pin electric insulation device in a cathode ray tube, which comprises: a stem of a cathode ray tube; and electric insulator described in 1 being attached to the external surface of the stem in a manner being penetrated by more than one stem pin including a high voltage stem pin which are protruding from the external surface of the stem and by a tip of exhaust pipe of the cathode ray tube; a stem base provided with throughholes, a tip acceptor, and an acceptor for high voltage stem pin, being placed and fixed in a manner that the stem pins penetrate the throughholes and that the stem base covers the tip at the tip acceptor and that the high voltage stem pin is isolated at the acceptor for high voltage stem pin.

4. The fourth aspect of the invention is a method for producing a cathode ray tube, which comprises: attaching an electron gun provided with more than one stem pin including a high voltage stem pin and with a stem introducing an exhaust pipe to a neck of funnel which structures a tube body; welding the periphery of the neck edge with the periphery of the stem; forming a tip and closing it after evacuating the tube



body through the exhaust pipe; attaching a clay-like electric insulator consisting of silicone compound which was formed aligning each of throughholes for receiving the stem pins and the tip of exhaust pipe; fitting the integrated stem base by penetrating the stem pins and the tip therethrough, and mounting and fixing the stem base to the stem.

Accordingly, an electric insulator of this invention suppresses the generation of bubbles described above or further eliminates the bubble formation, completely prevents the leak along surface which is also described above, secures the electric insulation between high voltage stem pins or the like in a cathode ray tube, and does not damage the cathode ray tube.

Since the electric insulator of this invention is a clay-like formed shape, the work for insulating high voltage stem pins or the like each other in a cathode ray tube is performed at a significantly improved efficiency.

In addition, the use of a stem base being attached with the electric insulator of this invention enhances the efficiency of the work for insulating high voltage stem pins or the like each other.

Furthermore, the use of a stem base of this invention allows a mechanical mounting of electric insulation device between high voltage stem pins or the like instead of



conventional manual work. The mechanical mounting procedure leads to the automatic operation.

The present invention will be further described hereinafter with reference to the following description of
5 exemplary embodiments, and the accompanying drawings, in which:-

Fig. 1 illustrates the method of electric insulation between stem pins including a high voltage stem pin of related art. Fig. 1A shows a stem base, and Fig. 1B shows
10 a neck of the cathode ray tube.

Fig. 2 illustrates the neck of cathode ray tube structured in accordance with the method of electrical insulation shown in Fig. 1. Fig. 2A gives a view of the neck, and Fig. 2B gives the cross sectional view along A-A
15 line in Fig. 2A.

Fig. 3 shows an electric insulator of the first embodiment in the present invention. Fig. 3A gives a view of the electric insulator. Fig. 3B shows the cross sectional view along A-A line of Fig. 3A.

20 Fig. 4 illustrates the procedure for attaching the electric insulator of Fig. 3 of the second embodiment in the present invention onto the stem base. Fig. 4A gives a view of the electric insulator of Fig. 3. Fig. 4B gives a



view of the electric insulator viewing from the stem side.
Fig. 4C is a stem base attached

Fig. 5 illustrates the structure of an electric
insulation device of the present invention of the neck of
5 cathode ray tube which uses the electric insulator for
more than one stem pins including a high voltage stem pin
is effected using the electrical insulator shown in Fig. 1
or the stem base shown in Fig. 4. Fig. 5A gives a view of
the device. Fig. 5B shows the cross sectional view along
10 A-A line in Fig. 5A. Fig. 5C shows a cross sectional view
of the stem of neck structuring the cathode ray tube.

An electric insulator of this invention, an electric
insulation device using the electric insulator, and a
method for producing a cathode ray tube using the electric
15 insulator are described below referring to Fig. 3 through
Fig. 5.

Fig. 3 shows an electric insulator of this invention.
Fig. 3A gives a bird eye view of the electric insulator,
and Fig. 3B shows the cross sectional view along A-A line
20 of Fig. 3A.

Fig. 4 illustrates the procedure for attaching the
electric insulator of Fig. 3 onto the stem base. Fig. 4A
gives a bird eye view of the electric insulator of Fig. 3.
Fig. 4B gives a bird eye view of the electric insulator
25 viewing from the stem side. Fig. 4C is a stem base attached



with an electric insulator of this invention.

Fig. 5 illustrates the structure of an electric insulation device of this invention of the neck of cathode ray tube in which electric insulation between several stem pins including a high voltage stem pin is effected using the electrical insulator shown in Fig. 3 or the stem base shown in Fig. 4. Fig. 5A gives a bird eye view of the device. Fig. 5B shows the cross sectional view along A-A line in Fig. 5A. Fig. 5C shows a cross sectional view of the stem of neck structuring the cathode ray tube.

The components common to those in the figures of related art, such as the electric device of high voltage inter-stem pin in cathode ray tube, have the same reference numbers with each other.

The following is the description of an electric insulator of the first embodiment in present invention.

Referring to Fig. 3, the electric insulator 20 of this invention is formed to a disc having a thickness described below. The disc has a throughhole 21 for receiving a tip 4 at the center, and has throughholes 22A, 22B, 22C, etc. for receiving stem pins 3A, 3B, 3C, etc. including the high voltage stem pin 3B, at an each corresponding position.

Those throughholes may be formed at a time when the electric insulator 20 is punched from a large flat electric insulator using a forming die. The punching of the



throughhole 21 for tip is preferably carried out to have a cross slit 23 at the inner periphery of the throughhole 21.

The electric insulator 20 with that type of slit 23 makes the insertion of tip 4 into the throughhole 21 easy and assures a close contact of the outer periphery of the tip 4 with the inner periphery of the throughhole 21, which ensures the electric insulation.

The electric insulator 20 is a clay-like silicone compound. An example of that type of silicon compound uses "Putty-stock SMX-5999" made by Fuji Polymer Co. Ltd. as the basic component. By mixing a plasticizer to "Putty-stock SMX-5999", the electric insulator 20 having an adequate degree of plasticity is obtained.

Fig. 3 shows an example of the electric insulator 20 having the tip-throughhole 21, the pin-throughholes 22A, 22B, 22C, etc., and the slit 23. An electric insulator may otherwise simply be formed by punching a silicone compound to the outside diameter, and it is pressed to the tip 4 of the neck 1 and to the stem pins 3A, 3B, 3C, etc. to open these throughholes using a compression force, and then mounting it to the stem 2. Nevertheless, an electric insulator 20 which forms the throughholes shown in Fig. 3 in advance has an advantage that the tip 4 and the stem pins 3A, 3B, 3C, etc. are easily mounted without defecting the shape of the insulator.



The inventors carried out further extensive study and invented the stem base 40 with electric insulator, which is the second invention shown in Fig. 4C.

The stem base 40 with electric insulator is formed by attaching the electric insulator 20 shown in Fig. 4A (Fig. 3) to the stem base 30 to integrate them. The material of the stem base 30 may be a high insulation resin such as polycarbonate which is used in prior art.

As illustrated in Fig. 4B, the stem base 30 consists of: a tip-throughhole 32 which is opened at the center of the disc base plate 31 and which accepts the tip 4; pin-throughholes 33A, 33B, 33C, etc. including the high voltage stem pin 3B, which are arranged along the peripheral pitch circle on the base plate 31 and which receive stem pins

3A, 3B, 3C, etc. at each corresponding position; and the tip acceptor 34 and acceptor for high voltage stem pin 35 locating on the side not facing the stem 2 of the base plate 31 to protect the tip 4 of the neck 1.

The stem base 30 has no skirt 14 which is seen on the stem base 10 of prior art. The skirt 14 may be formed at need. However, this invention uses a clay-like electric insulator 20 and is not the type of paste electric insulator 5, so there is not possibility of sagging of the insulator. Therefore, no skirt 14 is required in this invention. Moreover, elimination of the skirt 14 allows an easy



production of the stem base 40 with electric insulator, which stem base 40 is described below.

The following is the third embodiment of the present invention. The stem base 40 with electric insulator is formed by attaching the electric insulator 20 shown in Fig. 3 to the stem base 30 in advance while aligning each of the tip-throughhole 21, pin-throughholes 22A, 22B, 22C, etc. with the tip-throughhole 32, pin-throughholes 33A, 33B, 33C, etc. on the stem base 30, respectively. In other words, the stem base 40 with electric insulator has an integrated structure of the electric insulator 20 and the stem base 30.

When this type of stem base 40 with electric insulator is prepared in advance, the production line of cathode ray tubes at an assembly plant is shortened, and a special advantage is given in automatic mounting of the stem base 40 with electric insulator to the stem 2 as described before. Furthermore, even if the assembly is carried out manually, the workability should be significantly improved.

Accordingly, as illustrated in Fig. 5, the stem base 40 with electric insulator of this invention is attached to the evacuated neck 1 of a cathode ray tube under a compression force while aligning the tip-throughhole 32 with the tip-throughhole 21 on the mating electric insulator 20 and aligning each pin-throughholes 33A, 33B, 33C, etc. with the pin-throughholes 22A, 22B, 22C, etc. on the mating



electric insulator 20, and with the stem pins 3A, 3B, 3C, etc., respectively, and while pressing down the stem base 40 with electric insulator at the mating state to firmly contact the stem 2. The compression force is described later. In this manner, the inter-stem insulation is performed using the electric insulation device shown in Fig. 5A and Fig. 5B.

Otherwise, the electric insulator 20 shown in Fig. 3 may be directly mounted on the stem pins, 3A, 3B, 3C, etc. and the tip 4 of the stem 2, and may further accept the stem base 30 as shown in Fig. 4B or the stem base 10 of prior art. However, the stem base 40 with electric insulator of this invention shown in Fig. 2C is used, the mounting can be performed by a robot, which means that the production line of cathode ray tubes is automated.

Either electric insulator of this invention may be used to enhance the curing by the heat of cathode aging (80 - 120°C) after mounting the electric insulator to the stem 2 at room temperature as described before. Since the electric insulator of this invention has a clay-like property, the amount of included solvent is quite small compared with the paste electric insulator of prior art. As a result, the generation of bubbles in the curing stage due to the heat is minimum, and the required breakdown voltage is secured.

The following is experimental examples of the clay-like silicone compound electric insulator of this invention.



Experimental Example 1

The clay-like silicone compound used had the following properties. The experiments were conducted with various thickness, T, of the electric insulator 20 shown in Fig. 3B.

1. Volume resistivity: $1 \times 10^{14} \Omega \cdot \text{cm}$
2. Dielectric breakdown strength: 25 KV/mm
3. Diameter of pin-throughhole: 0.97mm
4. Degree of plasticity (Note 1): $1/2$
5. Adhesive force (Note 2): 10 Kg*f
6. Thickness: 0.5, 0.8, 1.3, 1.8, 2.0, and 2.3mm

The clay-like silicone compound having the above listed properties was formed in a forming die to prepare the electric insulator 20 having the diameter of 22mm, the pin-throughhole spacing of 4mm corresponding to the space of stem pins 3A and 3B and of stem pins 3B and 3C. The electric insulator 20 was mounted to the stem 2 to measure the dielectric breakdown voltage between stem pins. The result is summarized in Table 1.

The term "degree of plasticity" means that the rate of shrinking of the sample thickness determined by sandwiching the clay-like silicone compound of 10mm square between glass plates and by applying a compression force of 10 Kg*f.

The term "adhesive force" means that the adhesive force determined by sandwiching the sample between a glass plate and the stem base 30 shown in Fig. 4B and by applying a



compression force of 10 Kg.f.

Table 1

Thickness of electric insulator (mm)	0.5	0.8	1.3	1.8	2.0	2.3
Inter-pin dielectric breakdown voltage (KV)	10	30	38	45	37	15

The figures of dielectric breakdown voltage are the average of 20 samples.

The depth, D, of the recess 2A on the stem 2 shown in Fig. 5C, which recess generated during the closing stage of the cathode ray tube, was normally in a range of from 0.3 to 0.5 mm. An electric insulator 20 having the thickness of 0.5 mm had a tendency of incapable of absorbing the recess 2A and degraded the dielectric breakdown voltage. When the thickness of the electric insulator 20 exceeds 2.0 mm, the thickness was too large and a loose mount occurred. In both cases, a preferable thickness of the electric insulator 20 was in a range of from 0.8 to 2.0 mm.

Experimental Example 2

The clay-like silicone compound used had the following properties. The experiments were conducted with various degree of plasticity of the electric insulator 20 shown in Fig. 3.

1. Volume resistivity: same as in Experimental example 1
2. Dielectric breakdown strength: same as in Experimental



Example 1

3. Diameter of pin-throughhole: same as in Experimental Example 1
4. Degree of plasticity: 2/10, 4/10, 5/10, 6/10, 8/10
5. Adhesive force: same as in Experimental Example 1
6. Thickness: 1.8 mm

The clay-like silicone compound having the above listed properties was formed in a forming die to prepare the electric insulator 20 having the diameter of 22 mm, and the pin-throughhole spacing of 4 mm corresponding to the space of stem pins 3A and 3B and of stem pins 3B and 3C. The dielectric electric insulator 20 was mounted to the stem 2 to measure the breakdown voltage between stem pins. The result is summarized in Table 2.

Table 2

Degree of plasticity of electric insulator	2/10	4/10	5/10	7/10
Inter-pin dielectric breakdown voltage (KV)	12	35	45	40

The experimental results showed a tendency that an electric insulation having a lower degree of plasticity (excess hardness) could not absorb the recess 2A of the stem 2 as observed in Experimental example 1, and likely left



bubbles in the insulator, and degraded the breakdown voltage.

As described above, the electric insulator of this invention induces no degradation of dielectric breakdown voltage between stem pins nor fracture caused by unwelcome phenomena such as the generation of bubbles or irregular application of resin which are the disadvantages of conventional RTV resin. Consequently, the electric insulator of this invention does not suffer a discharge between pins and fully utilizes the electric characteristics inherent to silicon compound. In addition, the electric insulator of this invention can form the pin-throughholes and tip-throughhole simultaneously with the punching to form itself in a forming die, which allows the mass-production of electric insulators which are easy to mount on stems.

Furthermore, the stem base with electric insulator of this invention is easily handled manually, as described before, and is mounted by a mechanical means, and allows an automatic mounting. Accordingly, this invention provides various effects as described above.

The detailed description given above used a cathode ray tube as an example. This invention, however, is not limited to the cathode ray tube, and naturally deals with the electric insulation between electrodes of electric equipment such as between electrodes of a high voltage transformer actuating under a high voltage.



known voltage.
this



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CLAIMS

1. An electric insulator comprising a clay-like
silicone compound being formed to secure electrical
5 insulation between stem pins or the like for high voltage
service in a cathode ray tube.

2. An electric insulator of claim 1 or 2, wherein the
silicone compound has a volume resistivity ranging from 1×10^{12} to $1 \times 10^{15} \Omega \cdot \text{cm}$ and a dielectric breakdown strength
10 ranging from 10 to 30 KV/mm.

3. An electric insulator of claim 1, wherein the
clay-like insulator has a degree of plasticity giving a
deformation ranging from about 4/10 to about 7/10 under a
compression of 19 Kg. f.

15 4. An electric insulator of claim 1, 2 or 3, wherein
a thickness of the formed shape is in a range of from 0.8
to 2.0 mm.

5. An electric insulator of any one of claims 1 to 4,
wherein more than one throughhole are formed corresponding
20 to at least a spacing of electrodes of an electric
equipment and being acceptable of these electrodes
penetrating therethrough.

6. An electric insulator of any one of claims 1 to 5,
wherein throughholes corresponding to more than one stem
25 pin including a high voltage stem pin in a cathode ray tube

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and to a tip of exhaust pipe of the cathode ray tube are formed.

7. A stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip
5 of exhaust pipe of the cathode ray tube, wherein the electric insulator is attached to the stem base while aligning these throughholes with the throughholes of an electric insulator according to claim 6.

8. An inter-stem pin electric insulation device in a
10 cathode ray tube comprising: a stem of a cathode ray tube; and electric insulator according to any one of claims 1 to 6 being attached to the external surface of the stem in a manner being penetrated by more than one stem pin, including a high voltage stem pin, which protrude from the
15 external surface of the stem and by a tip of exhaust pipe of the cathode ray tube; a stem base provided with throughholes, a tip acceptor, and an acceptor for high voltage stem pin, being placed and fixed in a manner that the stem pins penetrate the throughholes and that the stem
20 base covers the tip at the tip acceptor and that the high voltage stem pin is isolated at the acceptor for high voltage stem pin.

9. A method for producing a cathode ray tube comprising; attaching an electron gun provided with more
25 than one stem pin including a high voltage stem pin and

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with a stem introducing an exhaust pipe to a neck of funnel which structures a tube body; welding the periphery of the neck edge with the periphery of the stem; forming a tip and closing it after evacuating the tube body through the
5 exhaust pipe; attaching a clay-like electric insulator consisting of silicone compound which was formed aligning each of throughholes for receiving the stem pins and the tip of exhaust pipe therethrough; fitting the integrated stem base by penetrating the stem pins and the tip, and
10 mounting and fixing the stem base to the stem.

10. An electric insulation constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.

15 11. A cathode ray tube constructed substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.

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A B S T R A C T**METHOD OF MANUFACTURING AN INSULATING**
MEMBER AND APPARATUS THEREFOR

5 This invention secures the breakdown voltage between
stem pins or the like for high voltage service in a
cathode ray tube. This CRT formed clay-like silicone
compound having a tip-throughhole and pin-throughholes or a
stem base with the electric insulator mounted to the stem
10 base, and a inter-stem electric insulation device is
structured by mounting either one of the electric insulator
or the stem base with the electric insulator to the stem
of a cathode ray tube and by pressing to fix together.
This structure does not occur bubble generation caused by
15 the electric insulator, and makes the handling easy, and
furthermore, accomplish an automatic mounting of the
electric insulator to a stem.

FIGURE 5B

Company 2056

1/4

FIG. 1A

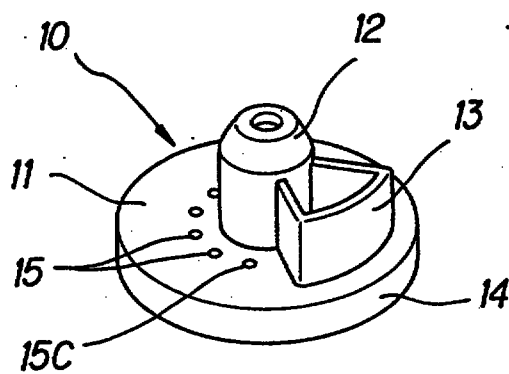
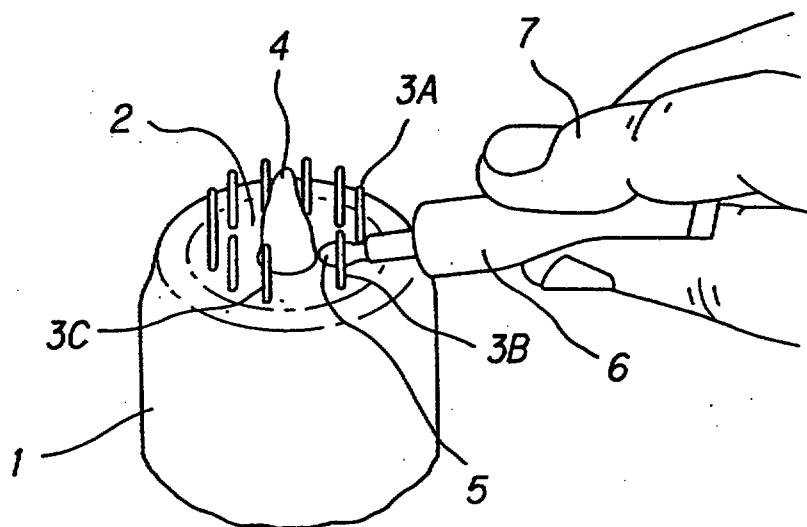


FIG. 1B



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FIG. 2A

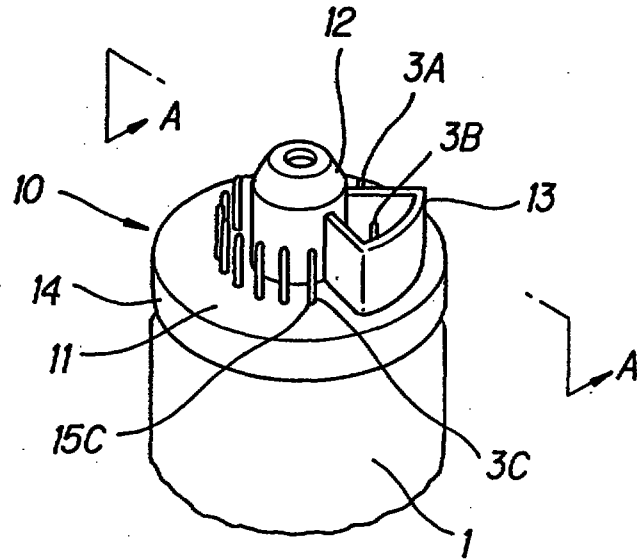


FIG. 2B

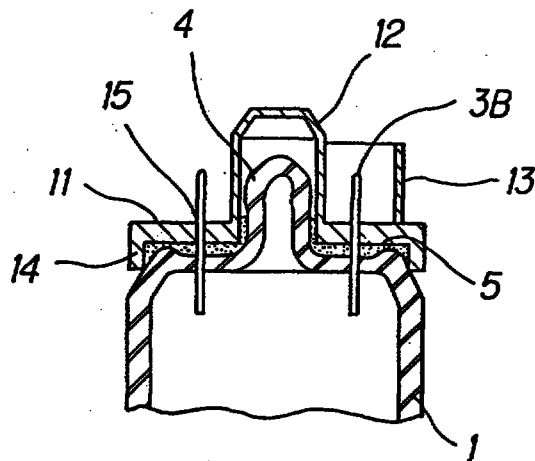


FIG. 3A

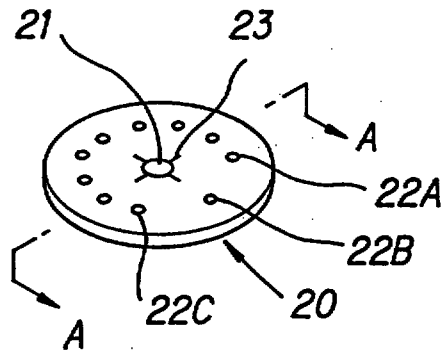


FIG. 3B

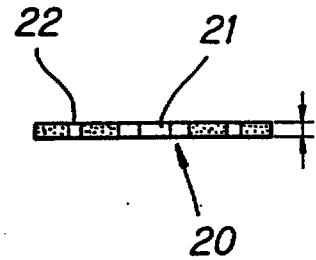


FIG. 4A

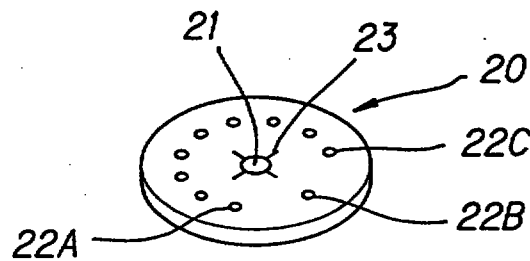


FIG. 4B

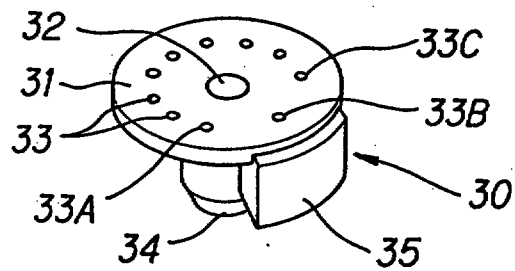
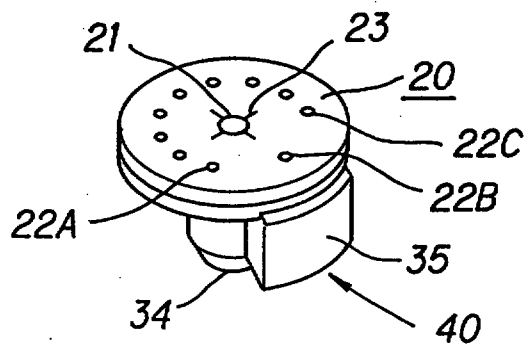


FIG. 4C



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FIG. 5A

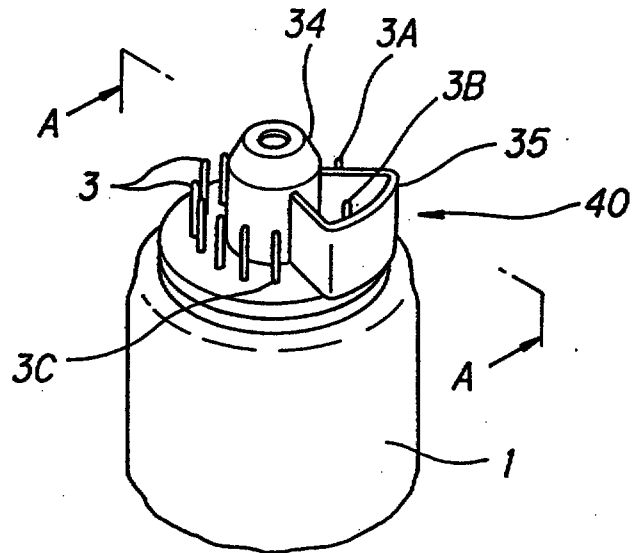


FIG. 5B

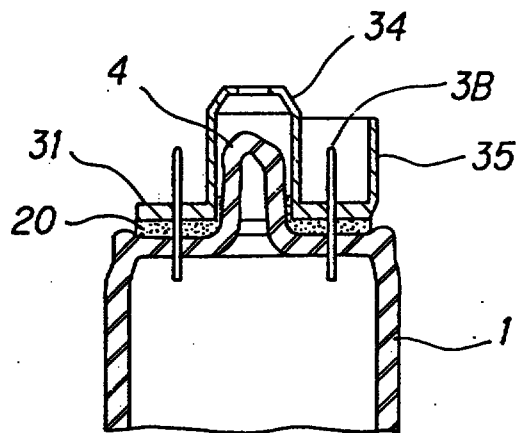
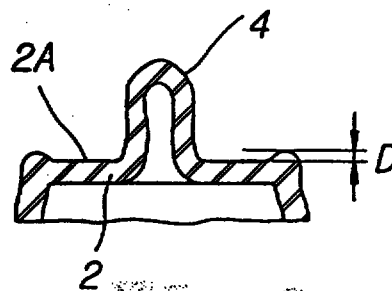


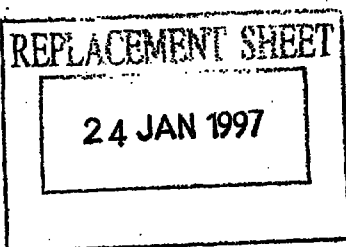
FIG. 5C



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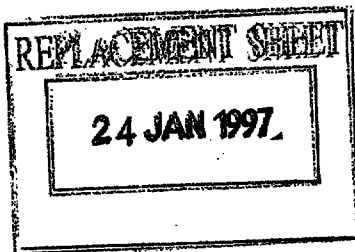
METHOD OF MANUFACTURING AN INSULATING
MEMBER AND APPARATUS THEREFOR

- 5 This invention relates to an electric insulator being
capable of insulating between high voltage stem pins, e.g.
in a cathode ray tube used for an electric equipment
provided with high voltage electrodes, which electric
equipment particularly includes color television picture
10 tubes and monitor of image screens and computers, and for
other electrodes being subjected to a high voltage, and
relates to an electric insulation device using thereof, and
further relates to a method of electrical insulation using
the electric insulator.
- 15 The cathode ray tube described above is a typical
example of the electric equipment provided with high
voltage electrodes. The high voltage inter-stem pin
electric insulator in a cathode ray tube of prior art and
the method for producing a cathode ray tube using the
20 insulator are described below referring to Fig. 1 and Fig.
2.

Fig. 1 illustrates the method of electric insulation
between stem pins including a high voltage stem pin of
prior art. Fig. 1A shows a stem base, and Fig. 1B shows a
25 neck of the cathode ray tube. Fig. 2 illustrates the neck

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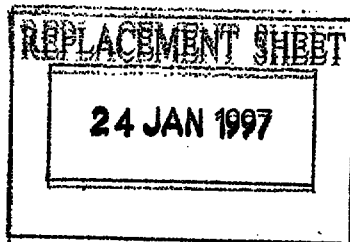


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of cathode ray tube structured in accordance with the method of electrical insulation illustrated in Fig. 1. Fig. 2A gives a view of the neck, and Fig. 2B gives the cross sectional view along A-A line in Fig. 2A.

5 In Fig. 1B, the reference number 1 designates the neck of a cathode ray tube which is installed in a color television picture tube or a monitor for image screen or computer. The neck accepts an electron gun being mounted on a stem 2, which is not shown, by inserting therein, and
10 the stem 2 is provided with more than one stud electrode, stem pins 3A, 3B, 3C, etc. The glass periphery of the stem 2 and the glass edge periphery of the neck 1 are welded together to integrate them. The assembled cathode is evacuated through the tip 4 of the exhaust pipe formed at
15 the center of the stem 2, then the tip 4 is sealed. The stem pins 3A, 3B, 3C, etc. are studded along a specified pin pitch circle.

 In Fig. 1A, the reference number 10 designates a stem base. The stem base 10 consists of a bottom disc plate 11,
20 a tip acceptor 12 which is formed at the center of the bottom disc plate 11 and protects the tip 4, an acceptor for high voltage stem pin 10 in a fan-shape to receive a high voltage stem pin 3B and acts also as a part of the side wall of the tip acceptor 12, a skirt 14 which covers
25 the edge periphery of the neck 1 formed at the periphery of



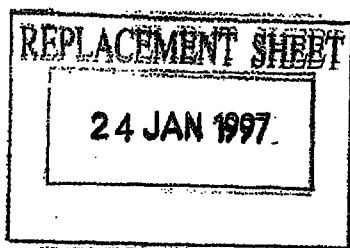
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the bottom plate 11 and which prevents sagging of the paste electric insulator 5, and more than one throughhole, 15A, 15B, 15C, etc. aligning to the stem pins 3A, 3B, 3C, etc. formed at the periphery of the bottom plate 11.

5 A common material for the stem base 10 is a resin such as polycarbonate which has excellent insulation property. The dielectric breakdown voltage of polycarbonate resin is 30 KV/mm.

10 A conventional method to electrically insulate between the stem pins 3A, 3B, 3C, etc. being studded onto the stem 2 on the neck 1 of cathode ray tube is to evacuate the cathode ray tube, to seal the tip 4, then, as illustrated in Fig. 1B, to insert the nozzle of a tube 6 filled with paste electric insulator 5 between the stem
15 pins 3A, 3B, 3C, etc. of the stem 2, and to squeeze out to apply a small amount of the electric insulator 5 from the tube 6 using fingers 7.

20 The stem base 10 shown in Fig. 1A is placed on the applied electric insulator 5 in a manner that the tip acceptor 12 accepts the tip 4 and that the acceptor for high voltage stem pin 13 accepts the high voltage stem pin 3B and that each of the throughholes 15A, 15B, 15C, etc accepts corresponding stem pin 3A, 3B, 3C, etc. under a slight
25 compression. Then, the configuration becomes to the one



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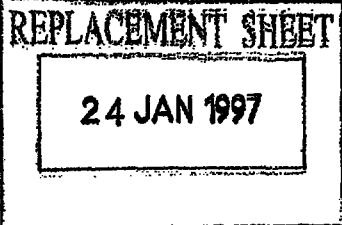
illustrated in Fig. 2. The structure assures the electric insulation between the stem pins, 3A, 3B, 3C, etc.

As realized in the present color television picture tubes and monitors for image screens and computers, the cathode ray tubes for these equipments are requested to have high brightness and high resolution. To cope with the ever increasing demand, a high voltage is applied not only to the anode of cathode ray tube but also to the electrode of electron gun in the cathode ray tube. In particular, a focus electrode is unavoidably applied with a high voltage for improving the focusing characteristic.

The outside diameter of the neck 1 receiving the electron gun has an upper limit from the standpoint for saving the deflection power of electron gun. Consequently, the area of stem 2 is limited. Since such a limited area of the stem 2 receives the stem pins 3A, 3B, 3C, etc., which receive various levels of voltage, the spacing of these stem pins 3A, 3B, 3C, etc. becomes narrow.

For example, a color cathode ray tube for monitoring a graphic display made by SONY CORP. has the pin pitch circle diameter of 15.24 mm, and the number of studed pins is 14 with the pin spacing of 3.42 mm.

Among these stem pins, 3A, 3B, 3C, etc., the stem pin 3A, for example, is called the G1 pin which is applied with a voltage of 0 to several volts, and the stem pin 3B is the



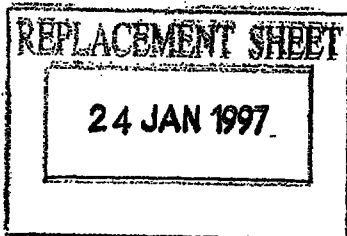
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one for focus electrode which is applied with maximum 9800 volts, and the stem pin 3C is the one to supply voltage to the convergence electrode and is applied with 0 to 2000 volts.

Accordingly, there exists the difference of maximum 9800 volts between the stem pin 3A and the stem pin 3B, and the maximum 8750 volts between the stem pin 3B and the stem pin 3C. For a new cathode ray tube, or if the surface of the glass stem 2 is clean, the glass dielectric breakdown voltage (the lead along the stem glass surface) between the stem pins 3A and 3B and between the stem pins 3B and 3C has not problem. However, a temperature rise or deposition of dust or dirt caused by static charge degrades the dielectric breakdown voltage during operation, or an excess voltage over the dielectric breakdown voltage is often applied to the stem pins, so the dielectric breakdown voltage is not necessarily secured during operation.

To assure the necessary dielectric breakdown voltage, conventional technology uses a paste silicone resin of a room-temperature-curing type such as KE03490 made by Shin-Etsu Chemical Co. Ltd. and SE-9168 made by Toray Dow Corning Co., Ltd. That type of resin is hereinafter referred to simply as "RTV resin".

The RTV resin has basic electric characteristics, but it lacks flowability because of its paste property. As



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illustrated in Fig. 1B, the RTV resin 5 is squeezed out from the tube 6 between the stem pins before mounting the stem base 10 to the stem 2, then the stem base 10 is attached. Usually, the application of RTV resin 5 is manually carried out.

However, the RTV resin raises several problems such that it likely includes bubbles during application work, and that a solvent existing in itself foams at a temperature range of from 80 to 120°C under the heat generated during the aging stage for activating the cathode of electron gun, and that bubbles occur during the insertion and withdrawal of connector of an instrument employed several times of inspection in the period from the application of RTV resin to the complete curing, (normally 7 days), which bubbles interfere the perfect functioning of electric characteristics of the resin and degrades the dielectric breakdown voltage and, in the worst case, discharge occurs between stem pins to damage the cathode ray tube.

The inventors solved these problems by providing the following invention.

1. The first aspect of the invention is an electric insulator as an electric insulator for inter-electrode such as inter-stem pin for high voltage service in a cathode ray tube, which

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electric insulator comprises:

(1) An electric insulator comprising a clay-like silicone compound being formed to secure electrical insulation between stem pins or the like for high voltage service in a cathode ray tube.

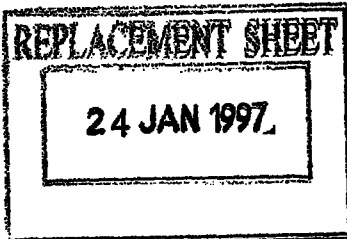
(2) An electric insulator of (1), wherein the silicone compound has a volume resistivity ranging from 1×10^{12} to $1 \times 10^{15} \Omega \cdot \text{cm}$ and a dielectric breakdown strength ranging from 10 to 30 KV/mm.

(3) An electric insulator of (1), wherein the clay-like insulator has a degree of plasticity giving a deformation ranging from 4/10 to 7/10 under a compression of 19 Kg-f.

(4) An electric insulator of (3), wherein a thickness of the formed shape is in a range of from 0.8 to 2.0mm.

(5) An electric insulator of (1) through (4), wherein more than one throughhole are formed corresponding to at least a spacing of electrodes of an electric equipment and being acceptable of these electrodes penetrating therethrough.

(6) An electric insulator of (1) through (5), wherein throughholes corresponding to more than one stem pin including a high voltage stem pin in a cathode ray tube and to a tip of exhaust pipe of the cathode ray tube are



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formed.

2. The second aspect of the invention is a stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip of exhaust pipe of the cathode ray tube, wherein the electric insulator is attached to the stem base while aligning these throughholes with the throughholes of the electric insulator described in (6) of 1.

3. The third aspect of the invention is an inter-stem pin electric insulation device in a cathode ray tube, which comprises: a stem of a cathode ray tube; and electric insulator described in 1 being attached to the external surface of the stem in a manner being penetrated by more than one stem pin including a high voltage stem pin which are protruding from the external surface of the stem and by a tip of exhaust pipe of the cathode ray tube; a stem base provided with throughholes, a tip acceptor, and an acceptor for high voltage stem pin, being placed and fixed in a manner that the stem pins penetrate the throughholes and that the stem base covers the tip at the tip acceptor and that the high voltage stem pin is isolated at the acceptor for high voltage stem pin.

4. The fourth aspect of the invention is a method for producing a cathode ray tube, which comprises: attaching an electron gun provided with more than one stem pin including a high voltage stem pin and with a stem introducing an exhaust pipe to a neck of funnel which structures a tube body; welding the periphery of the neck edge with the periphery of the stem; forming a tip and closing it after evacuating the tube

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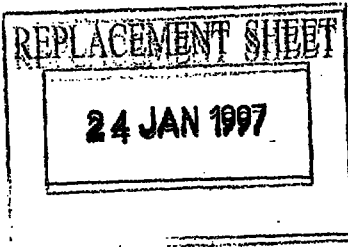
body through the exhaust pipe; attaching a clay-like electric insulator consisting of silicone compound which was formed aligning each of throughholes for receiving the stem pins and the tip of exhaust pipe; fitting the integrated stem base by penetrating the stem pins and the tip therethrough, and mounting and fixing the stem base to the stem.

Accordingly, an electric insulator of this invention suppresses the generation of bubbles described above or further eliminates the bubble formation, completely prevents the leak along surface which is also described above, secures the electric insulation between high voltage stem pins or the like in a cathode ray tube, and does not damage the cathode ray tube.

Since the electric insulator of this invention is a clay-like formed shape, the work for insulating high voltage stem pins or the like each other in a cathode ray tube is performed at a significantly improved efficiency.

In addition, the use of a stem base being attached with the electric insulator of this invention enhances the efficiency of the work for insulating high voltage stem pins or the like each other.

Furthermore, the use of a stem base of this invention allows a mechanical mounting of electric insulation device between high voltage stem pins or the like instead of



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conventional manual work. The mechanical mounting procedure leads to the automatic operation.

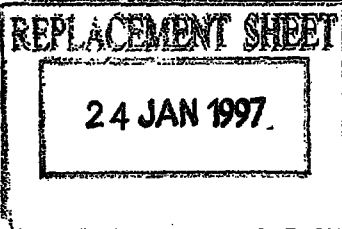
The present invention will be further described hereinafter with reference to the following description of
5 exemplary embodiments, and the accompanying drawings, in which:-

Fig. 1 illustrates the method of electric insulation between stem pins including a high voltage stem pin of related art. Fig. 1A shows a stem base, and Fig. 1B shows
10 a neck of the cathode ray tube.

Fig. 2 illustrates the neck of cathode ray tube structured in accordance with the method of electrical insulation shown in Fig. 1. Fig. 2A gives a view of the neck, and Fig. 2B gives the cross sectional view along A-A
15 line in Fig. 2A.

Fig. 3 shows an electric insulator of the first embodiment in the present invention. Fig. 3A gives a view of the electric insulator. Fig. 3B shows the cross sectional view along A-A line of Fig. 3A.

20 Fig. 4 illustrates the procedure for attaching the electric insulator of Fig. 3 of the second embodiment in the present invention onto the stem base. Fig. 4A gives a view of the electric insulator of Fig. 3. Fig. 4B gives a



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view of the electric insulator viewing from the stem side.

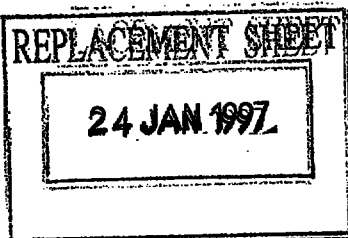
Fig. 4C is a stem base attached

Fig. 5 illustrates the structure of an electric insulation device of the present invention of the neck of cathode ray tube which uses the electric insulator for more than one stem pins including a high voltage stem pin is effected using the electrical insulator shown in Fig. 1 or the stem base shown in Fig. 4. Fig. 5A gives a view of the device. Fig. 5B shows the cross sectional view along A-A line in Fig. 5A. Fig. 5C shows a cross sectional view of the stem of neck structuring the cathode ray tube.

An electric insulator of this invention, an electric insulation device using the electric insulator, and a method for producing a cathode ray tube using the electric insulator are described below referring to Fig. 3 through Fig. 5.

Fig. 3 shows an electric insulator of this invention. Fig. 3A gives a bird eye view of the electric insulator, and Fig. 3B shows the cross sectional view along A-A line of Fig. 3A.

Fig. 4 illustrates the procedure for attaching the electric insulator of Fig. 3 onto the stem base. Fig. 4A gives a bird eye view of the electric insulator of Fig. 3. Fig. 4B gives a bird eye view of the electric insulator viewing from the stem side. Fig. 4C is a stem base attached



with an electric insulator of this invention.

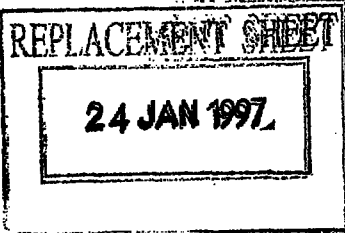
Fig. 5 illustrates the structure of an electric insulation device of this invention of the neck of cathode ray tube in which electric insulation between several stem pins including a high voltage stem pin is effected using the electrical insulator shown in Fig. 3 or the stem base shown in Fig. 4. Fig. 5A gives a bird eye view of the device. Fig. 5B shows the cross sectional view along A-A line in Fig. 5A. Fig. 5C shows a cross sectional view of the stem of neck structuring the cathode ray tube.

The components common to those in the figures of related art, such as the electric device of high voltage inter-stem pin in cathode ray tube, have the same reference numbers with each other.

The following is the description of an electric insulator of the first embodiment in present invention.

Referring to Fig. 3, the electric insulator 20 of this invention is formed to a disc having a thickness described below. The disc has a throughhole 21 for receiving a tip 4 at the center, and has throughholes 22A, 22B, 22C, etc. for receiving stem pins 3A, 3B, 3C, etc. including the high voltage stem pin 3B, at an each corresponding position.

Those throughholes may be formed at a time when the electric insulator 20 is punched from a large flat electric insulator using a forming die. The punching of the



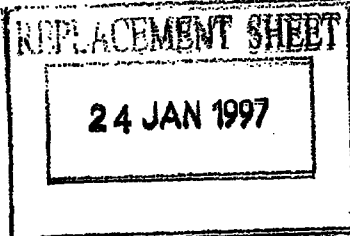
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throughhole 21 for tip is preferably carried out to have a cross slit 23 at the inner periphery of the throughhole 21.

The electric insulator 20 with that type of slit 23 makes the insertion of tip 4 into the throughhole 21 easy and assures a close contact of the outer periphery of the tip 4 with the inner periphery of the throughhole 21, which ensures the electric insulation.

The electric insulator 20 is a clay-like silicone compound. An example of that type of silicon compound uses "Putty-stock SMX-5999" made by Fuji Polymer Co. Ltd. as the basic component. By mixing a plasticizer to "Putty-stock SMX-5999", the electric insulator 20 having an adequate degree of plasticity is obtained.

Fig. 3 shows an example of the electric insulator 20 having the tip-throughhole 21, the pin-throughholes 22A, 22B, 22C, etc., and the slit 23. An electric insulator may otherwise simply be formed by punching a silicone compound to the outside diameter, and it is pressed to the tip 4 of the neck 1 and to the stem pins 3A, 3B, 3C, etc. to open these throughholes using a compression force, and then mounting it to the stem 2. Nevertheless, an electric insulator 20 which forms the throughholes shown in Fig. 3 in advance has an advantage that the tip 4 and the stem pins 3A, 3B, 3C, etc. are easily mounted without defecting the shape of the insulator.



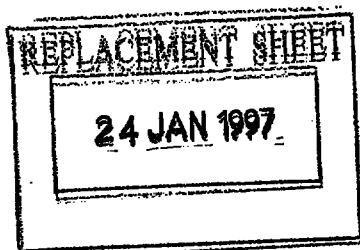
The inventors carried out further extensive study and invented the stem base 40 with electric insulator, which is the second invention shown in Fig. 4C.

The stem base 40 with electric insulator is formed by attaching the electric insulator 20 shown in Fig. 4A (Fig. 3) to the stem base 30 to integrate them. The material of the stem base 30 may be a high insulation resin such as polycarbonate which is used in prior art.

As illustrated in Fig. 4B, the stem base 30 consists of: a tip-throughhole 32 which is opened at the center of the disc base plate 31 and which accepts the tip 4; pin-throughholes 33A, 33B, 33C, etc. including the high voltage stem pin 3B, which are arranged along the peripheral pitch circle on the base plate 31 and which receive stem pins

3A, 3B, 3C, etc. at each corresponding position; and the tip acceptor 34 and acceptor for high voltage stem pin 35 locating on the side not facing the stem 2 of the base plate 31 to protect the tip 4 of the neck 1.

The stem base 30 has no skirt 14 which is seen on the stem base 10 of prior art. The skirt 14 may be formed at need. However, this invention uses a clay-like electric insulator 20 and is not the type of paste electric insulator 5, so there is not possibility of sagging of the insulator. Therefore, no skirt 14 is required in this invention. Moreover, elimination of the skirt 14 allows an easy



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production of the stem base 40 with electric insulator, which stem base 40 is described below.

The following is the third embodiment of the present invention. The stem base 40 with electric insulator is formed by attaching the electric insulator 20 shown in Fig. 3 to the stem base 30 in advance while aligning each of the tip-throughhole 21, pin-throughholes 22A, 22B, 22C, etc. with the tip-throughhole 32, pin-throughholes 33A, 33B, 33C, etc. on the stem base 30, respectively. In other words, the stem base 40 with electric insulator has an integrated structure of the electric insulator 20 and the stem base 30.

When this type of stem base 40 with electric insulator is prepared in advance, the production line of cathode ray tubes at an assembly plant is shortened, and a special advantage is given in automatic mounting of the stem base 40 with electric insulator to the stem 2 as described before. Furthermore, even if the assembly is carried out manually, the workability should be significantly improved.

Accordingly, as illustrated in Fig. 5, the stem base 40 with electric insulator of this invention is attached to the evacuated neck 1 of a cathode ray tube under a compression force while aligning the tip-throughhole 32 with the tip-throughhole 21 on the mating electric insulator 20 and aligning each pin-throughholes 33A, 33B, 33C, etc. with the pin-throughholes 22A, 22B, 22C, etc. on the mating

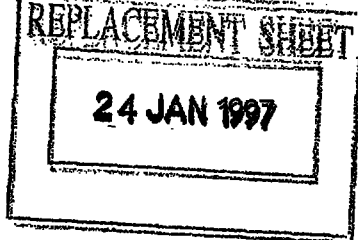
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electric insulator 20, and with the stem pins 3A, 3B, 3C, etc., respectively, and while pressing down the stem base 40 with electric insulator at the mating state to firmly contact the stem 2. The compression force is described later. In this manner, the inter-stem insulation is performed using the electric insulation device shown in Fig. 5A and Fig. 5B.

Otherwise, the electric insulator 20 shown in Fig. 3 may be directly mounted on the stem pins, 3A, 3B, 3C, etc. and the tip 4 of the stem 2, and may further accept the stem base 30 as shown in Fig. 4B or the stem base 10 of prior art. However, the stem base 40 with electric insulator of this invention shown in Fig. 2C is used, the mounting can be performed by a robot, which means that the production line of cathode ray tubes is automated.

Either electric insulator of this invention may be used to enhance the curing by the heat of cathode aging (80 - 120°C) after mounting the electric insulator to the stem 2 at room temperature as described before. Since the electric insulator of this invention has a clay-like property, the amount of included solvent is quite small compared with the paste electric insulator of prior art. As a result, the generation of bubbles in the curing stage due to the heat is minimum, and the required breakdown voltage is secured.

The following is experimental examples of the clay-like silicone compound electric insulator of this invention.



Experimental Example 1

The clay-like silicone compound used had the following properties. The experiments were conducted with various thickness, T , of the electric insulator 20 shown in Fig. 3B.

1. Volume resistivity: $1 \times 10^{14} \Omega \cdot \text{cm}$
2. Dielectric breakdown strength: 25 KV/mm
3. Diameter of pin-throughhole: 0.97mm
4. Degree of plasticity (Note 1): $1/2$
5. Adhesive force (Note 2): 10 Kg*f
6. Thickness: 0.5, 0.8, 1.3, 1.8, 2.0, and 2.3mm

The clay-like silicone compound having the above listed properties was formed in a forming die to prepare the electric insulator 20 having the diameter of 22mm, the pin-throughhole spacing of 4mm corresponding to the space of stem pins 3A and 3B and of stem pins 3B and 3C. The electric insulator 20 was mounted to the stem 2 to measure the dielectric breakdown voltage between stem pins. The result is summarized in Table 1.

The term "degree of plasticity" means that the rate of shrinking of the sample thickness determined by sandwiching the clay-like silicone compound of 10mm square between glass plates and by applying a compression force of 10 Kg*f.

The term "adhesive force" means that the adhesive force determined by sandwiching the sample between a glass plate and the stem base 30 shown in Fig. 4B and by applying a

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compression force of 10 Kg.f.

Table 1

Thickness of electric insulator (mm)	0.5	0.8	1.3	1.8	2.0	2.3
Inter-pin dielectric breakdown voltage (KV)	10	30	38	45	37	15

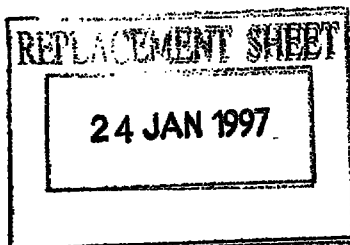
The figures of dielectric breakdown voltage are the average of 20 samples.

The depth, D, of the recess 2A on the stem 2 shown in Fig. 5C, which recess generated during the closing stage of the cathode ray tube, was normally in a range of from 0.3 to 0.5 mm. An electric insulator 20 having the thickness of 0.5 mm had a tendency of incapable of absorbing the recess 2A and degraded the dielectric breakdown voltage. When the thickness of the electric insulator 20 exceeds 2.0 mm, the thickness was too large and a loose mount occurred. In both cases, a preferable thickness of the electric insulator 20 was in a range of from 0.8 to 2.0 mm.

Experimental Example 2

The clay-like silicone compound used had the following properties. The experiments were conducted with various degree of plasticity of the electric insulator 20 shown in Fig. 3.

1. Volume resistivity: same as in Experimental example 1
2. Dielectric breakdown strength: same as in Experimental



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Example 1

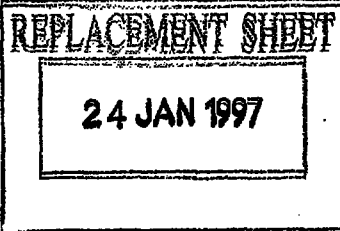
3. Diameter of pin-throughhole: same as in Experimental Example 1
4. Degree of plasticity: 2/10, 4/10, 5/10, 6/10, 8/10
5. Adhesive force: same as in Experimental Example 1
6. Thickness: 1.8 mm

The clay-like silicone compound having the above listed properties was formed in a forming die to prepare the electric insulator 20 having the diameter of 22 mm, and the pin-throughhole spacing of 4 mm corresponding to the space of stem pins 3A and 3B and of stem pins 3B and 3C. The dielectric electric insulator 20 was mounted to the stem 2 to measure the breakdown voltage between stem pins. The result is summarized in Table 2.

Table 2

Degree of plasticity of electric insulator	2/10	4/10	5/10	7/10
Inter-pin dielectric breakdown voltage (KV)	12	35	45	40

The experimental results showed a tendency that an electric insulation having a lower degree of plasticity (excess hardness) could not absorb the recess 2A of the stem 2 as observed in Experimental example 1, and likely left



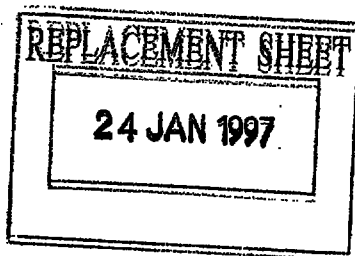
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bubbles in the insulator, and degraded the breakdown voltage.

As described above, the electric insulator of this invention induces no degradation of dielectric breakdown voltage between stem pins nor fracture caused by unwelcome phenomena such as the generation of bubbles or irregular application of resin which are the disadvantages of conventional RTV resin. Consequently, the electric insulator of this invention does not suffer a discharge between pins and fully utilizes the electric characteristics inherent to silicon compound. In addition, the electric insulator of this invention can form the pin-throughholes and tip-throughhole simultaneously with the punching to form itself in a forming die, which allows the mass-production of electric insulators which are easy to mount on stems.

Furthermore, the stem base with electric insulator of this invention is easily handled manually, as described before, and is mounted by a mechanical means, and allows an automatic mounting. Accordingly, this invention provides various effects as described above.

The detailed description given above used a cathode ray tube as an example. This invention, however, is not limited to the cathode ray tube, and naturally deals with the electric insulation between electrodes of electric equipment such as between electrodes of a high voltage transformer actuating under a high voltage.



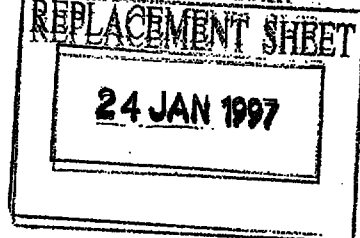
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C L A I M S

1. An electric insulator comprising a clay-like
silicone compound being formed to secure electrical
5 insulation between stem pins or the like for high voltage
service in a cathode ray tube.
2. An electric insulator of claim 1 or 2, wherein the
silicone compound has a volume resistivity ranging from 1×10^{12} to $1 \times 10^{15} \Omega \cdot \text{cm}$ and a dielectric breakdown strength
10 ranging from 10 to 30 KV/mm.
3. An electric insulator of claim 1, wherein the
clay-like insulator has a degree of plasticity giving a
deformation ranging from about 4/10 to about 7/10 under a
compression of 19 Kg f.
- 15 4. An electric insulator of claim 1, 2 or 3, wherein
a thickness of the formed shape is in a range of from 0.8
to 2.0 mm.
5. An electric insulator of any one of claims 1 to 4,
wherein more than one throughhole are formed corresponding
20 to at least a spacing of electrodes of an electric
equipment and being acceptable of these electrodes
penetrating therethrough.
6. An electric insulator of any one of claims 1 to 5,
wherein throughholes corresponding to more than one stem
25 pin including a high voltage stem pin in a cathode ray tube

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and to a tip of exhaust pipe of the cathode ray tube are formed.

7. A stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip
5 of exhaust pipe of the cathode ray tube, wherein the electric insulator is attached to the stem base while aligning these throughholes with the throughholes of an electric insulator according to claim 6.

8. An inter-stem pin electric insulation device in a
10 cathode ray tube comprising: a stem of a cathode ray tube; and electric insulator according to any one of claims 1 to 6 being attached to the external surface of the stem in a manner being penetrated by more than one stem pin, including a high voltage stem pin, which protrude from the
15 external surface of the stem and by a tip of exhaust pipe of the cathode ray tube; a stem base provided with throughholes, a tip acceptor, and an acceptor for high voltage stem pin, being placed and fixed in a manner that the stem pins penetrate the throughholes and that the stem
20 base covers the tip at the tip acceptor and that the high voltage stem pin is isolated at the acceptor for high voltage stem pin.

9. A method for producing a cathode ray tube comprising; attaching an electron gun provided with more
25 than one stem pin including a high voltage stem pin and

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with a stem introducing an exhaust pipe to a neck of funnel which structures a tube body; welding the periphery of the neck edge with the periphery of the stem; forming a tip and closing it after evacuating the tube body through the exhaust pipe; attaching a clay-like electric insulator consisting of silicone compound which was formed aligning each of throughholes for receiving the stem pins and the tip of exhaust pipe therethrough; fitting the integrated stem base by penetrating the stem pins and the tip, and mounting and fixing the stem base to the stem.

10. An electric insulation constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.

15 11. A cathode ray tube constructed substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.



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A B S T R A C TMETHOD OF MANUFACTURING AN INSULATING
MEMBER AND APPARATUS THEREFOR

5 This invention secures the breakdown voltage between
stem pins or the like for high voltage service in a
cathode ray tube. This CRT formed clay-like silicone
compound having a tip-throughhole and pin-throughholes or a
stem base with the electric insulator mounted to the stem
10 base, and a inter-stem electric insulation device is
structured by mounting either one of the electric insulator
or the stem base with the electric insulator to the stem
of a cathode ray tube and by pressing to fix together.
This structure does not occur bubble generation caused by
15 the electric insulator, and makes the handling easy, and
furthermore, accomplish an automatic mounting of the
electric insulator to a stem.

FIGURE 5B

FIG. 1A

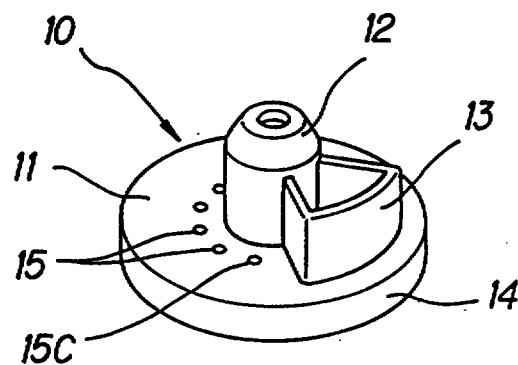


FIG. 1B

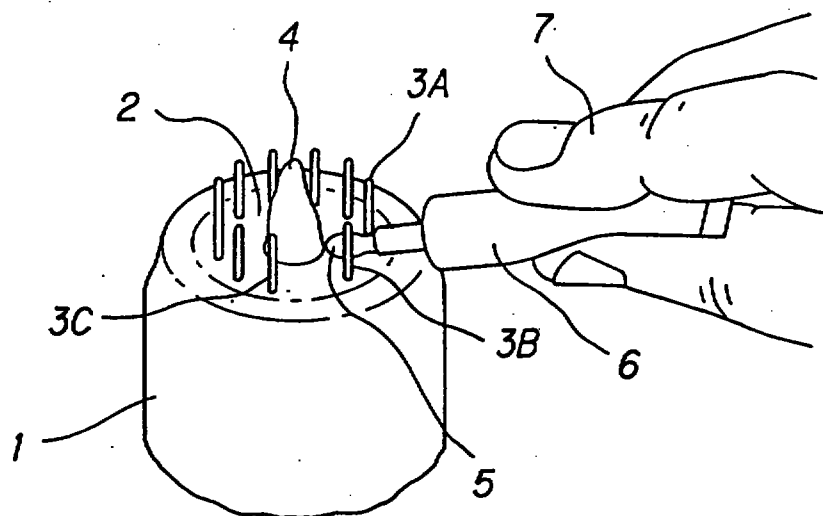


FIG. 2A

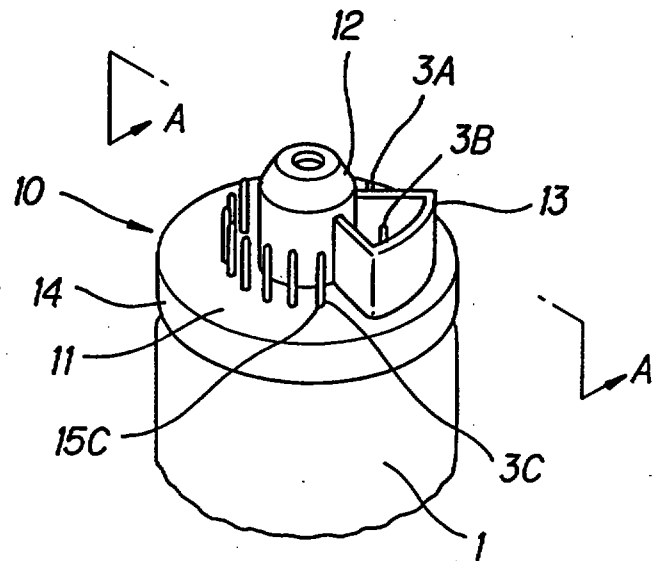


FIG. 2B

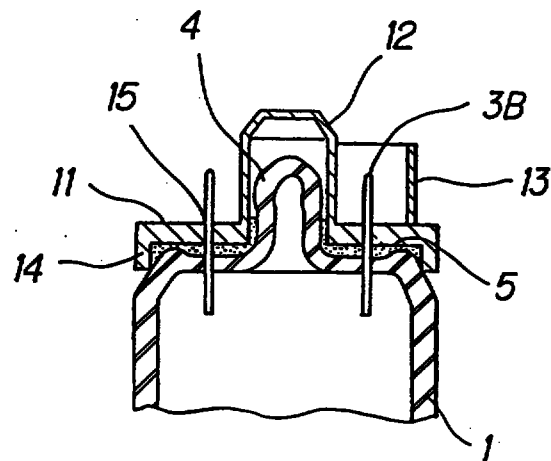


FIG. 3A

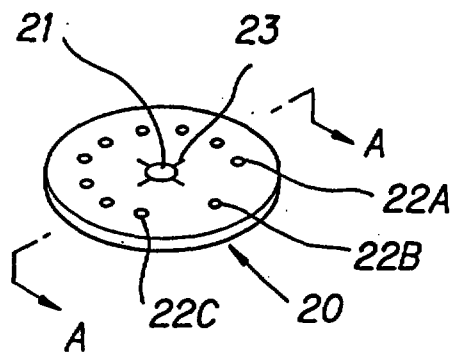


FIG. 3B

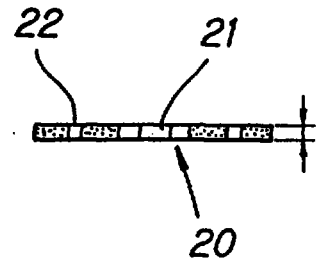


FIG. 4A

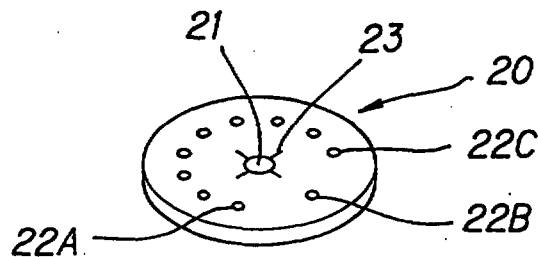


FIG. 4B

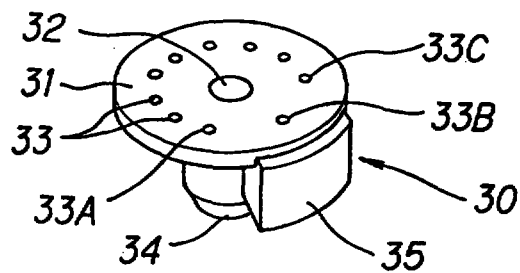


FIG. 4C

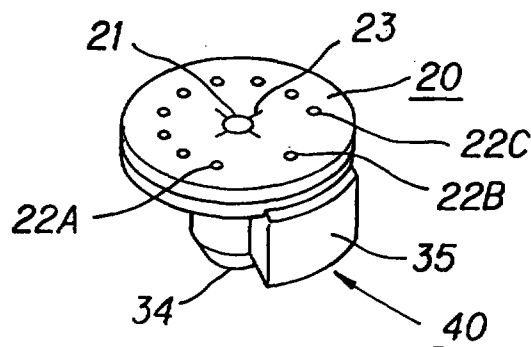


FIG. 5A

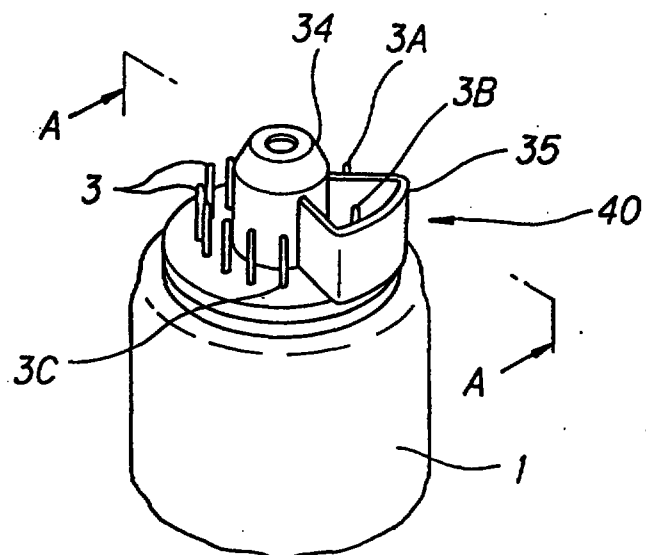


FIG. 5B

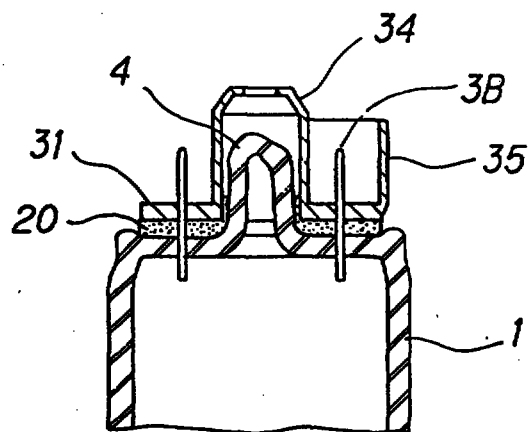
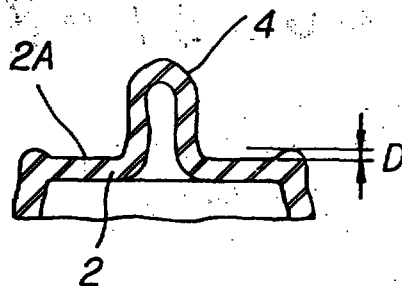


FIG. 5C





CLAIMS

1. A preformed electric insulator comprising a clay-like silicone compound, said insulator being formed to a shape so as to provide electrical insulation between stem pins or the like for high voltage service when mounted on the stem of a cathode ray tube.
2. An electric insulator of claim 1, wherein the silicone compound has a volume resistivity ranging from 1×10^{12} to $1 \times 10^{15} \Omega\text{-cm}$ and a dielectric breakdown strength ranging from 10 to 30 KV/mm.
3. An electric insulator of claim 1 or 2, wherein the clay-like insulator has a degree of plasticity giving a deformation ranging from about 4/10 to about 7/10 under a compression of 19 Kg-f.
4. An electric insulator of claim 1, 2 or 3, wherein a thickness of the formed shape is in a range of from 0.8 to 2.0 mm.
5. An electric insulator of any one of claims 1 to 4, in which more than one throughhole are formed so as to correspond to at least a spacing of electrodes of an electric equipment and so as to accept these electrodes penetrating therethrough.
6. An electric insulator of any one of claims 1 to 5, in which throughholes corresponding to more than one stem pin including a high voltage stem pin in a cathode ray tube and to a tip of an exhaust pipe of the cathode ray tube are formed.
7. A stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip of an exhaust pipe of the cathode ray tube, wherein attached to the stem base is an electric insulator

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REPLACEMENT SHEETS SG

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- ☒ Claim(s) : paged 21 to paged 23
- ☐ Drawing(s) : paged to paged
- ☐ Abstract : paged to paged

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according to claim 6, the throughholes of the stem base being aligned with the throughholes of said electric insulator.

8. An inter-stem pin electric insulation device in a cathode ray tube comprising: a stem of the cathode ray tube; and electric insulator according to any one of claims 1 to 6 attached to the external surface of the stem in such a manner that it is penetrated by more than one stem pin, including a high voltage stem pin, which protrude from the external surface of the stem and by a tip of an exhaust pipe of the cathode ray tube; a stem base provided with throughholes, a tip acceptor, and an acceptor for the high voltage stem pin, said stem base being placed and fixed in such a manner that the stem pins penetrate the throughholes, that the tip acceptor covers the tip of the exhaust pipe and that the high voltage stem pin is isolated by the acceptor for the high voltage stem pin.

9. A method for producing a cathode ray tube comprising:
15 attaching an electron gun provided with more than one stem pin including a high voltage stem pin and with a stem introducing an exhaust pipe to a neck of a funnel which structures a tube body; welding the periphery of the neck edge with the periphery of the stem; forming a tip and closing it after
20 evacuating the tube body through the exhaust pipe; attaching a preformed clay-like electric insulator consisting of silicone compound including aligning each of a plurality of throughholes of the insulator for receiving the stem pins and the tip of the exhaust pipe therethrough; fitting the integrated stem base by penetrating the stem pins and the tip, and mounting and fixing the stem base to the stem.

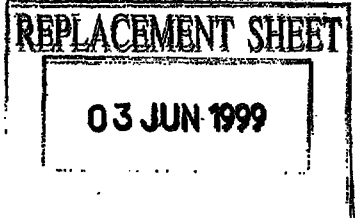
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10. An electric insulation constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.

11. A cathode ray tube constructed substantially as hereinbefore
5 described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.



CLAIMS

1. A preformed electric insulator comprising a clay-like silicone compound, said insulator being formed to a shape so as to provide electrical insulation between stem pins or the like for high voltage service when mounted on the stem of a cathode ray tube.
2. An electric insulator of claim 1, wherein the silicone compound has a volume resistivity ranging from 1×10^{12} to 1×10^{15} Ω -cm and a dielectric breakdown strength ranging from 10 to 30 KV/mm.
3. An electric insulator of claim 1 or 2, wherein the clay-like insulator has a degree of plasticity giving a deformation ranging from about 4/10 to about 7/10 under a compression of 10 Kg-f.
4. An electric insulator of claim 1, 2 or 3, wherein a thickness of the formed shape is in a range of from 0.8 to 2.0 mm.
5. An electric insulator of any one of claims 1 to 4, in which more than one throughhole are formed so as to correspond to at least a spacing of electrodes of an electric equipment and so as to accept these electrodes penetrating therethrough.
6. An electric insulator of any one of claims 1 to 5, in which throughholes corresponding to more than one stem pin including a high voltage stem pin in a cathode ray tube and to a tip of an exhaust pipe of the cathode ray tube are formed.
7. A stem base having throughholes corresponding to more than one stem pin in a cathode ray tube and to a tip of an exhaust pipe of the cathode ray tube, wherein attached to the stem base is an electric insulator

