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3,349,270

SELF-ALIGNING ELECTRON GUN ASSEMBLY

Filed March 4, 1966

2 Sheets-Sheet 1

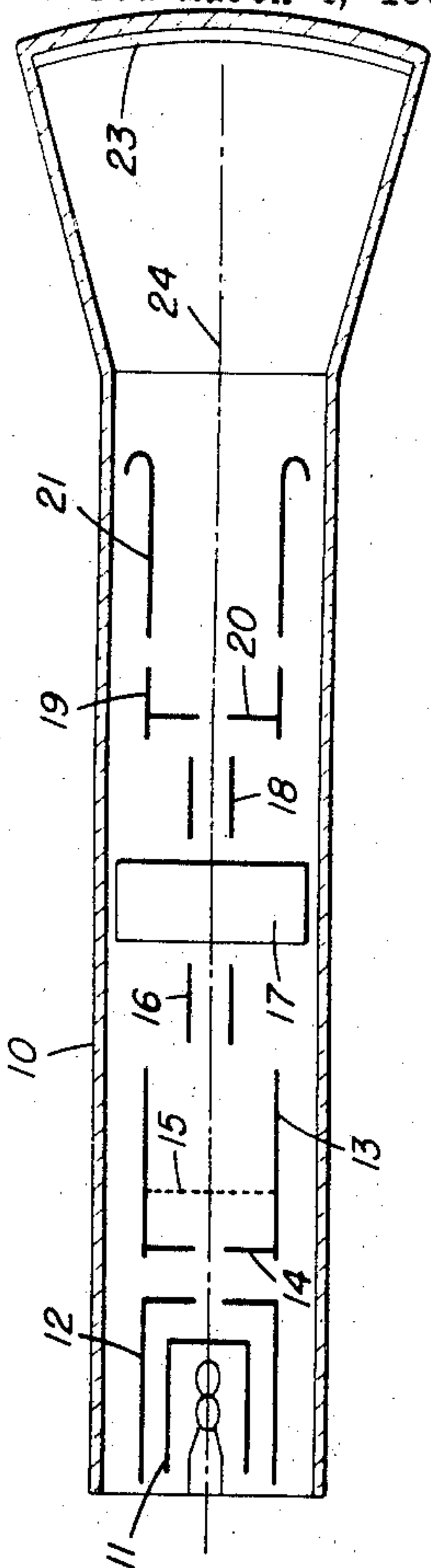


FIG. 1.

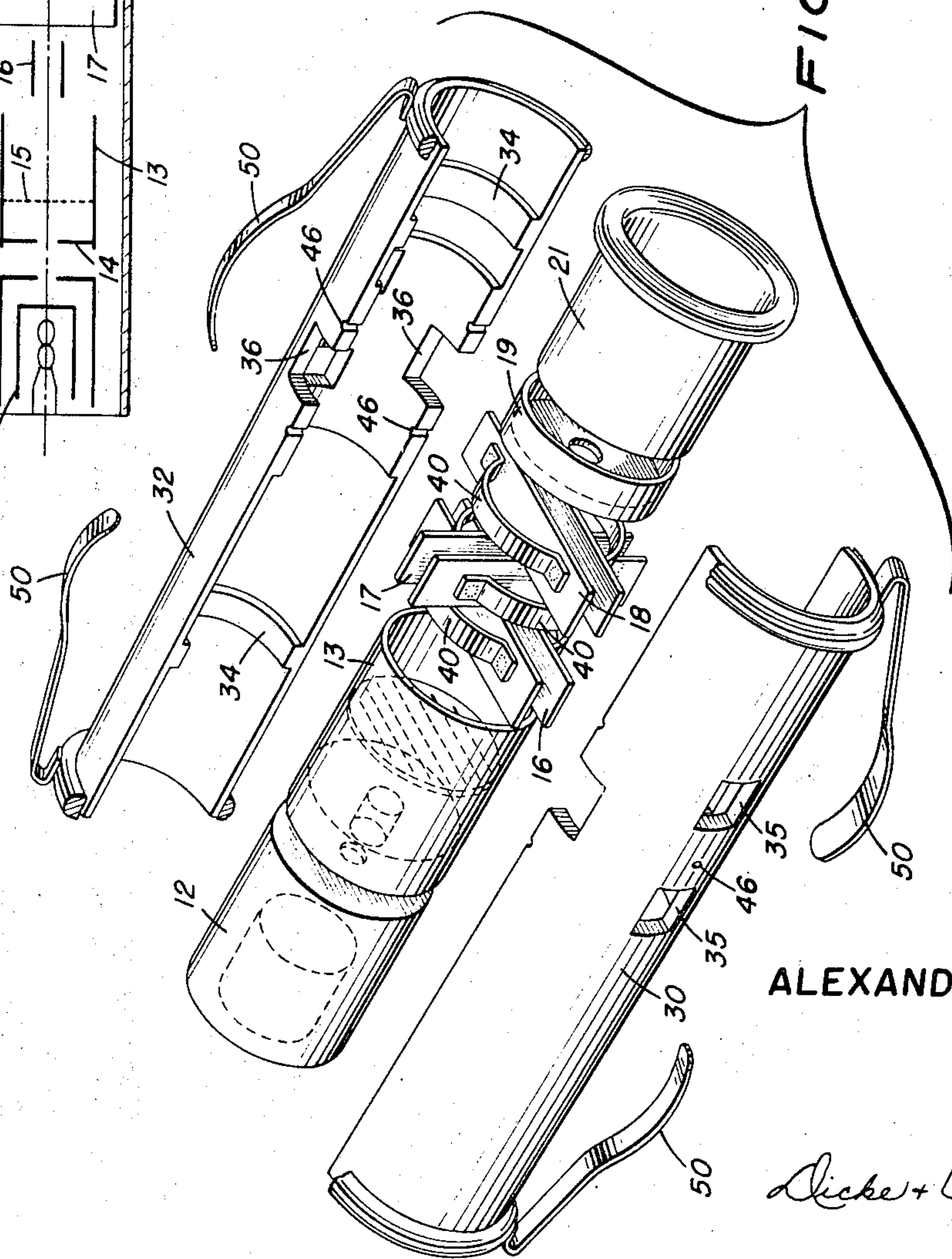


FIG. 2.

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FIG. 3.

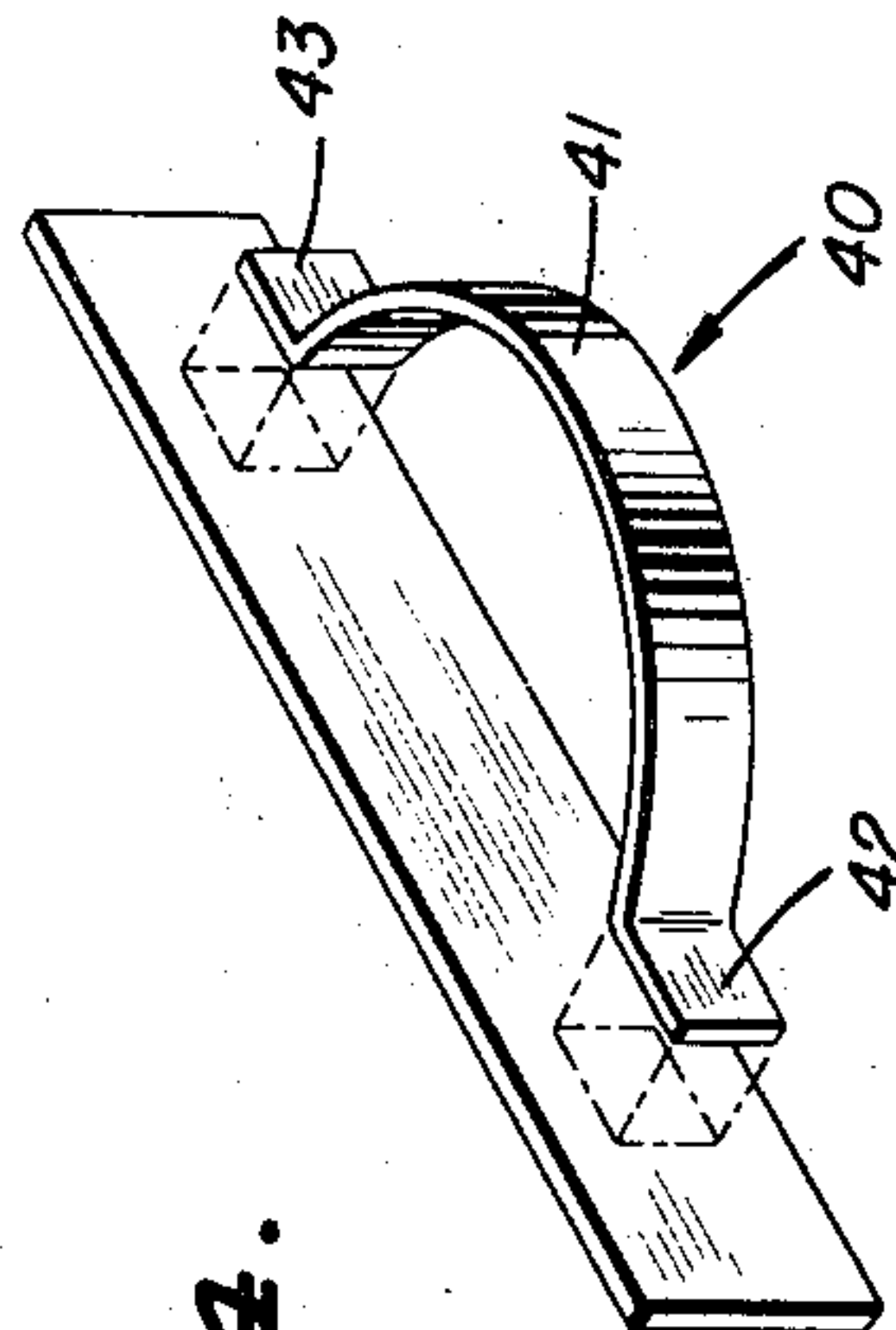
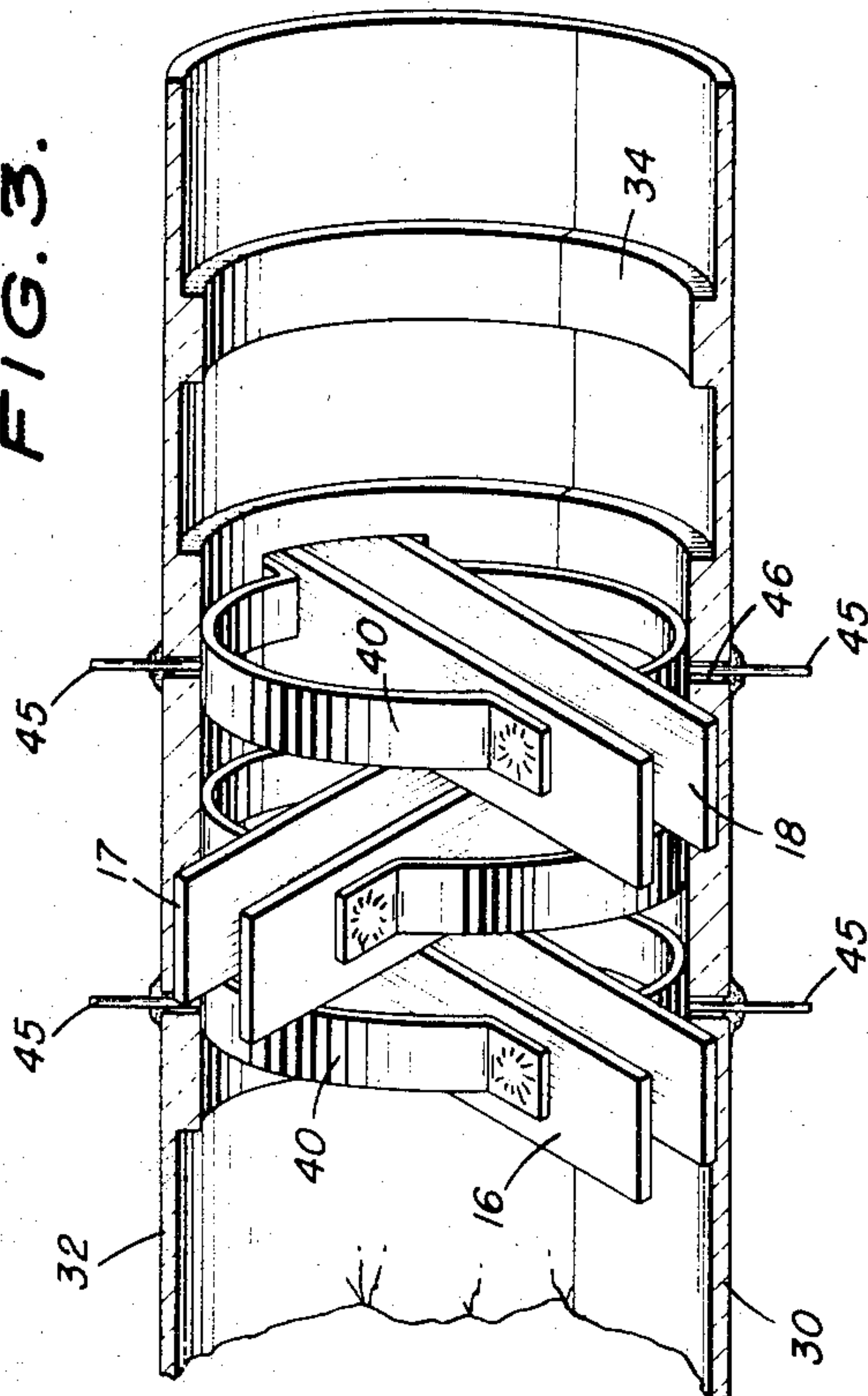


FIG. 4.

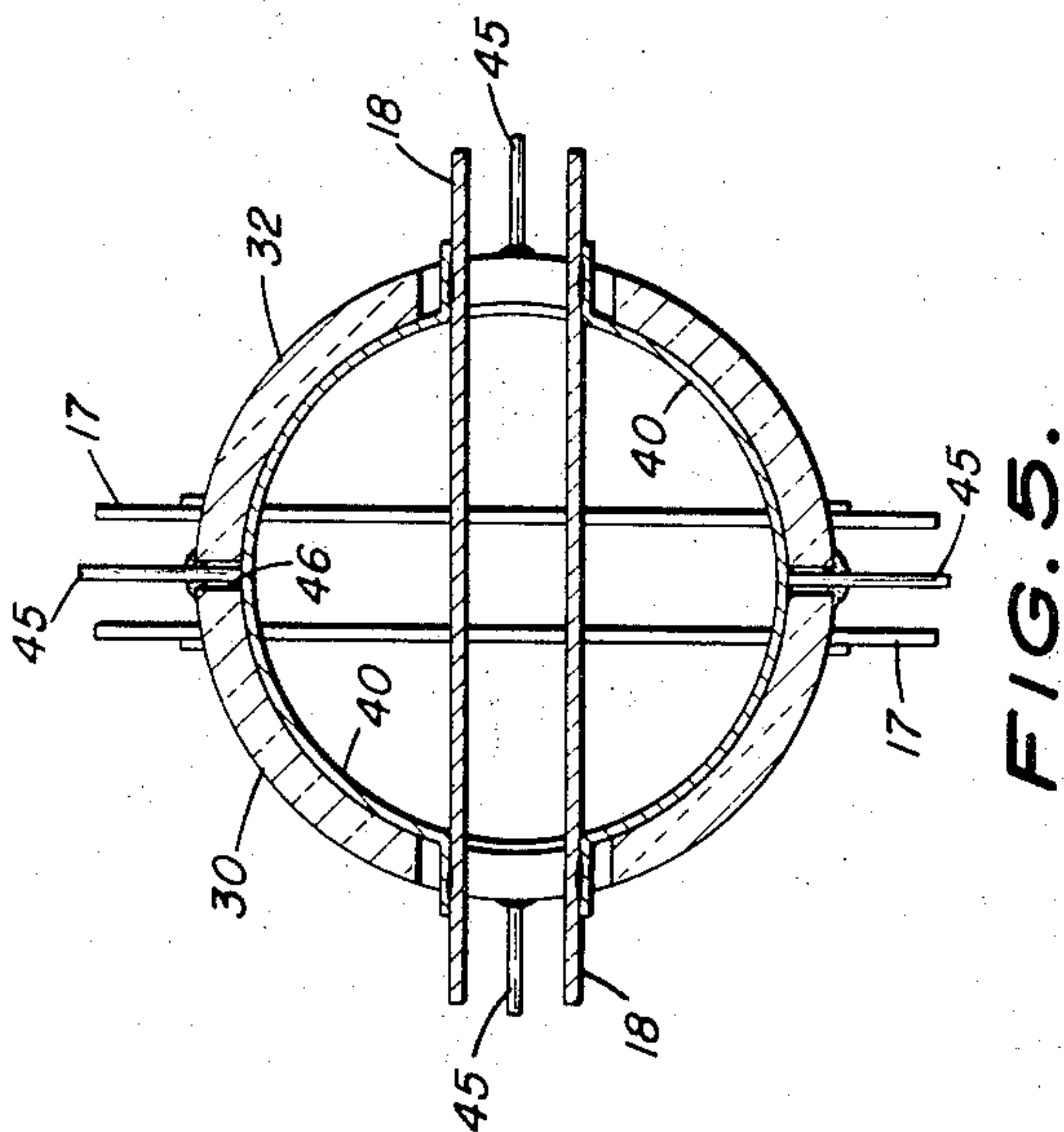


FIG. 5.

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## 3,349,270 SELF-ALIGNING ELECTRON GUN ASSEMBLY

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10 Claims. (Cl. 313-78)

The present invention relates in general to electron discharge devices and more particularly to cathode ray tube electron gun constructions and assembly techniques.

The invention has general utility in cathode ray devices, but has been specifically designed for and is of particular advantage in the improvement of the internal construction of cathode ray tubes known as shaped beam tubes.

The shaped beam tube is generally known as a character image generating device comprising an evacuated envelope having at one end therefrom a beam generating means and at the other end a screen coated on the inside surface with an electron sensitive phosphor capable of generating a light image in response to electron bombardment; intermediate the two ends of the tube a character forming matrix is provided which subdivides the electron beam into a plurality of character shaped streams. Positioned between the character forming matrix and the screen of the tube is a means responsive to a control voltage for selecting one of the group of character shaped streams to be projected onto the screen of the tube, the selection means itself comprising, in the known construction, one or more electrostatic lenses and a series of magnetic deflection coils or electrostatic deflection plates capable of positioning the entire group of character shaped streams with respect to the single aperture disc so as to permit only a single selected stream to pass through to the screen of the tube. Such a shaped beam tube is described more fully in U.S. Patent 2,761,988 issued to Joseph T. McNaney and assigned to the common assignee hereof.

Due to the fundamental operation of these shaped beam tubes and the necessarily small size and close spacing of the electron optical lens elements and of the character shaped streams formed by the character forming matrix upon interception of the electron beam, the alignment accuracy and tolerances of the electron gun structure must be very precise to insure continued accurate operation under different conditions of use. In addition, this extreme accuracy of construction has resulted in the need for complicated manufacturing techniques including intricate jiggling and alignment procedures requiring special techniques and skilled assembly.

In order to eliminate these disadvantages in the assembly and continued efficient operation of such shaped beam tubes, it has been proposed to provide a so-called "self-aligning" gun construction wherein the various elements and electrodes of the gun construction are supported in rigid accurate alignment in module form using the internal surface of the cathode ray tube, or internal surfaces of auxiliary means supported within the cathode ray tube, as the confining or encompassing dimension, thereby providing the various electrodes of the assembly in proper position with respect to this surface. In this way, the envelope, or auxiliary means supported within the tube envelope, provides for the necessary constraining of the modular construction and gives it alignment and structural rigidity necessary to the simplified initial assembly and continued accurate positioning of these elements during use of the tube.

One such self-aligning construction is proposed in U.S. Patent No. 3,047,759 issued to Joseph T. McNaney and assigned to the common assignee hereof in the form of

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an electron gun structure wherein the series of electron optical elements are supported within a longitudinal tubular member in rigid precise alignment, which tubular member is formed of two semi-tubular shells constructed so as to provide accurately machined grooves and keyed interconnections to effect the necessary support and alignment for each of the elements in the electron gun structure.

The present invention provides a cathode ray tube structure of the shaped beam type in which each of a series of electron optical elements within the cathode ray tube is supported within a longitudinal tubular member of the type set forth in the above mentioned McNaney patent and wherein novel means are provided in conjunction with said tubular member for supporting respective pairs of horizontal and vertical electrostatic deflection plates for proper alignment and continued rigid support.

In brief, each of the horizontal and vertical deflection plates provided for properly positioning the character shaped streams with respect to the selection aperture is secured to a semicircular shaped bracket which conforms to the internal shape of the longitudinal tubular member and serves as a means for properly positioning each deflection plate with respect to this tubular member. The tubular member is additionally provided with a plurality of substantially rectangular apertures which permit the deflection plates to pass through the walls of the tubular member in a manner so as to properly control the alignment and spacing of the deflection plate pairs both during assembly and use. In addition, the interior surface of the tubular member is provided with a plurality of rib-like annular projections which serve to properly space the various electrodes within the gun assembly, while holes or apertures properly positioned along the length of the tubular member serve as means for providing electrical connection to the electrodes and also simultaneously provide proper alignment for the respective electrodes.

It is an object of the instant invention to provide within a cathode ray tube of the shaped beam type and improved self-aligning electron gun construction.

It is another object of the instant invention to provide a beam deflection means for a shaped beam tube which is capable of simplified assembly within the electron gun construction and provides self-aligning properties for continued accurate alignment of the various elements thereof during use of the device.

It is a further object of the instant invention to provide a beam deflection means for use in shaped beam tubes having a construction which facilitates the assembly of the electron gun construction, eliminating the need for fixtures, jigs, and measuring devices.

It is still another object of the instant invention to provide an electron gun construction for shaped beam tubes which is self-aligning, under the influence of a support member capable of providing modular construction thereof supported within the tube envelope and insuring permanent alignment of each of the elements of the construction.

These and other objects, features and advantages of the instant invention will become more apparent from the following detailed description of the invention, when taken in conjunction with the accompanying drawings which disclose one embodiment of the instant invention, and wherein:

FIGURE 1 shows schematically and diagrammatically the construction of a cathode ray tube of the shaped beam type;

FIGURE 2 is an exploded view, showing a typical assemblage of shaped beam tube elements fabricated according to the invention;



FIGURE 3 is a detailed view partly in section showing the arrangement of deflection plates and supporting means therefor in accordance with the teachings of the instant invention;

FIGURE 4 is a detailed view of a deflection plate sub-assembly in accordance with the construction illustrated in FIGURE 3; and

FIGURE 5 is an end section view illustrating the disposition of the deflection plate assemblies in accordance with the construction illustrated in FIGURE 3.

Referring more particularly to the drawings for a detailed explanation thereof, wherein like reference numerals are used throughout the separate views to indicate similar elements wherever possible, and more particularly to FIGURE 1, a cathode ray tube of the shaped beam type basically comprises an evacuated envelope 10 within which is provided in series arrangement electrodes 11 through 22, forming the electron optical lens construction of the cathode ray tube. The envelope 10 encloses an electron beam generating and control means at one end thereof consisting of a cathode 11 and a control grid 12, which will generate and project an electron beam along the axis of the tube envelope 10 toward a target 23 at the opposite end of the tube. The target 23 may be of any well known electron responsive coating such as phosphor or the like. The phosphor may have an aluminum undercoating, as is well known in the art, to enhance the response of the screen to the impingement of the beam, causing a light image thereupon. The light image is then viewed externally of the tube at the face or window of the envelope.

The longitudinal axis 24 of the envelope 10 of the cathode ray tube serves additionally as the optical axis for the beam generation and control system formed by the electron optical elements of the cathode ray tube gun assembly. Therefore, both the beam generating and control means 11 and 12 and the target or screen 23 must be coaxially disposed with respect to the longitudinal axis 24 effecting alignment of the necessary electron optical elements thereabout.

The electrode elements, referred to as electron optical elements, which provide for a control of the beam positioning and cross section thereof between the cathode 11 and the screen or target 23 consists of a first anode in the form of a cylindrical electrode 13 for accelerating the beam, including an aperture disc 14 positioned therein for effecting a first cross-over of the beam, a character matrix 15 containing a plurality of character-shaped openings for forming the electron beam into a plurality of character-shaped streams. Positioned beyond the first anode 13 is a beam positioning unit consisting of pairs of deflection plates 16, 17 and 18 which through generation of an electrostatic field in response to application of selective voltages serve to adjust the position of the electron beam formed of the plurality of character-shaped streams with respect to the optical axis 24 of the system so as to align, in the well-known manner, one of the character streams with the aperture in aperture disc 20, mounted within the cylindrical anode 19. The single character-shaped stream of electrons passing through the aperture in disc 20 is then further accelerated by the second cylindrical anode 21 and eventually impinges upon target 23 to provide a character representation thereon.

It is quite obvious that completely accurate alignment of each of the elements of the electron gun construction of shaped beam tubes must be effected and maintained for proper operation thereof. Slight misalignments of any one or more of the electrodes of the optical system can result in improper or incomplete character representation on the screen of the cathode ray tube, and due to the close tolerances of the optical system and the close spacing between the character-shaped streams of the electron beam only slight inaccuracies in alignment are necessary to result in substantially complete inoperability of the system.

In order to aid in proper alignment of the various optical elements of the system there is provided, as seen in FIG. 2, a pair of semi-tubular members 30 and 32, made from a suitable insulating material such as ceramic or any other rigid material suitable for inclusion in a cathode ray tube. The semi-tubular members serve as structural supports and spacers for the electron optical elements and form therewith a modular construction providing relative immobility between the various elements thereof and effecting a self-aligning of the optical elements so as to insure continued proper alignment of the electron gun assembly under all conditions of use with respect to the optical axis 24 of the tube. The two tubular members 30 and 32 are preferably of molded construction and cooperate to form an elongated tube within which the optical elements are mounted. Projections 34 in the form of annular ribs formed in a plane transverse to the center longitudinal axis 24 of the tube and concentric therewith, are spaced along the internal surface of the tube and act as spacing means between the various electrodes of the electron optical construction.

Each of the semi-tubular members is also provided with substantially rectangular apertures 35 and rectangular notches 36 which serve to accommodate the projecting deflection plates 16, 17 and 18 of the beam positioning portion of the optical system. The notches 36 on each of the semi-tubular members 30 and 32 cooperate to form in the combined tubular construction substantially rectangular apertures similar in size and configuration to the apertures 35.

The major feature of the instant invention resides in the provision of support means for the deflection plates 16, 17 and 18 by which a self-aligning support of the deflection plates in proper orientation and position is easily effected during the assembly process and is accurately maintained during the use of the device. The mounting of the deflection plates is illustrated in detail in FIGURE 3. Proper aligning and spacing of the deflection plate pairs is effected by the substantially rectangular apertures 35 and 36 formed in the tubular support member such that with the deflection pairs positioned within the support tube with the ends thereof extending through the respective apertures at diametrically opposite points of the tube so that the individual plates are in abutting relationship with opposite parallel sides of the apertures, these deflection plate pairs will be aligned for proper horizontal and vertical deflection of the electron beam, and individual plates of each pair will be positioned in spaced parallel relationship at the proper spacing and orientation within the support tube with respect to the optical axis 24 of the cathode ray tube. The individual deflection plates are maintained in their proper position with the ends thereof extending through the respective support aperture by substantially semi-circularly shaped brackets 40 which are dimensioned to conform to the shape of the inside surface of the support tube formed by the semi-tubular members 30 and 32. As seen in FIG. 4, the brackets have a substantially semi-circularly shaped portion 41 and straight end portions 42 and 43 which may be spot welded, or secured in any suitable fashion, to a deflection plate to form a deflection plate assembly which is then mounted within the support tube formed by the semi-circular members 30 and 32 so that the ends of the deflection plate along with the straight portions 42 and 43 of the bracket extend out through the substantially rectangular alignment apertures in the semi-tubular members. The semi-circular portion 41 of the bracket is formed in abutting relationship with the inside surface of the semi-tubular members and maintained in this position by the wiring leads 45 extending out of the tubular member through suitable apertures 46 therein. A bonding of the wiring leads to the tube will then maintain the brackets 40 in position against the inside surface of the support member and thereby maintain the deflection plates in properly oriented position within the tube.



Due to the shape of the brackets secured to the individual deflection plates and the corresponding shape of the semi-tubular support members, and due to the extension of the deflection plates through the substantially rectangular alignment apertures in the semi-tubular support members, there is only one position of equilibrium which can be maintained by the deflection plates with the brackets 40 pressed against the internal surface of the support members and that single position will provide for proper positioning and alignment of the deflection plates within the electron gun assembly. Not only will this facilitate the assembly operation by eliminating the need for special jigs, harnesses, and measuring devices but the construction will obviously provide a self-aligning feature which will maintain this accurate positioning and alignment of the elements after sealing of the tube and during operation under extreme conditions thereafter.

The resultant precise alignment of the deflection plates within the tubular support construction is further illustrated in FIGURE 5 which shows the end sectional view of the support member adjacent the deflection or beam positioning portion of the electron optical assembly. It is seen that not only the substantially rectangular alignment apertures 35 and 36, but also the extension of the wiring leads 45 through the semi-tubular members, serve to provide for proper alignment and positioning of this assembly. As a result, special keying elements associated with the various electrodes of the electron optical assembly are unnecessary with the construction in accordance with the instant invention, since even with the disc type electrodes and cylindrical electrodes such as electrodes 12, 13, 19 and 21, the wiring leads extending through the support member serve not only as a means for applying electrical potential thereto but serve in addition as a keying member providing proper positioning and alignment of the electrodes in conjunction with the rib-like projections 34.

Assembly of the construction is also considerably simplified as compared to the constructions of the prior art since it is merely necessary to insert the optical elements, as illustrated in FIG. 2, into one of the semi-tubular members with the wiring leads extending through the apertures 46 and the electrodes properly positioning between the respective rib-like projection 34. The electrodes are then secured to the semi-tubular members by sealing the wiring lead to the member in any suitable fashion. The construction is then completed by fitting the other semi-tubular member over the assembly and securing the two semi-tubular members to one another either by spot welding or by providing suitable clamping members in the well known manner. The resulting construction which may be effected without delicate positioning and in a relatively simple manner results in a substantially rigid modular construction wherein the various electrode elements are securely positioned in proper relative orientation to the other elements of the electron optical system in a substantially permanent manner.

The semi-tubular members may be dimensioned so as to form a tube conforming to the inside diameter of the envelope of the cathode ray tube or the support tube may be provided with snubbers 50, as seen in FIGURE 2, for absorbing vibrations applied through the envelope of the cathode ray tube so that the modular assembly may be positioned in spaced relationship to the walls of the envelope of the cathode ray tube at the interior thereof.

Although the invention has been described with a degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes may be made in the configuration and arrangement of the structural components without departing from the spirit and scope of the instant invention all within the scope of the appended claims.

I claim:

1. An electron gun construction for cathode ray tubes comprising
  - an electron beam generating means for generating an electron beam,
  - a plurality of electron optical elements for controlling the position and cross-section of said electron beam, including a plurality of pairs of electrostatic deflection plates,
  - a tubular support member having a plurality of annular ribs disposed transversely to the axis thereof, said electron beam generating means and said optical elements being mounted within said tubular member with said annular ribs providing the axial spacing therebetween,
  - said tubular member being provided with a pair of diametrically disposed rectangular apertures for each pair of said electrostatic deflection plates provided, said pairs of deflection plates being positioned within said tubular member with each plate of a pair in contact with one of two parallel edges of a respective rectangular aperture.
2. An electron gun construction as defined in claim 1 wherein each pair of deflection plates extends at both ends thereof through a respective pair of diametrically disposed apertures in said tubular member.
3. An electron gun construction as defined in claim 2 further including a bracket having a shape corresponding to the shape of the inside surface of said tubular member secured to each deflection plate, each said bracket being mounted with its associated deflection plate within said tubular member in contiguous contact with the walls thereof.
4. An electron gun construction as defined in claim 1 wherein said tubular member further includes a plurality of apertures spaced along the length thereof, and a wiring lead connected to each of said plurality of optical elements and passing through a respective one of said apertures spaced along the length of said tubular member.
5. An electron gun construction as defined in claim 3 wherein said tubular member includes an exit aperture in the wall thereof interrupting each bracket secured to a deflection plate, and a wiring lead passing through each of said exit apertures and connected to a respective bracket, said apertures and wiring leads being positioned with respect to said brackets to insure proper alignment of said deflection plates.
6. An electron gun construction as defined in claim 1 wherein said tubular support member is formed of a pair of identical semi-tubular members.
7. A modular support member for an electron gun construction for cathode ray tubes having an electron beam generating means and a plurality of electron optical elements for controlling the position and cross-section of the electron beam including a plurality of pairs of electrostatic deflection plates, the invention comprising
  - a tubular support member having a plurality of annular ribs disposed transversely to the axis thereof at the inner surface thereof, said ribs being spaced axially within said tubular member and having a thickness sufficient to provide proper spacing for said electron optical elements,
  - said tubular support member being provided with at least two pairs of diametrically disposed substantially rectangular apertures with the diametric line joining one of said pairs being transverse to the diametric line joining the other of said pairs.
8. A modular support member as defined in claim 7 wherein said tubular support member is formed of a pair of identical semi-tubular members.
9. A modular support member as defined in claim 7 further including a plurality of holes provided in said tubular support member along the length thereof, with



each hole providing access to a respective electron optical element.

10. A self-aligning beam deflection system for cathode ray tubes comprising

- a hollow support member of rectangular geometrical configuration, 5
- a plurality of electrostatic deflection plates of linear configuration mounted diametrically within said hollow support member with the ends thereof extending through the walls of said support member, and
- a bracket secured to each deflection plate and having a shape corresponding identically to the shape of the inner wall of said hollow support member, each said bracket being mounted with its associated de-

flection plate so as to be in contiguous contact with the walls of said hollow support member.

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