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MAY 25, 1943.	CATHODE RAY TUBE	**334,552**
BY A. P. C.	Filed May 11, 1940	2 Sheets-Sheet 1

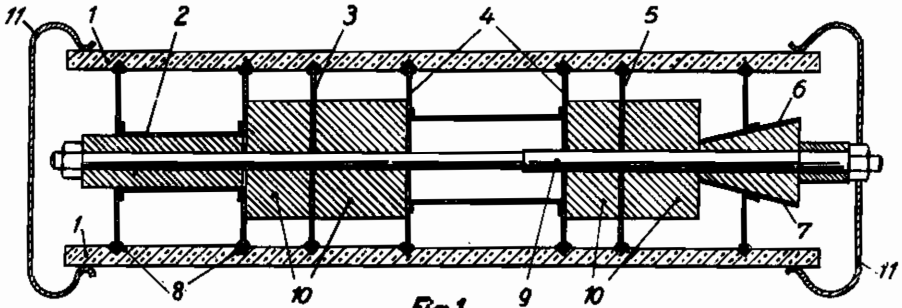

Fig.1

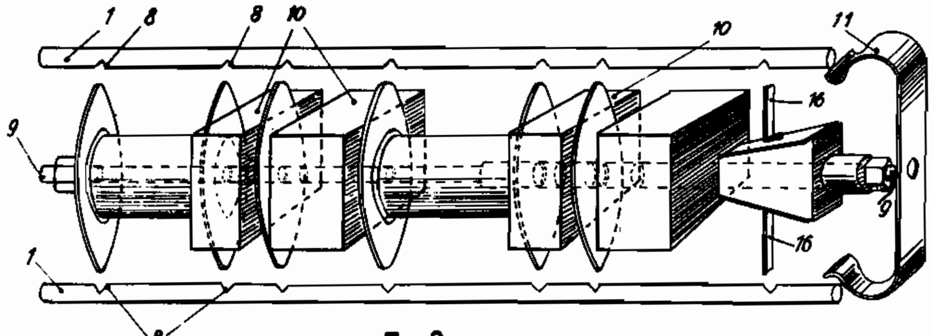

Fig.2.

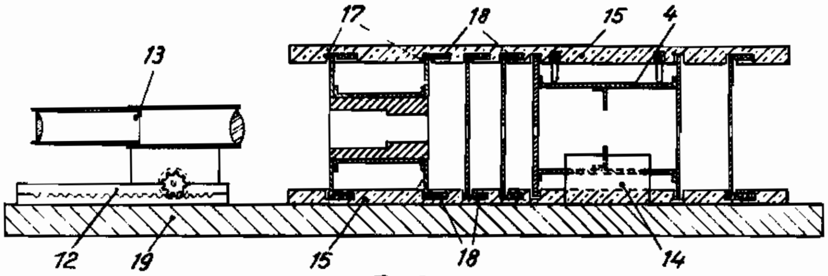

Fig.3.

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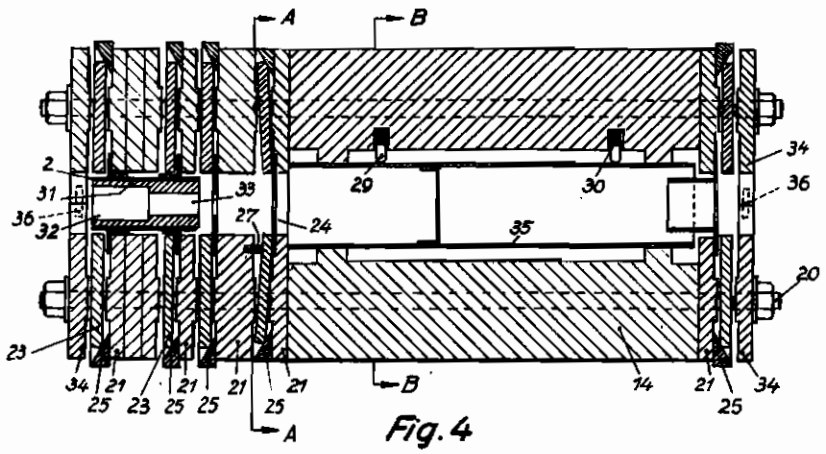

Fig. 4

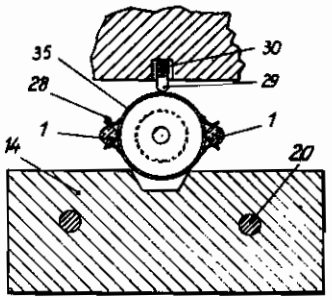

Fig. 5

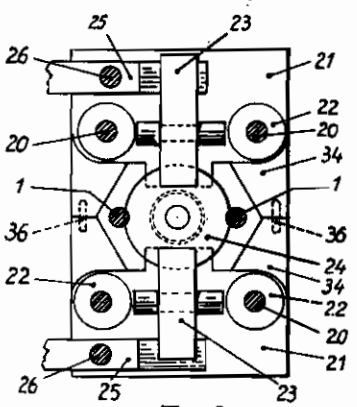

Fig. 6

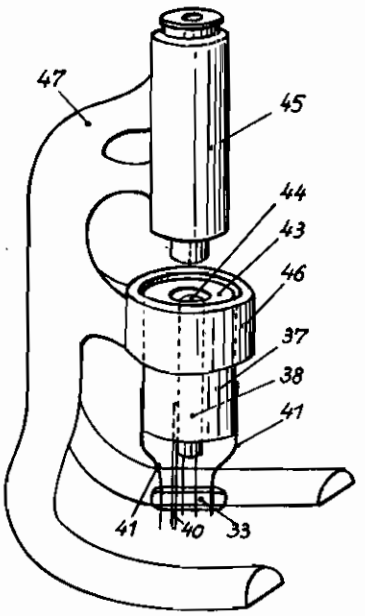

Fig. 7

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ALIEN PROPERTY CUSTODIAN

CATHODE RAY TUBE

Wilhelm Riedel and Kurt Heinz Graefe, Berlin, Germany; vested in the Alien Property Custodian

Application filed May 11, 1940

In assembling the electrode system of a cathode ray tube, more particularly such as is used for oscillographic and television purposes, special care must be taken that the single system elements are maintained in their correct position with respect to one another even after their being fitted in the tube body and heated for the purpose of degassing. This condition can be fulfilled when the stresses to which the elements are exposed during the sequence of operation are as small as possible. Electrode systems of the kind in which the electrodes are fixed to clips by a spot welding process and the clips are secured to insulating supports do not admit a sufficiently unstressed assembly. Each welding spot gives rise to stresses within the system which are again relieved by the heating and thus are able to cause the system elements to shift with respect to one another.

It is an object of the invention to provide a method for manufacturing the electrode assembly of a cathode ray tube whereby an invariable position of the electrodes during the whole process of manufacture is safely obtained.

It is a further object of the invention to provide a cathode ray tube in which some or all of the system elements are fixed to holders composed of insulating, more particularly ceramic material by cementation.

Another object of the invention is to provide special centering means for adjusting the position of the elements of the electrode system with respect to one another.

A further object of the invention is the combination of mechanical and optical centering means for the just mentioned adjusting purposes.

The invention will be better understood with the aid of, and further features of the invention will be apparent from the following more detailed description and the accompanying drawings, of which in a purely diagrammatic fashion and by way of example.

Fig. 1 shows a cross-section of a simple cathode ray tube system provided with means for securing the position of the electrodes with respect to one another,

Fig. 2 is a perspective view of a system according to Fig. 1,

Fig. 3 shows in cross-section an arrangement for centering the electrode system of a cathode ray tube,

Fig. 4 is a longitudinal cross-section of a modification of the holding and clamping device according to the invention, while

Fig. 5 shows a view taken from the left side of plane B—B of the device illustrated by Fig. 4, and

Fig. 6 shows a view taken from the left side of plane A—A of the device illustrated by Fig. 4, and

Fig. 7 illustrates a centering means for adjusting the position of the cathode with respect to its support and with respect to the control electrode.

As illustrated by Fig. 1, the single elements of the electrode system, for example the cylinder 2 which is adapted to support the cathode and, in a tube for television purposes, also the control grid, the anode diaphragm 3, the electro-static lens electrodes 4 and 5 as well as the deflecting plates 6 and 7, are fixed to two or more supporting members 1, preferably rods, which consist of insulating, more particularly ceramic material, by cementing them into notches 6 of the supports 1.

This manner of fastening the elements of the electrode system, besides the possibility of holding the elements perfectly without any stress, involves the further advantage that by suitable means the single electrodes can be centered with respect to a prescribed axis in a simple way.

When the demands on the accuracy of the system assembly are not too high, the system can be centered, as shown in Figs. 1 and 2, by slipping the single electrodes over a rod shaped centering means 9 the axis of which coincides with the axis of the system, and by defining the distanec of the elements from one another with the aid of spacing members 10 interposed between the structural elements of the assembly. The rod 9 may be threaded at its ends and thus allow the entire system to be thrusted together by means of nuts.

In manufacturing the electrode assembly, the notches 8 of the insulating supports 1 are filled with a suitable cementing material into which are pressed the system elements or the flanges of such elements which may be provided for this purpose. During the drying process the insulating supports are held in their correct position by means of clamps 11.

If a high accuracy of the assembly is required, there is applied an optical method for centering the electrodes.

The means which are provided according to the invention for performing a centering method of this kind are illustrated by Figs. 3–7.

Fig. 3 shows a stable base 19 carrying a telescope 13 adapted to be shifted along a slide 12,

as well as a support 14 which is carefully positioned with respect to the axis of the telescope. A suitable system element, e. g. the cylindrical patr of element 4 of the electrode system according to Fig. 1, is supported by this means.

The support 14 is united with a holding means which is so designed as to admit the single system elements to be adjusted independently. For this purpose e. g. may serve a metal piece 15 which is indented, preferably by milling, in the form of a crest. The single electrodes are put into the indentations 17 and held in the notches by cramping means, e. g. small springs 18, so that they cannot be displaced too easily. The holding means may be composed of two parts as illustrated in Fig. 3.

A modification of the centering means of the kind described is illustrated in detail by Figs. 4–6. The clamping device of the arrangement according to Fig. 4 comprises a plurality of spacing elements 21 which are positioned to have the correct distances from one another. The distances are secured by intermediate rings 22 (not shown in Fig. 4). Elements 21 and 22 are connected with one another and with the supporting element 14 by means of bolts 20. Tongue-shaped elements 23 which are capable of being turned round an axis are mounted between the rings 22 as shown in Fig. 6. The electrodes are pressed against the spacing elements 21 by means of the tongues 23 which are moved with the aid of wedges 25. The pressing position of a tongue 23 is illustrated in Fig. 4 with regard to electrode 24. The wedges are fastened to the spacing elements 21 and are supported by means of pivots 26. By moving the adjacent wedges 25 the tongues are pressed against the electrodes. To admit the position of the electrodes to be adjusted during the assembling process the pressure exerted by the wedges 25 is too strong. Therefore the tongues are provisionally pushed into the desired position by means of springs 27 without the aid of the wedges 25 in order to obtain a lower pressure of the tongues before the position of the electrodes is finally fixed. As soon as all of the system elements are definitely centered the wedges are brought into their pressing position and by the way prevent the electrodes safely from being displaced when the electrodes are fixed to the supporting members 1.

The position of the tubular member 2 of Fig. 4 can be adjusted by means of a cylindrical element 31 which is slipped into the interior of member 2. The apertures 32 and 33 of the auxiliary element 31 permit a correct centering of the front and rear edges of cylinder 2.

The supporting members 1 are provided with notches as shown in Figs. 1 and 2, and the ring-shaped system elements, or the additionally provided ring-shaped supporting parts of the system elements, are cemented in the notches of the supporting rods 1.

A cylindrical electrode, such as 35 in Fig. 4, can be fixed to the supporting members by means of small angles 28 which are welded to the tube 35 as may be seen from Fig. 5.

Deflecting plates may also be fastened in the just described way. Their position can be adjusted with the aid of an auxiliary spacing element having a central opening substantially as described in connection with elements 6 and 7 of Figs. 1 and 2, and element 2 of Fig. 4. The plates can be supported by hooks 16 which are welded to the plates and cemented in notches of the supports 1.

As already mentioned in connection with Fig. 3, the centering means may consist of two parts. Both parts are united by means of cheeks 34 and bolts 36 as illustrated by Figs. 4 and 6. The upper part of the centering means may be provided with pushing bolts 29 and springs 30 as shown in Fig. 5, for pressing the cylindrical element 35 against the support 14.

The ocular of the telescope 13 suitably is provided with a measuring plate bearing a reticule and a plurality of rings engraved concentrically with respect to the centre of the reticule. During the centering process the optical centering means is so adjusted as to successively produce sharp images of the apertures of the single electrodes.

In the above described way it is possible to adjust the position of each electrode in such a manner that its aperture is exactly concentric with respect to the axis of the electrode system and to fix this position by the clamping means. After the adjustment of the electrodes, the insulating supports 1 having their notches filled with cementing material are applied to the system and held fast by means of special clamps.

The advantage of the described method and arrangement for assembling the electrode system of a cathode ray tube lies in the fact that during the manufacturing process no stresses whatever can be caused in the system or its several parts either by the centering and spacing means or during the cementation process. The method according to the invention for adjusting the position of the electrodes with respect to one another by the combination of optical and mechanical centering means, of course, admits of various modifications. Thus, for instance, it is possible to control the centering of the system elements by reproducing their apertures with the aid of a light ray sent through the system instead of doing so by inspecting the apertures directly through a telescope.

The method of controlling the correct position of the several system elements by optical means is not limited to being applied only to those electrodes which are fixed directly on the insulating supports.

In certain embodiments of cathode ray tubes to which the invention relates, the cathode ray producing system, for example, especially the cathode and the heating device, is passed into a supporting element such as cylinder 2 of Fig. 1.

It has been found particularly advantageous to perform the centering of the emissive surface of the cathode and, according as the case may be, also of the control grid with respect to the supporting cylinder with the aid of optical means.

For this purpose there is required a centering means which has the dimensions of the cylinder 2 of Fig. 1 or of another suitable system element and which is rigidly united with an optical instrument.

Fig. 7, by way of example, illustrates an arrangement of this kind. A microscope 47 bears a ring-shaped support 46 which is carefully positioned with respect to the axis of tube 45 supporting the ocular of the microscope. The inner diameter of the support 46 corresponds to the inner diameter of cylinder 2 of Fig. 1. The cathode 38 is mounted within a cylinder 37 bearing at its one end the control diaphragm 43 by means of supporting elements 40 and 41 sealed in an insulating piece 33.

The cylinder 37 is passed into the support 46. Then the emissive surface 44 of the cathode 38

can be centered with respect to the axis of the system and with respect to the aperture of the control grid by viewing the cathode through the grid with the aid of the microscope.

According to a modification of the just described cathode system the control diaphragm is mounted within and near the right hand end of cylinder **2** of Fig. 1. The cathode is supported by a preferably ring-shaped insulating member and slipped into element **2**. The centering of this modified arrangement can also be performed by means as described in connection with Fig. 7. In this case, element **37/43** corresponds in its size to element **2** and is firmly connected with a support **46**.

In a similar way, more generally, several other groups of system elements can be assembled and adjusted to form a number of structural units each of which is irreproachably centered in itself, before they are associated with the other system elements which are united and adjusted with respect to their mutual position with the aid of the before described centering means.

After all system elements which are fixed directly to the supporting members **1** have been secured by cementation to, say, four rod-shaped insulating supports, the auxiliary centering and spacing means are removed, the cathode assembly comprising the heating elements is passed into the supporting cylinder, other groups of system elements which possibly have been assembled before with the aid of separate centering means are brought into their correct position with respect to their supporting members, and the system is sealed into the tube vessel.

The entire electrode assembly may be supported within the tube by means of flat ring-shaped elements consisting of mica or phosphor bronze or another suitable material, the outer edges of which are indented or provided with springs for obtaining that the system is supported in an elastic manner by the tube wall.

The cementing material which is used according to the invention must satisfy certain conditions, viz.:

They must be perfectly vacuum-proof, i. e. no gas must be liberated even at high temperatures.

They must stick safely to insulating material as well as to metal,

They must be able to withstand high temperatures without change and without losing their adhesive properties. Cements of the desired kind can be obtained by mixing up together talc, powdered fire-clay, or similar vacuum-proof insulating material, with water-glass.

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