June 16, 1953 L. J. PATLA 2,642,546

ION TRAP

Filed Oct. 10, 1950

Fig. 1.

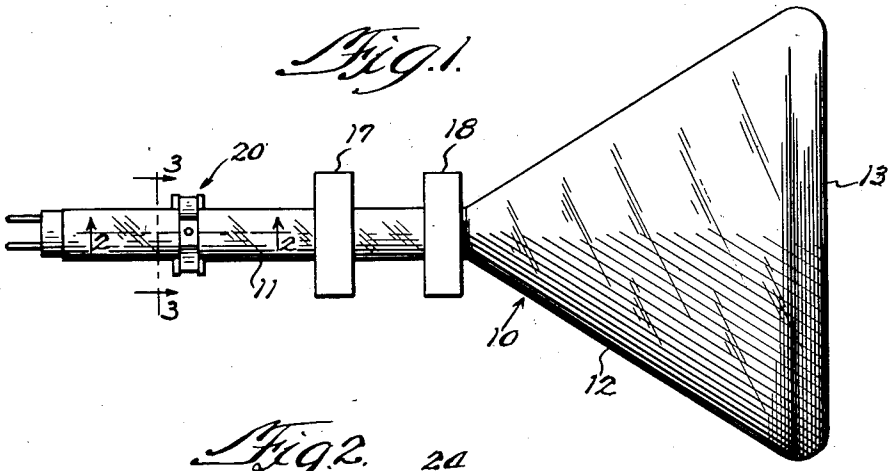


Fig. 2.

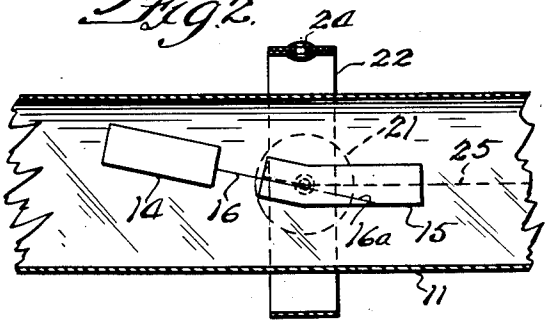


Fig. 3.

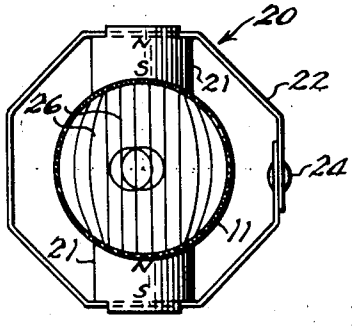
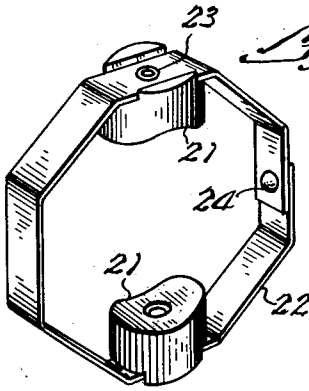


Fig. 4.



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ION TRAP

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8 Claims. (Cl. 313—75)

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This invention relates to an ion trap and more particularly to an ion trap for a cathode ray tube. It is an object of the invention to provide improved apparatus of that character.

It has been found that certain elements in the beam of a cathode ray tube will not respond to a magnetic field, through which they pass, to the same degree as do the electrons which are present in the beam. These elements are generally termed "ions" and are objectionable in a cathode ray tube which employs magnetic deflection means since they do not strike the fluorescent screen at the same points at the same times as do the electrons. More particularly the magnetic deflecting means may cause the electrons in the beam to form a pattern covering substantially the entire area of the screen while the ions are concentrated in a small area at the center of the screen, being deflected little if any by the magnetic deflection means. This, of course, confuses the pattern or picture which the electrons form on the screen and, in addition, tend to burn out the centrally located spot upon which they concentrate.

These ions are commonly separated from the electrons in the beam and disposed of by an ion trap which may be of any one of several well known forms. In one form, the beam is originally started along the axis of the tube or along a line parallel to the axis of the tube and is deflected by means of an oblique gap between the first and second anodes of the tube so that the beam travels for a short distance at a substantial angle to the axis of the tube. Another type of trap, commonly called the "bent-gun" form, initiates a beam which travels at a substantial angle to the axis of the tube. In either case a magnetic field is employed to bend the stream of electrons and direct them along the axis of the tube. The ions, however, do not respond to the magnetic field forming a part of the ion trap and accordingly continue along their oblique path until they strike the second anode and are dissipated.

Prior to the present invention, magnetic means have been employed in the ion trap which produce an irregular field, causing some dispersement of the stream of electrons. Such dispersement is, of course, objectionable since a better picture or pattern is obtained on the screen if the beam is extremely thin and concentrated. Furthermore, the means commonly employed in ion traps causes extraneous magnetic fields which interfere with the operation of the magnetic deflection means in an unpredictable and hence

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not readily compensatable manner. Still further, the magnetic means previously employed in ion traps have been expensive, awkward to install, and not readily adjustable.

The magnetic means employed in an ion trap for a cathode ray tube are frequently referred to in the art as an ion trap, and it is in this sense that the term is used hereinafter.

It is another object of the invention to provide an improved ion trap producing a substantially uniform field.

It is another object of the invention to produce an improved ion trap in which extraneous fields are substantially eliminated.

It is another object of the invention to produce an improved ion trap which is readily applied to a cathode ray tube and readily adjusted in its position relative thereto.

It is another object of the invention to provide an improved ion trap having the advantages mentioned above while being simple, rugged and economical to manufacture.

This invention, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings, in which like parts are designated by like reference numerals,

Fig. 1 is an elevational view of a cathode ray tube, such as is used in television receivers, and an ion trap constructed in accordance with the invention;

Fig. 2 is an enlarged cross-sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1; and

Fig. 4 is a perspective view of the same ion trap shown in the preceding figures.

The ion trap appearing in the drawing is shown applied to a cathode ray tube 10 such as is commonly used in television receivers. A long neck portion 11 is provided over the length of which various control operations are performed on the beam. A funnel shaped portion 12 is provided leading from the neck to the face 13 of the tube, the inner surface of the latter being coated with a fluorescent material.

Toward the left-hand end of the neck 11 of the tube a control grid 14 is provided. Within the control grid, but not shown on the drawings, is a cathode and cathode heater which supply a beam 16 which ultimately traces a pattern or picture on the tube face 13. To the right of the

control grid 14 is an anode 15 which serves to accelerate the beam emitted by the cathode referred to above. A focusing coil 17 and horizontal and vertical deflection coils 18 are provided, these coils being shown only schematically in Fig. 1 since their particular nature is not of significance to the present invention other than that an ion trap of any nature is of particular value only when the beam is deflected magnetically rather than electrostatically. The purpose of the control grid 14 and the anode 15 are well understood in the art and accordingly, need not be discussed in detail herein. It is believed to be sufficient to point out that the control grid 14 is generally negative with respect to the cathode and serves to funnel the beam toward the positively charged anode 15.

The orientation of the control grid 14 with respect to the neck of the tube, as best seen in Fig. 2, indicates this as being a "bent-gun" type of tube in which the beam 16 is originally directed at a substantial angle to the axis of the neck of the tube. The purpose of this arrangement is to dispose of objectionable ions before they reach the fluorescent screen on the face of the tube.

The beam 16 is made up of electrons and heavier particles commonly referred to as "ions." Since these ions are many times heavier than the electrons they are not accelerated by the anode 15 to the same high velocity as are the electrons. If these ions are permitted to continue toward the fluorescent screen of the tube along with the electrons, it has been found that because of their substantially greater weight and their relatively slow speed, as compared to the electrons, these ions will be relatively unresponsive to the deflection coils 18 and, accordingly, will focus on a small central portion of the fluorescent screen. This not only confuses the central portion of the picture but also rapidly burns out this central portion of the screen. The "bent-gun" formation of the tube elements along with the ion trap subsequently to be described eliminates these ions prior to their reaching the fluorescent screen and thereby avoids these difficulties.

According to the preferred embodiment of the invention, the ion trap 20, best seen in Figs. 3 and 4, includes a pair of magnets 21 and preferably a flexible band or tube 22 of magnetic material which supports the magnets 21 and serves as a magnetic shield therefor. The magnets may be secured to the band in any suitable way, such as by rivets or eyelets 23, and the band 22 is closed upon itself and the ends secured to each other by a rivet 24 such that a tubular or continuous magnetic path is formed. The polarity of the magnets is as indicated in Fig. 3; specifically, the tube-engaging faces of the magnets are of opposite polarity.

The function of the ion trap 20 is to swing the electrons in the oblique beam 16 to an axial path indicated by the dotted line 25 in Fig. 2. The ions being relatively non-responsive to magnetic fields, as previously pointed out, do not respond to the field of the ion trap 20 and, accordingly, continue along the path 16a substantially in alignment with the beam 16 until they strike the wall of the anode 15 and are dissipated. The objectionable ions are in this manner substantially removed from the beam with the result that only the electrons travel along the path 25 and ultimately reach the fluorescent screen.

Various devices are well known in the art for obtaining an oblique beam 16 but since the manner of creating this oblique beam is not of importance in the application of an ion trap, the preceding general description of the "bent-gun" form of tube element arrangement will suffice. It is common practice also to swing the electrons in the oblique beam 16 onto an axial path 25 by magnetic means. However, such magnetic means have, prior to the present time produced a distorted field with a resultant scattering of the beam of electrons. They have also produced substantial extraneous fields which have interfered with the proper operation of the focusing coil 17 and the deflection coils 18. On the other hand an ion trap constructed in accordance with the invention produces a substantially uniform field in the area traversed by the beam and substantially eliminates any extraneous fields which might otherwise interfere with the operation of the coils 17 and 18.

Furthermore, ion traps constructed in accordance with the prior art have been awkward to install and difficult to adjust while an ion trap in accordance with the invention can be installed and adjusted with great ease and, in addition, is inexpensive to manufacture.

It will be noted upon reference to Fig. 3 that the flux lines 26 produced by the magnets or magnetic elements 21 are substantially uniform and straight in that portion of the field encompassed by the anode 15 and hence in the area through which the electron beam passes.

As will be readily understood by those skilled in the art it is not essential that both of the elements 21 be magnets since a substantially uniform field can be obtained if only one of the elements 21 is a magnet while the other is a block of magnetic material. In such case there will be little tendency for the flux lines to curl out to the band 22 or directly through the air to the other pole of the magnet but will, instead, tend to pass across the tube to the block of magnetic material at the opposite side thereof and hence through the band 22 to the opposite pole of the magnet. It is preferable, however, that both of the elements 21 be magnets as this increases the uniformity of the magnetic field within the tube.

It is also within the scope of the invention that the magnets 21 be electromagnets rather than permanent magnets, but the permanent magnets are considered superior for reasons of economy and convenience.

Extraneous fields which might otherwise extend a substantial distance from the magnets 21 and interfere with the operation of the coils 17 and 18 are substantially eliminated by use of the band 22 of magnetic material. Substantially all of the flux lines which would otherwise make up such extraneous fields pass instead through the path of low permeability provided by the band 22. The band 22 by providing a path of low permeability between the outer poles of the two magnets, or between the outer pole of one magnet and a block of magnetic material which may form the other of the elements 21, also increases the intensity of the field within the tube for a given pole strength of the magnet or magnets 21.

The use of a flexible band 22, as, for example, a band of spring metal, permits very convenient attachment of the ion trap to the neck of the tube and permits ready adjustment of the ion trap longitudinally and circumferentially of the tube. The two vertically extending portions of the band 22 as viewed in Fig. 3 may, for example, be grasped between two fingers and squeezed slightly with the result that the two elements 21 move radially outward and away from the neck of the

tube. While the band **22** is so distorted the ion trap may be removed from or applied to the neck of the tube or may be moved axially or circumferentially of the tube. Upon release of pressure the band **22** brings the two elements **21** resiliently into contact with the neck of tube, preferably with an appreciable pressure, whereupon the ion trap will maintain its position with respect to the neck of the tube. It will be noted that the ion trap is in substantially perfect balance about the axis of the tube and, accordingly, has no tendency to creep or slide circumferentially even though the tube might be vibrated.

The inner faces of the elements **21** are preferably curved to match the outer surface of the neck of the tube. This permits a greater frictional grasp and assures that the magnets will be centered about the neck of the tube with the axes of the magnets lying along a diameter of the neck of the tube. The curvature of the inner faces of the magnets to match the outer surface of the neck of the tube also assures a stronger and more uniform magnetic field within the tube than would otherwise be obtained.

While a particular embodiment of the invention has been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made, and it is, therefore, contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

The invention having thus been described, what is claimed and desired to be secured by Letters Patent is:

1. An ion trap for a cathode ray tube comprising, a continuous band of magnetic material, and a pair of permanent magnets attached to the inner surface of said band at diametrically opposed points and extending radially inwardly therefrom, said ion trap being adapted to encompass the neck of said tube, and said magnets being arranged with opposed poles facing each other.

2. An ion trap for a cathode ray tube comprising, a continuous band of magnetic material, and a pair of permanent magnets attached to the inner surface of said band at diametrically opposed points and having their inwardly directed faces curved to fit the neck of said tube, said ion trap being adapted to encompass the neck of said tube, with a radial clearance substantially equal to the radial dimensions of said magnets and said magnets being arranged with opposed poles facing each other.

3. An ion trap for a cathode ray tube comprising a continuous band of magnetic material, and a pair of permanent magnets attached to the inner surface of said band at diametrically opposed points, said band being adapted to hold said magnets firmly against the outer surface of the neck of said tube and being adapted to flex and thereby to move said magnets radially apart whereby said ion trap may readily be moved longitudinally and circumferentially on said neck, and said magnets being arranged with opposed poles facing each other.

4. An ion trap for a cathode ray tube comprising, a band of magnetic material, and a pair of permanent magnets attached to the inner surface of said band at diametrically opposed points and having their inwardly directed faces curved to fit the neck of said tube, said band being adapted to hold said magnets firmly against the outer surface of the neck of said tube and being adapted to flex and thereby to move said magnets radially apart whereby said ion trap may readily be moved longitudinally and circumferentially on said neck, and said magnets being arranged with opposed poles facing each other.

5. An ion trap for a cathode ray tube comprising, a band of magnetic spring metal, and a pair of permanent magnets attached to the inner surface of said band at diametrically opposed points and having their inwardly directed faces curved to fit the neck of said tube, said band being adapted to hold said magnets firmly against the outer surface of the neck of said tube and being adapted to flex and thereby to move said magnets radially apart whereby said ion trap may readily be moved longitudinally and circumferentially on said neck, and said magnets being arranged with opposed poles facing each other.

6. An ion trap for a cathode ray tube comprising, a pair of magnetic elements arranged at diametrically opposed points on the neck of said tube, and a shield of magnetic material extending circumferentially around said neck of said tube and over said magnetic elements, at least one of said magnetic elements being a magnet and having one pole face abutting said neck.

7. An ion trap for a cathode ray tube comprising, a pair of magnets arranged at diametrically opposed points on the neck of said tube with one pole of each of said magnets facing said neck of said tube, and a magnetic shield magnetically connecting the other poles of said magnets.

8. An ion trap for a cathode ray tube comprising, a substantially circular band of magnetic spring metal, and a pair of magnets attached to the inner surface of said band at diametrically opposed points and having inwardly directed pole faces of opposite polarity curved to fit the neck of said tube, said band being adapted to hold said magnets firmly against the outer surface of the neck of said tube and being adapted to flex and thereby to move said magnets radially apart whereby said ion trap may readily be moved longitudinally and circumferentially on said neck.

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