Oct. 21, 1930. E. F. GATES 1,779,311

METHOD AND APPARATUS FOR SEALING THIN METAL MEMBERS TO GLASS ENVELOPES

Filed Oct. 17, 1929

Fig. 1.

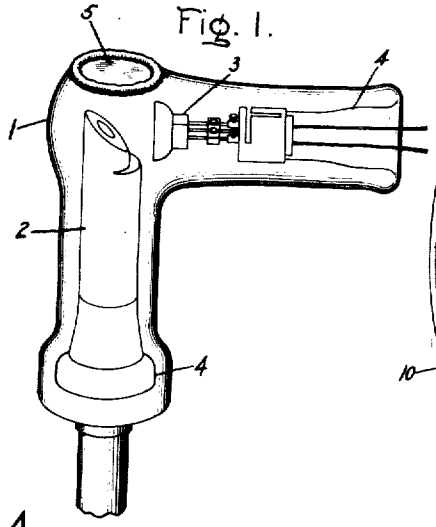


Fig. 2.

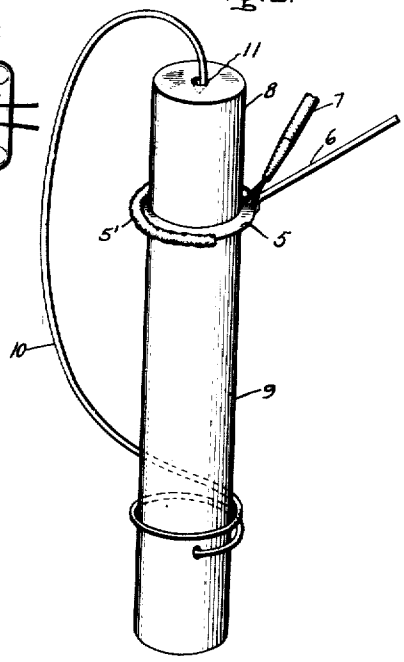


Fig. 4.

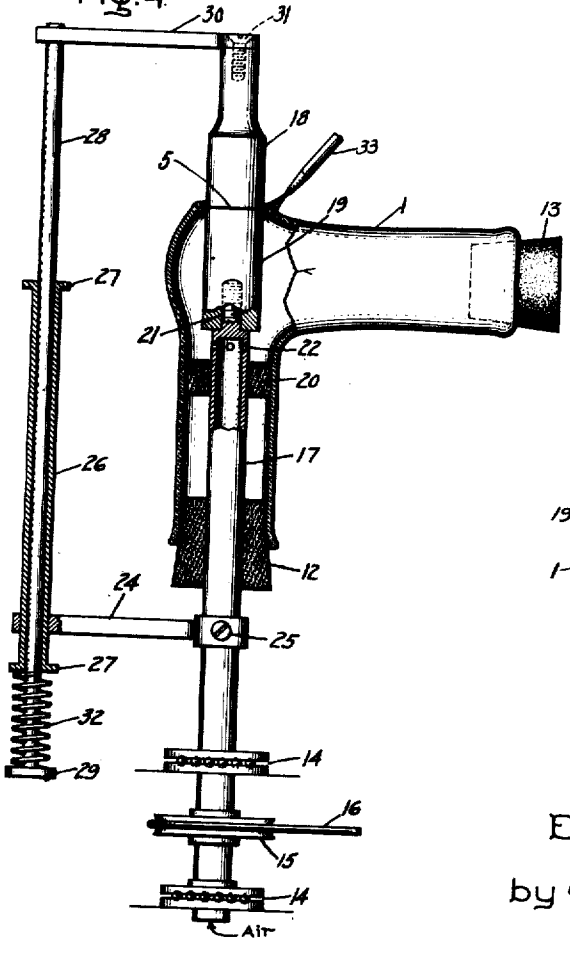
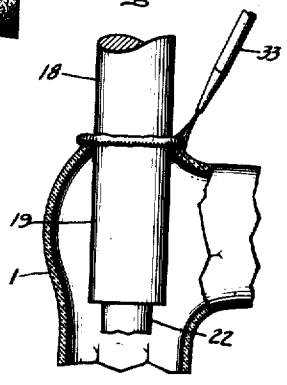


Fig. 3.



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1,779,311

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR SEALING THIN METAL MEMBERS TO GLASS ENVELOPES

Application filed October 17, 1929. Serial No. 400,421.

The present invention relates to the art of joining metal to glass and more particularly to the method of and apparatus for sealing thin metal pieces to glass envelopes.

In the arts, there frequently arises the necessity of forming a hermetic seal between the thin metal member and the glass envelope, for example, in an X-ray apparatus it may be desired to fabricate a tube to generate X-rays of relatively low intensity for particular kinds of radiographic work and calling for a window of thin material in order not to absorb the rays to an appreciable extent. If thin glass be employed for the window it tends to fracture easily. On the other hand, when metal is used, the window is much tougher and can stand harder usage, and besides, may be rolled to a definite and uniform thickness but there are involved difficulties of construction. One difficulty is in forming the seal around the metal; the heat from the sealing torch may warp or otherwise deform the metal member, thus introducing strains and leakage at the sealing edge as well as offering different thicknesses of metal for the X-rays to traverse, and under extremely adverse conditions the torch may actually melt and destroy the window. When the window contains deformations of the surface, e. g. corrugations, the rays are absorbed in a variable manner over the window area and variations are produced in the X-ray output.

Objects of the invention are to provide an improved method of constructing X-ray tubes having a metal window whereby the disadvantages attending this form of window are obviated and, in general, to improve the technique of hermetically sealing thin metal sheets to glass, requiring the minimum apparatus and labor. Other objects and features will be apparent as the specification is perused in connection with the accompanying drawing in which Fig. 1 illustrates a side view in perspective of an X-ray tube provided with a metal window sealed in the improved manner; Fig. 2 represents one step in the improved method of sealing, together with the apparatus for performing the method; while Figs. 3 and 4 illustrate further steps and apparatus.

Referring to Fig. 1, numeral 1 designates an evacuated envelope containing the usual electrodes for producing X-rays, i. e. a tungsten copper-backed anode or a target 2 and a combined cathode or ray-focusing arrangement 3. The electrodes may be secured in any suitable manner to the reentrant stems 4, 4 which are disposed normal to each other. X-rays of relatively low penetrating power may be produced at the target by accelerating the electrons through a suitable potential gradient, for example, of the order of 4,000 to 10,000 volts and directed through a metal window 5. The window may be constituted of a chrome-iron alloy, commonly called in the arts "Ascoloy" or other suitable material and in order to allow the rays facility of traverse, i. e. without undue absorption, the metal must be exceedingly thin, for example, of the order of .5 mil.

It has heretofore been considered impossible to seal a window of this kind into a glass envelope but in accordance with the present invention the technique of construction has been improved to such an extent that not only is a perfect seal obtained, but also the metal remains flat in position. The first step in the improved method is to cause a sealing bead or layer 5′ of glass, preferably applied from a cane 6 by means of a torch 7, to adhere about the peripheral edge of the window 5. A glass known as French lead glass is suitable for this purpose. During this operation, the window is held rigidly between two metal members 8, 9 shown in the form of cylinders and provided with flat abutting faces. The cylinders are clamped about the window 5 in any suitable manner, for example, by means of a flexible wire member 10 which is affixed at the lower end to a cylinder 9 and at the upper end projects into a counter-sink 11 formed on the top surface of the cylinder 8. The upper cylinder may be removed to break the clamp by simply forcing the spring member out of the counter-sink.

The next step is to seal the window in the glass envelope and this is accomplished preferably in a machine or attachment therefor adapted to rotate the envelope as shown in Fig. 4. The window is affixed in place pref-

erably before the reentrant stems 4 are sealed to the envelope, the openings in the latter provided for the stems being temporarily closed by plugs 12, 13 of cork, rubber or the like. The attachment consists in part of a shaft constituted of several portions, described hereinafter, which is adapted to revolve in ball bearings 14 by means of a pulley 15 and a power driven belt 16. The shaft comprises a support rod 17 and a clamping device 18, 19 which has a function similar to that described in connection with Fig. 2. The support rod 17 is maintained in central alignment within one arm of the envelope 1 by means of a centering ring 20 of cork or rubber and also by passing tightly through a central opening in the plug 12. The rod terminates in a screw 21 and is hollow throughout its length except for a wall of metal left at the screw end; in other words, the rod may constitute a heavy tubing plugged at one end and fitted with a screw portion at the plugged end. There are a number of holes 22 drilled through the material of the rod and equi-distantly spaced about the tubing at the closed end; the purpose of the holes will be explained presently. The lower clamp member 19 is secured by the screw 21 while the upper clamp member 18 is held in place by an overhanging structure which is secured to the rod 17 by means of an arm 24 and a set screw 25. The arm 24 has an opening at its lower end into which is tightly fitted an upright tubular member 26 provided at each end with flanges 27. Within the tube 26, there is slidably arranged a rod 28 which terminates at the lower end in a flange 29 and at the upper end is fitted into a horizontally disposed bar 30. The latter is rigidly affixed to the upper clamp member 18 in any suitable manner, for example, by screw 31. Between the lower flange 27 and flange 29, there is positioned a compression spring 32 which tends to force the flanges apart, thereby causing the member 18 to press against the juxtaposed member 19 with a force sufficiently rigid to hold the window 4 between the flat surfaces. In the sealing operation, the envelope 1 is so positioned on the composite shaft, i. e. by adjusting the tube 17 within the plug 12 that the window 5 to which the glass bead has already been applied, when held between the clamp members, rests upon the opening in the envelope, as shown in Fig. 3. The opening is of a size large enough to allow the glass bead to contact with the envelope, thereby providing a glass to glass seal at this point. A torch 33 may be applied to the joint and at the same time the shaft turned rather slowly by the belt 16 until the two glass portions are hermetically sealed or fused in a uniform manner. In order to prevent any deformation or collapse of the envelope at the place where the heat is applied a blast of air may be blown, conveniently by the mouth of the operator, into the lower end of the tube 17 at the place indicated on the drawing, the air passing through the apertures 22 to maintain a pressure against the interior surface of the envelope. When the seal has been completed, the rotation of the envelope is stopped and the upper clamp member 18 raised against the compression of the spring 32 and swung aside. The plug 12 may now be loosened and the envelope withdrawn by moving it in an upward direction in which case the envelope leaves the lower plug and may be slipped over the member 20. The plug 13 is thereupon removed and the envelope is ready to have the reentrant stems and electrodes sealed in place in the usual manner.

It will be noted that the clamping members 8 and 9 in the preliminary operation of the members 18 and 19 in the final sealing operation serve not only rigidly to hold the window absolutely flat in its proper position but also to provide a mechanical barrier for preventing the torch flame from reaching the metal except at the sealing edge and in addition, to provide a large mass of metal to absorb and distribute the excess heat generated at the point of the seal. The metal window of minute thickness is thus effectively sealed without the danger of being either deformed or destroyed by the heat utilized in the sealing process. It is apparent that the position of the window with respect to the envelope may readily be adjusted in the clamp arrangement to give any desired orientation or position and that the clamping pieces may be given a configuration to conform to any shape of window. It will also occur to those skilled in the art that a single set of clamping members if desired, may be utilized for both the preliminary and final sealing operations and the apparatus simplified further to that extent.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In the method of sealing a thin, flat metal member to a glass body, the steps of clamping the member between two flat, heat-conducting surfaces, then applying a layer of glass to the sealing edge of said member, finally fusing the glass sealing edge to the glass body.

2. In the art of sealing a thin, metal window to the glass envelope of an X-ray tube, the method which consists in clamping the window between two plate surfaces, then applying a layer of glass to the sealing edge of the window, then positioning the window on the envelope, finally sealing the window to the envelope by heating the joint between the layer of glass and the envelope while maintaining a flat, clamping surface on each side of the window.

3. Apparatus for sealing a thin, flat metal member to a glass body comprising a pair of elements of heat conducting material adapt-

ed to be clamped about said metal member and provided with flat clamping surfaces, said elements being of a size sufficient to cover the metal member except at the portion which is to be sealed to the glass body.

4. Apparatus for sealing a thin, flat metal member to a glass envelope comprising a pair of metallic elements adapted to be clamped about said metal member and provided with flat clamping surfaces, said members being of a size sufficient to cover the metal member except at the portion which is to be sealed to the glass envelope, and means for rotating the clamping elements during the sealing operation.

In witness whereof, I have hereunto set my hand this 16th day of October, 1929.

EDWIN F. GATES.

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4. Apparatus for sealing a thin, flat metal member to a glass envelope comprising a pair of metallic elements adapted to be clamped about said metal member and provided with flat clamping surfaces, said members being of a size sufficient to cover the metal member except at the portion which is to be sealed to the glass envelope, and means for rotating the clamping elements during the sealing operation.

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CERTIFICATE OF CORRECTION.

Patent No. 1,779,311. **Granted October 21, 1930, to**

EDWIN F. GATES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 120, claim 2, for the word "plate" read flat; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of December, A. D. 1930.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

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