May 12, 1970 F. G. OESS 3,510,926

ELECTRON GUN ALIGNMENT DEVICE

Filed Jan. 2, 1968 2 Sheets-Sheet 1

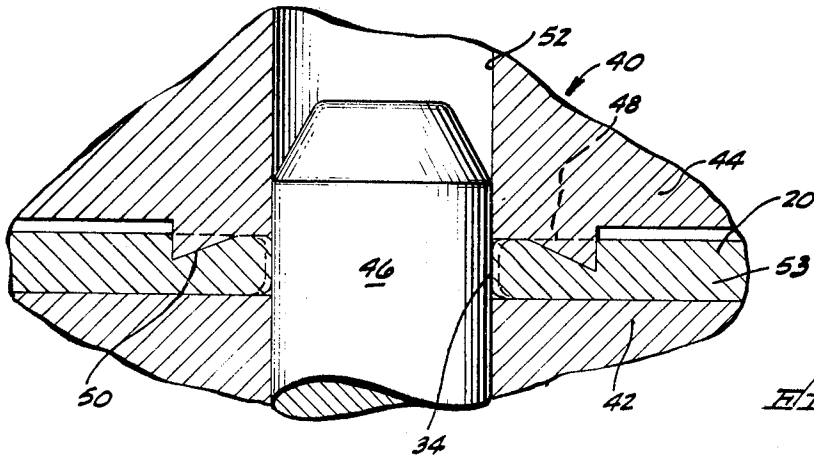


FIG. 1.

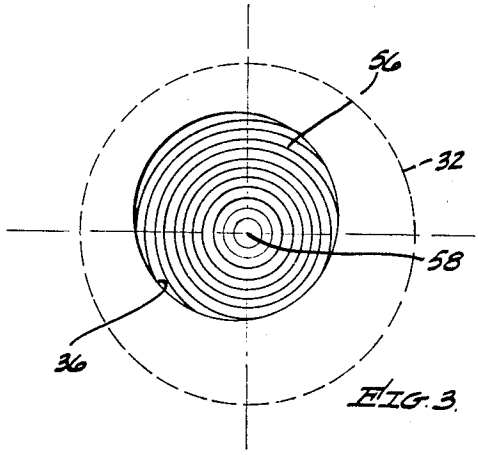


FIG. 3.

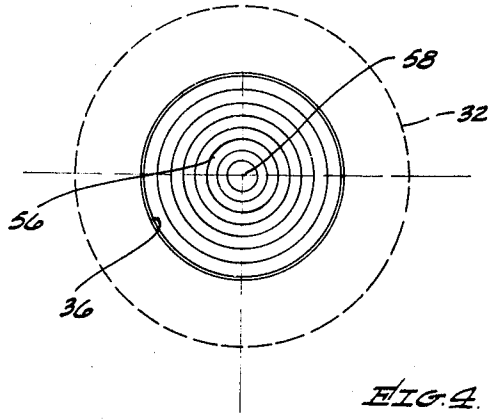


FIG. 4.

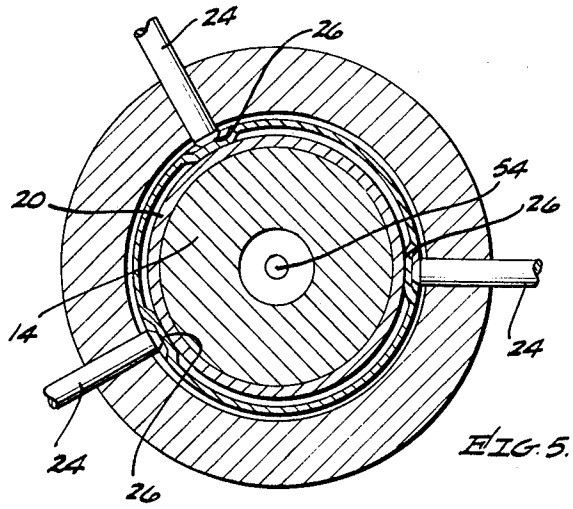


FIG. 5.

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May 12, 1970 F. G. OESS 3,510,926

ELECTRON GUN ALIGNMENT DEVICE

Filed Jan. 2, 1968 2 Sheets-Sheet 2

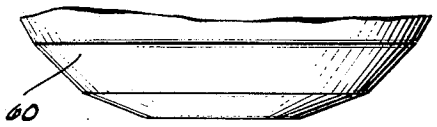
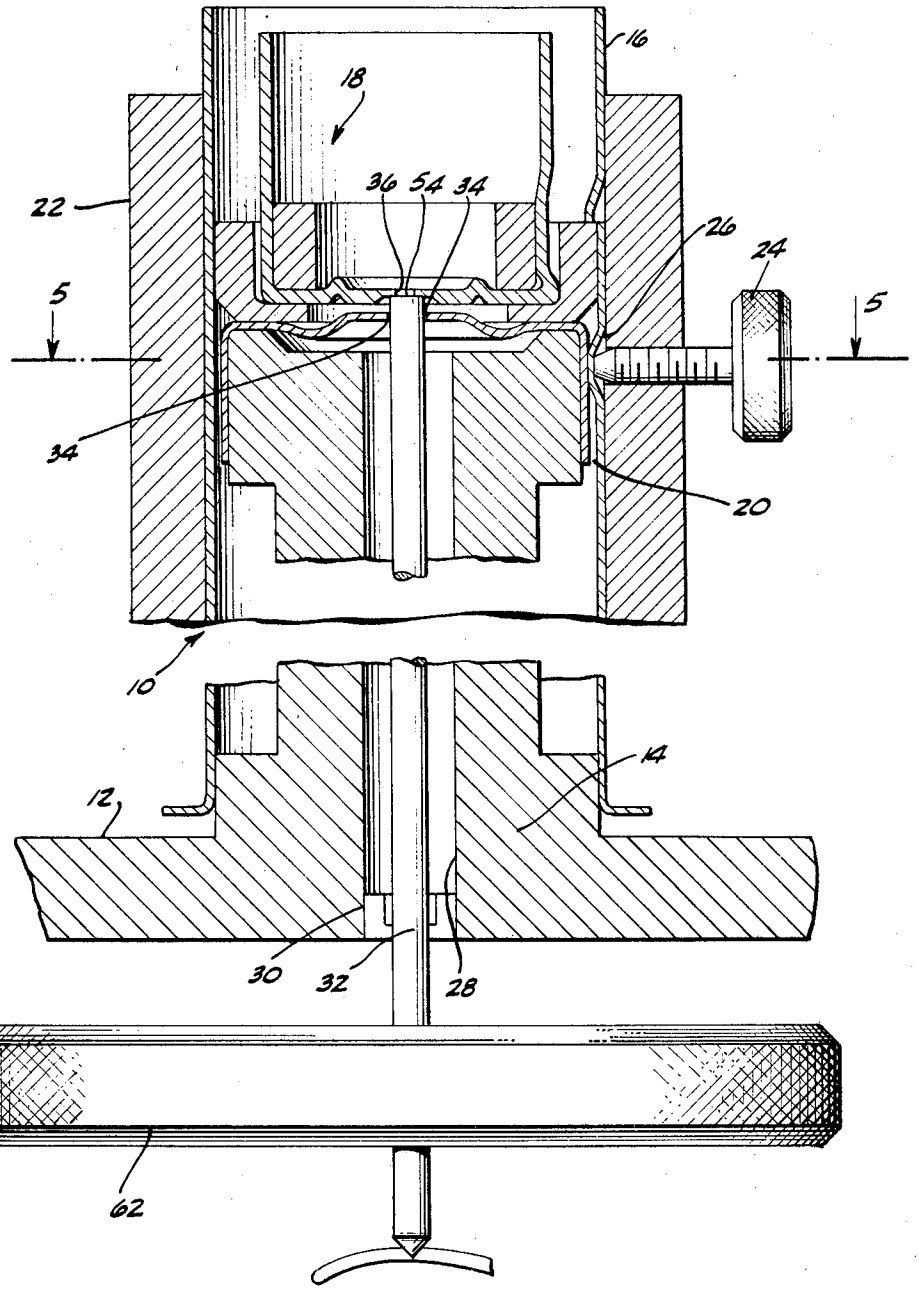


FIG. 2.



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ELECTRON GUN ALIGNMENT DEVICE

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U.S. Cl. 29—25.19 5 Claims

ABSTRACT OF THE DISCLOSURE

An aligning jig and method of operation to precisely align the G1 and G2 electrode apertures of an electron gun is disclosed. An aligning mandrel is positioned in one aperture and adjacent the other and rotated to view misalignment. The supporting cylinder is then manually distorted to produce aperture alignment.

The invention relates to a method of aligning electrodes forming part of an electron gun and a device for accomplishing said alignment.

Structurally a typical electron gun comprises an annular cylinder having a cathode at one end thereof, a G1 electrode mounted forwardly of the cathode and a G2 electrode positioned forwardly in the G1 electrode. Both the G1 and G2 electrodes are provided with central apertures aligned with the electron emitting face of the cathode, the apertures providing openings to permit passage of the created electron beam. The operating efficiency of any electron gun is importantly affected by the proper alignment of the G1 and G2 apertures. The more precise this alignment the better the operating characteristics of the gun.

The present invention provides a method of obtaining precise alignment of the apertures of the G1 and G2 electrodes. Though applicable to electron guns of various configurations, the disclosed method is particularly adapted to provide precise alignment for that type of electron gun structure as shown in my co-pending application filed on instant date herewith and entitled "Electron Gun Electrode Mounting Araringement and Method of Fabrication."

Accordingly, it is the primary object of the present invention to provide a method of obtaining precise alignment of the apertures of the G1 and G2 electrodes in a typical electron gun, and at a point in the assembly operation after mounting of the G1 and G2 electrodes to a supporting cylinder.

It is the further object of the invention to provide a method of determining, if desired, the degree of misalignment existent in a given electron gun structure between the beam passing apertures of the G1 and G2 electrodes.

It is yet another object of the invention to provide a novel aligning jig not only adapted to determining the degree of misalignment between G1 and G2 apertures but providing an operative mode to realign, with a high degree of preciseness, misaligned G1 and G2 apertures in a partially fabricated electron gun.

These and other objects and features of the invention will become apparent in the course of the following description and from the examination of the related drawings, wherein:

FIG. 1 is a fragmentary illustration of a coining operation adapted to provide precise sizing of the beam passing aperture in a G2 electrode;

FIG. 2 is a central vertical sectional view, partially fragmentary, of a jig arrangement adapted to perform the method herein disclosed;

FIG. 3 is a visual representation of the device appearance to an operator of an electron gun having misaligned G1 and G2 apertures;

FIG. 4 is a graphic representation of the device appearance to the operator of an electron gun having aligned G1 and G2 apertures; and

FIG. 5 is a fragmentary sectional view taken along line 5—5 of FIG. 2 illustrating the structure of FIG. 2 used to provide aperture alignment for electron guns wherein the apertures were misaligned upon original fabrication.

Describing the invention in detail in directing attention initially to FIG. 2, an aligning jig indicated generally at **10** is provided having a base **12** with an upstanding support mandrel **14**. The support mandrel **14** is telescopically received in the cylinder **16**, as shown at the lower portion of FIG. 2. The electron gun support cylinder **16** with the G1 electrode **18** and the G2 electrode **20** assembled thereto is positioned over the supporting mandrel **14** so that the cavity of the G2 electrode **20** telescopically receives the supporting mandrel **14**. A clearance of approximately one to two-thousdanths of an inch may be provided between an external surface of the supporting mandrel **14** and the internal surface of the cavity of the G2 electrode **20**. An adjustment sleeve **22** is positioned to surround the supporting cylinder **16** to provide backup reinforcement to the cylinder **16** and to bring the adjusting screws **24**, **24** into alignment with dimples **26**, **26** formed in the peripheral wall of the cylinder **16**. As noted in the referenced patent application the dimples **26** provide points of weld connection between the cylinder wall **16** and the surface of the G2 electrode **20**.

The support mandrel **14** is centrally apertured as at **28**, said aperture having an alignment bearing **30** at its lower aspect. Aligning mandrel **32** is carried in the cavity **28** and supported by the bearing **30** for precise alignment within base **12**. The upper tip of the mandrel **32** is received within the G2 aperture **34** so that the axial edge of the mandrel **32** is positioned immediately below the G1 aperture **36**.

It will be understood that precise sizing of the G2 aperture **34** is an important facet in obtaining the proper alignment of the apertures **36** and **34** as hereinafter will be described. Accordingly, and as a preliminary step prior to the utilization of the aligning device **10**, the G2 electrode **20** is positioned in a sizing die indicated generally at **40** in FIG. 1, said die comprising a base member **42** and a sizing member **44** and sizing pin **46**. The sizing pin **46** is provided with a diameter identical with the alignment mandrel **32**. The dotted line **48** in FIG. 1 illustrates the configuration of aperture **34** prior to the sizing and coining operation. The coining element **44** is provided with an angled die segment **50** which annularly surrounds the opening **52** formed in element **44**. In a conventional coining operation, the die element **44** is impacted against the wall **52** of the G2 electrode **20** whereby the angled die segment **50** of die element **44** induces the material of wall **52** to flow radially inwardly and to tightly conform to the diameter of sizing pin **46**. Thus, the aperture **34** is precisely sized to the diameter of the alignment mandrel **32** prior to the aligning operation utilizing device **10** of FIG. 2.

Returning to FIG. 2, it will be understood that the tip **54** of the mandrel **32** is provided with visible markings **56** which may be circular grinding marks formed at the tip end which provide concentric indicia about the exact center **58** of the mandrel tip **54**. If desired, other marking indicia may be utilized to visibly define the exact center of the mandrel tip.

An operator's microscope **60** which is used to magnify and view the tip **54** of the mandrel **32** is positioned to view the openings of apertures **34** and **36** and the visible segment of the tip **54**. The mandrel **32** is provided with a rotating knob **62** which may be turned by the operator to induce rotation of the mandrel **32** and its tip **54**. The

operator, concurrently with rotation of the knob **62**, views the apertures **34** and **36** via the microscope **60** and if the apertures **34** and **36** are misaligned the field of view appears as shown in FIG. 3. As shown in FIG. 3, it is obvious that the center of the opening **34** in the G2 electrode **20** is misaligned with the opening **36** of the G1 electrode **18**. To correct misalignment, three adjusting screws arranged in 120 degree angular spacing (FIG. 5) may be alternately and selectively rotated to selectively apply distorting pressure to the respective adjusting screws **24**. The distortions induced by the adjusting screws **20** change the position of the central aperture **34** of the G2 electrode **20** in relation to the central longitudinal axis of the carrying cylinder **16**. This change results from small or minor distortions in the surface of the cylinder **16**, as well as repositioning of the G2 electrode **20** internally in the cylinder. The operation is successively repeated by the operator with continued visual examination of the appearance of the mandrel tip **54** via the microscope **60** with concurrent rotation of the knob **62** until such time as the center of the tip appears to be centrally aligned with the aperture **36** of the G1 electrode **18**. The appearance upon a proper alignment of the tip **54** is shown in FIG. 4. Once alignment is obtained the operator retracts adjusting screws **24** to relieve pressure induced thereby, again checks the alignment of the openings **34** and **36** by mandrel rotation and if the center condition still obtains no further repetitive centering operations are required.

If misalignment returns upon loosening of the adjusting screws **24**, the above described operations are repeated until exact aperture alignment is obtained. After alignment has been properly obtained, adjustment sleeve **22** may be removed, the electron gun supporting cylinder **16** can be removed from mandrel **14** and thereafter subject to further fabrication.

As earlier noted, a major factor in the proper operation of an electron gun is the precise alignment of the beam passing apertures in the G1 and G2 electrodes. The present invention provides a mode for accurately sizing the G2 aperture in a facile and economic manner. Additionally, the novel aligning jig provides an easy and simple mode of determining both the degree and direction of misalignment between the G1 and G2 apertures of partially manufactured electron guns. In addition to providing an easy check for possible misalignment, the device offers a mode of simple and efficient mechanical distortion of each gun to return misaligned apertures to proper alignment. Scrap loss during electron gun production is thereby minimized.

The invention as shown is by way of illustration and not limitation and may be modified in many aspects, all within the scope and the spirit of the invention.

What is claimed is:

1. In a jig for aligning electrode apertures in an electron gun the combination of means to support a cylindrical gun having electrodes therein secured to the inner surface of the cylinder, aligning mandrel means positionable within an aperture in one of said electrodes and adjacent the aperture in another electrode, said mandrel means having indicia on its tip to indicate the center thereof, means to rotate the mandrel to thereby visibly indicate the relative position between the center of said other aperture and the center of the mandrel, and means to mechanically distort the cylinder to accurately align said other aperture with the center of said mandrel tip.

2. In a jig for aligning electrode apertures in an electron gun according to claim **1**, and including an outer sleeve telescopically receiving the cylinder, said outer sleeve having manually movable means thereon to distort the wall of the outer cylinder.

3. In a jig for aligning electrode apertures in an electron gun according to claim **2**, wherein said last mentioned distortion means are peripherally arranged around the outer cylinder.

4. In a jig for aligning electrode apertures in an electron gun according to claim **3**, wherein said movable means are screws threadably received in said sleeve and engageable with the cylinder.

5. In a jig for aligning electrode apertures in an electron gun according to claim **4**, and including magnifying means to view the tip of said mandrel through the aperture in the other electrode.

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U.S. Cl. X.R.

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