Feb. 28, 1939. M. PLOKE 2,149,101

CATHODE RAY TUBE

Filed May 3, 1937

Fig. 1

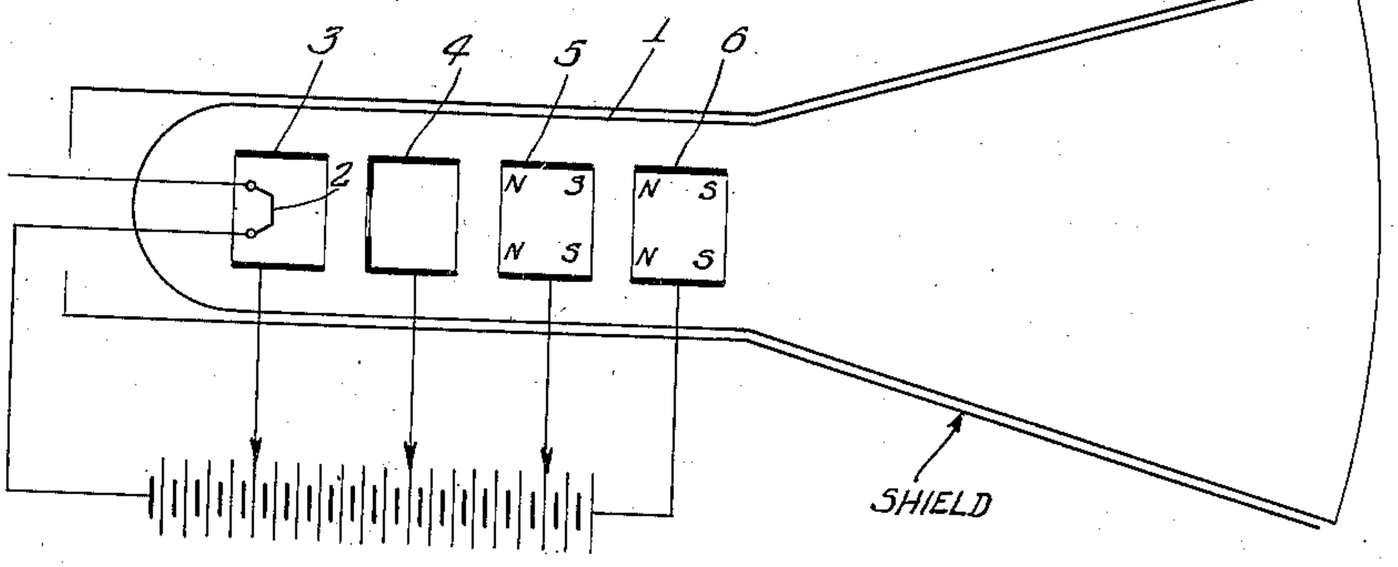


Fig. 2

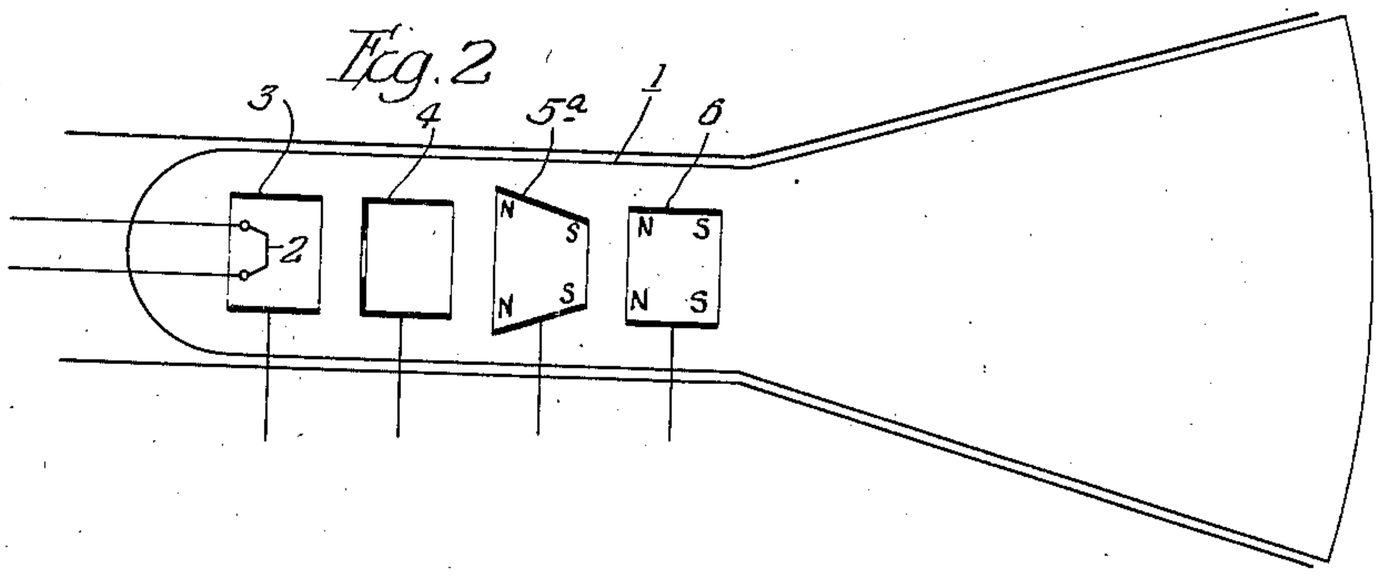
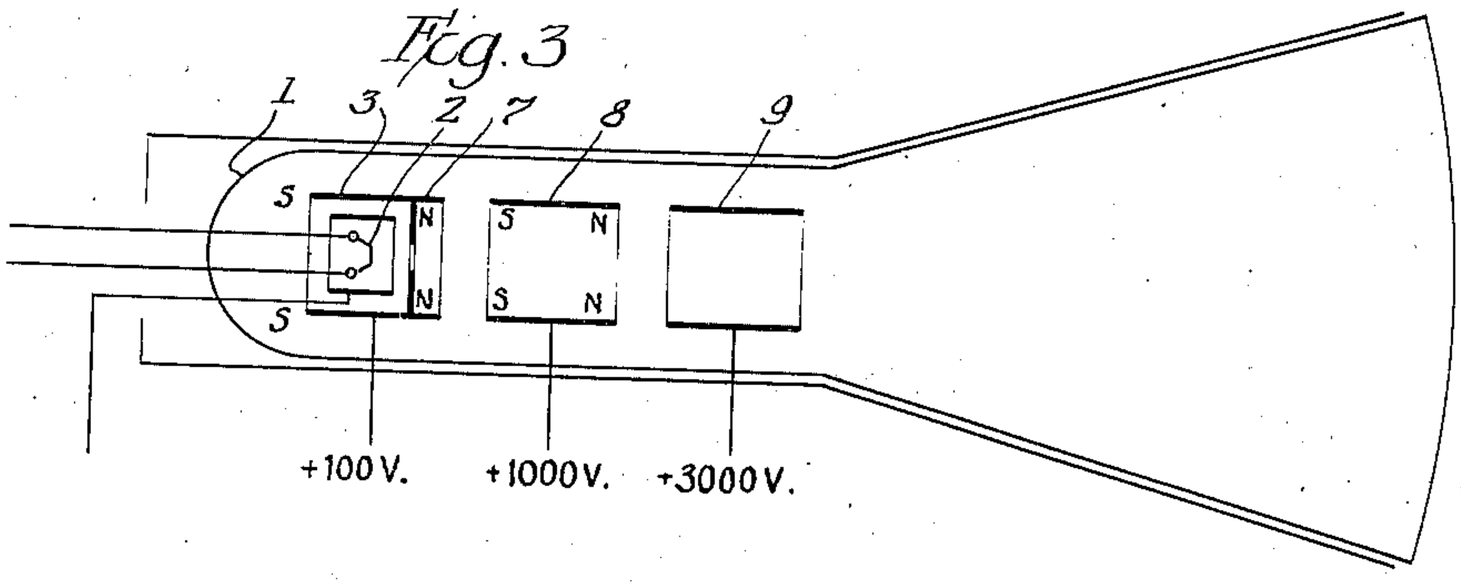


Fig. 3



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CATHODE RAY TUBE

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5 Claims. (Cl. 250—161)

The invention relates to improvements in cathode ray tubes and in particular is directed to Braun tubes.

It is customary to provide Braun tubes with magnetical means or with electro-statical means for concentrating the cathode ray beam, said magnetical means being arranged outside and around the envelope of the tube, while said electro-statical means is arranged inside said envelope. In spite of the fact, that experience has proven that magnetical lenses are more effective as far as the beam concentration is concerned, Braun tubes, especially the ones which are being closed by fusion at the end, are equipped with electrical lenses. The reason for this can be found in a number of disadvantages inherent in magnetical lenses, which are formed of coils arranged outside the envelope of the tube. The production and the current consumption of such coils are connected with considerable expense.

It is the principal object of the present invention to provide a Braun tube with magnetical lenses which are mounted in the interior of the envelope of the tube.

Another object of the invention is to provide a Braun tube with magnetical lenses formed of permanent magnets which are arranged within the envelope. Such magnetical lenses eliminate the disadvantages of the previously employed magnetical lenses and at the same time provide the tube with the advantage of a magnetical concentration of the electron beam.

A substantial advantage of the Braun tube of the present invention resides in this, that the dispersion of the magnetic field produced in the interior of the envelope is relatively small compared with that of a coil arranged outside the envelope, or in other words, the thickness of the lens is relatively small. Furthermore, the savings on space is another advantage of considerable importance if the tube is employed, for instance, in television receivers.

It is, in fact, another object of the invention to provide a cathode ray tube which is especially suitable for television purposes.

It is also an object of the invention to provide a Braun tube, in which the concentration of the electron beam is effected by electrical lenses with permanent magnets, which are mounted in the interior of the envelope and serve as a magnetic lens.

Still another object of the invention is to make the electrodes of the tube which constitute an electrical lens of permanent magnets, so that the electrodes serve also as a magnetical lens. The electrodes are magnetized to a degree as is required to obtain the desired concentration of the electron beam, and if necessary the magnetization may be as high as to cause magnetic saturation.

When employing magnetic electrodes as just mentioned, there is obtained at the same time a shielding of the electron beam against exterior magnetic fields having interfering tendencies.

The arrangement of the magnetic field producing means in the interior of the envelope of the Braun tube permits that the entire tube without substantial enlargement of the device may be mounted into a protective mantle, consisting for instance of iron. In this manner the tube is shielded against exterior electro-static fields and also against exterior magnetic fields.

The electrodes are preferably made of such types of steel which are and remain perfect when subjected to the vacuum produced in the envelope. Besides the types of steel mentioned other ferro-magnetical material may be used, for instance the alloys of Heuser and the like. In such cases where magnetic parts are employed which cannot be heated, it is advisable to introduce Getter material into the envelope to insure that the required degree of vacuum is maintained in the envelope.

With these and other objects in view the invention consists of the novel arrangements, construction of parts and combination of elements as hereinafter more fully described, illustrated by way of example in the drawing and recited in the claims.

In the drawing:

The Figs. 1 to 3 illustrate diagrammatically each a different embodiment of a cathode ray tube in accordance with the present invention.

According to Fig. 1, the cathode ray tube comprises an envelope 1, a source of cathode ray 2 surrounded by a Wehnelt-cylinder 3, an accelerator anode 4 and an electrical lens composed of the electrodes 5 and 6. The source of cathode rays 2 may consist for instance of an indirectly heated oxide cathode.

The electrodes 5 and 6 are of tubular form and are produced of ferromagnetic material magnetized to a certain degree. The position of the magnetic poles is indicated by the letters N and S respectively. The electrodes 5 and 6 do not only act as electrical lens, but also act as magnetic lens to cause a concentration of the electron beam in such a manner, that for instance a light spot adapted for television purposes is

produced on the fluorescent screen of the Braun tube.

Fig. 2 illustrates a cathode ray tube of substantially the same construction as Fig. 1, except that the electrode 5 has been substituted by a conically shaped electrode 5a which together with the electrode 6 forms a short magnetic lens. This last named lens results in a somewhat more favorable recording of the electron beam as is obtained with the arrangement illustrated in Fig. 1.

In the modification illustrated in Fig. 3 the envelope 1 contains again a source of cathode rays 2 surrounded by a Wehnelt cylinder 3. An accelerator electrode 7 surrounds the Wehnelt cylinder 3 and together with the tubular electrode 8 acts as electrical lens and also as magnetic lens. It is important that the electrode 7 is arranged with respect to the cathode 2 in such a manner that the stray field on the end on which the S pole is produced will be ineffective and that the electrons accelerated by this electrode enter directly the field of the magnetic lens, whose potential surfaces should have, if possible, the form of a sphere. After having passed through the magnetic lens the electrons preferably are additionally accelerated by the electrode 9. The distribution of the acceleration potentials may be selected for instance in a manner as indicated on the lead-in conductors for the various electrodes 7, 8 and 9 in Fig. 3.

It is believed to be obvious that the invention is not limited to the embodiments described and illustrated in the above description and drawing respectively. It is for instance possible to provide the accelerator electrode 4 with magnetical properties or to insert additional magnetic electrodes in the envelope. These and other modifications are clearly within the scope of the present invention without limitation, except as provided in the appended claims.

What I claim as my invention is:

1. A cathode ray tube comprising a source of cathode rays, a Wehnelt cylinder surrounding said source of cathode rays, a tubular accelerator anode axially spaced from said Wehnelt cylinder and arranged in the path of the electron stream issuing from said source, and two axially spaced tubular permanent magnets arranged in axial alinement with said tubular accelerator anode within the envelope, the permanent magnet next to said tubular accelerator anode being conical and having its smaller diameter positioned adjacent said other permanent magnet, said two permanent magnets forming in combination a short magnetic lens, and being adapted to serve also as an electric lens to concentrate the electron stream.

2. A cathode ray tube comprising a source of cathode rays, a Wehnelt cylinder surrounding said source of cathode rays, a tubular accelerator anode surrounding said Wehnelt cylinder and extending with both ends beyond the ends of said Wehnelt cylinder, a tubular electrode arranged axially spaced from said accelerator anode in the path of the electron stream issuing from said source of cathode rays, another tubular accelerator electrode in the path of the concentrated electron stream passing through said tubular anode, said first named accelerator anode and said tubular anode being of magnetic material and forming together a magnetic lens and simultaneously being adapted to form an electric lens for concentrating the electron stream.

3. A cathode ray tube comprising an envelope enclosing a source of cathode rays, a tubular accelerator anode axially spaced from said source of cathode rays and arranged in the path of the electron stream issuing from said source, and two axially spaced tubular permanent magnets arranged in axial alinement with said tubular accelerator anode, the permanent magnet next to said tubular accelerator anode being axially spaced from the same, the ends of said permanent magnets facing each other having opposite polarities, said two permanent magnets forming in combination a short magnetic lens and being adapted to serve also as an electric lens to concentrate the electron stream.

4. A cathode ray tube comprising an envelope enclosing a source of cathode rays, a tubular accelerator anode axially spaced from said source of cathode rays and arranged in the path of the electron stream issuing from said source, and two axially spaced tubular permanent magnets arranged in axial alinement with said tubular accelerator anode and having the same diameter as the latter, the permanent magnet next to said tubular accelerator anode being axially spaced from the same, the ends of said permanent magnets facing each other having opposite polarities, said two permanent magnets forming in combination a short magnetic lens and being adapted to serve also as an electric lens to concentrate the electron stream.

5. A cathode ray tube comprising an envelope enclosing a source of cathode rays, a tubular accelerator anode axially spaced from said source of cathode rays and arranged in the path of the electron stream issuing from said source, and two axially spaced tubular permanent magnets arranged in axial alinement with said tubular accelerator anode, the axial length of said tubular permanent magnets being at least as large as their largest radius, the permanent magnet next to said tubular accelerator anode being axially spaced from the same, the ends of said permanent magnets facing each other having opposite polarities, said two permanent magnets forming in combination a short magnetic lens and being adapted to serve also as an electric lens to concentrate the electron stream.

MARTIN PLOKE.