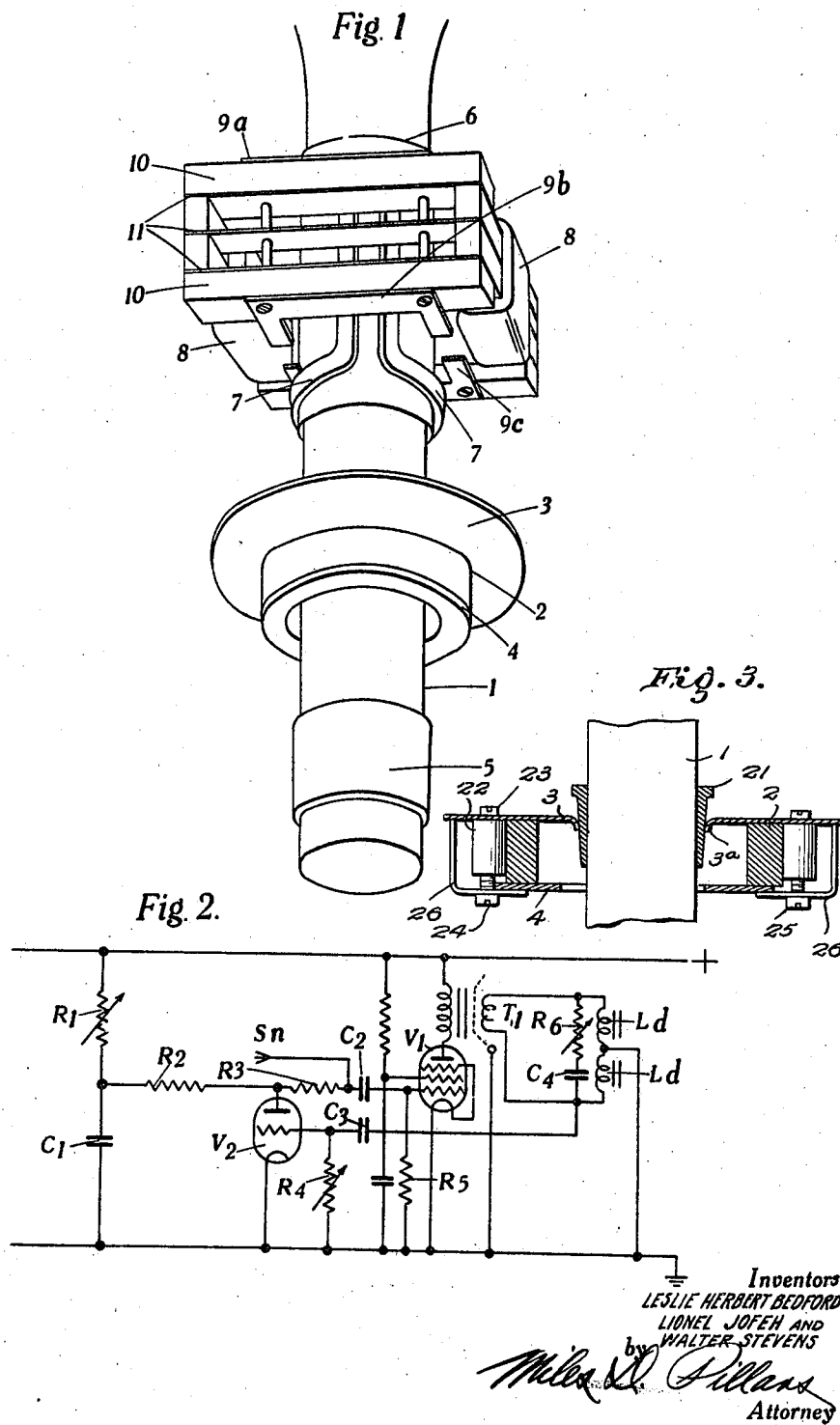


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ELECTRICAL APPARATUS

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This invention is concerned with apparatus which is employed in cathode ray tube television systems.

One feature of the invention is the provision of a magnetic focussing system for the electron beam which consists of an annular permanent magnet which surrounds the neck of the tube, is magnetised in the direction of its axis and is provided with two annular pole pieces of ferromagnetic material, each having smaller internal diameter than the permanent magnet. The effect of any irregularities in the magnetisation of the permanent magnet is smoothed out by the pole pieces, so that the resulting field within the neck of the tube is of regular form.

It is preferred that the pole piece at that end of the magnet which is nearer the screen of the cathode ray tube shall have an external diameter larger than that of the magnet. This will decrease the penetration of the field of the magnet into that part of the tube which is beyond the magnet in the direction of the screen.

The pole piece at the end of the magnet nearer the cathode is preferably so mounted as to be adjustable radially of the tube. It is then possible to give any necessary permanent deflection to the beam by adjustment of this pole piece.

A further preferred feature of the invention is a ring of magnetic material, mounted around the part of the neck of the tube which is beyond the magnet in the direction of the cathode. This ring is arranged to be adjustable in the axial direction, for the purpose of adjusting the focus of the beam.

Figure 1 of the accompanying drawing shows a perspective view of the neck of a cathode ray tube provided with a focussing system according to the invention. Figure 2 discloses a circuit diagram for energizing coils 7 shown in Figure 1. Figure 3 discloses the structural details of the focussing system.

The annular permanent magnet 2 is magnetized in the direction parallel to the axis, and is provided at its ends with the two annular disc pole pieces 3 and 4 of mild steel each having smaller internal diameter than the magnet 2.

The internal diameter of the pole piece 3 is slightly larger than the external diameter of the neck 1 of the tube, and its internal edge may be spun over into conical form as indicated by reference numeral 3a shown in Figure 3. The neck of the tube is located relatively to, and supported from, this pole piece by a split cylindrical wedge 21 of semi-rigid material, such as partially vulcanized rubber.

The pole piece 3 has an external diameter considerably greater than that of the magnet 2 and thus prevents the penetration of the magnet field to any considerable extent further up the neck of the tube and into the region of deflection.

The pole piece 4 is supported by the magnetic effect of the magnet and it is, therefore, adjustable radially of the tube for the purpose of producing permanent deflections of the beam (X-shift and Y-shift). Pole piece 4 is shown in Figure 3 in one limiting position, in which its periphery touches screw 24 but is spaced from screw 25. This pole piece may be moved radially to provide "shift" of the beam, until the beam is found to impinge at the desired point on the screen.

It is then clamped to magnet 2 by non-magnetic L shaped members 26 which are tightened up by screws 24 and 25 which are secured in non-magnetic bushings 22 fixed to pole piece 3 by screws 23.

Surrounding the neck of the tube, below the magnet 2, is a mild steel ring 5 which is slidably mounted for adjustment in the axial direction to adjust the focus of the beam.

The invention is further concerned with an electromagnetic system for the deflection of the electron beam in two mutually perpendicular directions. The electromagnetic fields are each of the kind comprising a central flux path passing through the tube and two side paths passing on mutually opposite sides of the tube. In the arrangement according to the invention, the coils for one direction of deflection are arranged about a common axis and on opposite sides of the tube on the central limb of their magnetic circuit, while the coils for the other direction of deflection are arranged with their centres substantially on the same axis, but with their own axes perpendicular thereto, on the side paths of their magnetic circuit.

A preferred arrangement is illustrated in Figure 1. The coils 7 are bent around to lie in contact with the former 6 which is a sleeve of insulating material closely surrounding the neck of the tube. The coils 8 have their centres substantially on the common axis of the coils 7, but their own axes are perpendicular to the axis of the coils 7. The field of the coils 8 passes through the neck of the tube in the direction parallel to the axes of the coils 8.

The part of the magnetic circuit of the coils 8 external to the tube is formed by laminations 11 in the form of complete rectangles of ferromagnetic material. These laminations are spaced apart by wooden spacers.

The part of the magnetic circuit of the coils 7 external to the tube is formed by laminations 9a, 9b, 9c of ferro-magnetic material. These are divided, the part 9a, in the form of a complete rectangle, being placed on the end of the assembly nearer the screen, and the other part 9b, 9c forming substantially a rectangle, being placed on the end of the assembly nearer the cathode. The part 9b, 9c is subdivided into two U-shaped parts by the provision of gaps in the region of the ends of the central limb of the magnetic circuit belonging to the coils 7. These gaps minimise the short-circuiting of the magnetic circuit of the coils 8. The laminations 9a, 9b, 9c are spaced from the two outer laminations 11 by wooden spacers 10, and are thus arranged at the ends of the coils 7.

By virtue of the arrangement of the coils 8 in relation to the coils 7, the electromagnetic pick-up of the coils 8 resulting from current changes in the coils 7 is neutralised. The coils 8 may be arranged for adjustment in the direction of their axes so as to provide for accurate adjustment of this neutralisation.

The coils 8 should preferably be enclosed in electrostatic screens to minimise electrostatic interference between the two pairs of coils. The coils 7 should preferably be operated, in respect to alternating current, symmetrically about earth.

When the deflection system described is used for television scanning, the coils 8 are employed to produce the frame deflection and the coils 7 to produce the line deflection. The laminations 9 are preferably then made of "Rhometal" and the laminations 11 of "Stalloy."

The permeability of "Rhometal" is higher at the line frequency than at the frame frequency, but the permeability of "Stalloy" is higher at the frame frequency than at the line frequency.

It will be understood that features of this invention are applicable not only to cathode ray tubes having fluorescent screens but also to other types such as iconoscopes and electron beam valves. The focussing features are independent of the type of deflection system, if any. The term "screen" as used in reference to cathode ray tubes in this specification must be understood to include all types of target for the electron beam.

Figure 2 shows a diagram of a preferred generator for the supply of saw-tooth deflection currents to the coils 7 of Figure 1 for television line scanning. These coils 7 are indicated in Figure 2 by the symbols L_a.

A voltage of saw-tooth waveform is developed across condenser C₁ by charging from a direct current source through resistance R₁, the flybacks being produced by intermittent discharges at regular intervals through thermionic valve V₂, shown as a triode. The voltage of the condenser C₁ is applied through resistances R₂, R₃ and condenser C₂ to the control grid of the output valve V₁ shown as a pentode. The coils L_a are coupled to the output circuit of the valve V₁ by the transformer T₁, and a damping circuit comprising resistance R₆ and condenser C₄ is connected across the coils L_a.

A return coupling by condenser C₃ and resistance R₄ to the grid of thermionic valve V₂ is employed to accelerate the flyback.

The initiation of the flyback is effected by the application of synchronising signals at S_n. These are impressed through condenser C₂ upon the control grid of output valve V₁ and, therefore,

appear in amplified form in the output circuit. Thence they are passed through the return coupling to the control grid of valve V₂ where they appear as positive pulses.

During the discharge of condenser C₁ through valve V₂ there is a potential drop across resistance R₂. This is superimposed upon the voltage of condenser C₁, as applied to the control grid of valve V₁, in the sense to drive this control grid more negative. The effect of the inductive load in the output circuit is to give the anode of the output valve V₁ a highly positive excursion during the flyback period. The value of the resistance R₂ is made sufficiently large to ensure that current is cut off in the valve V₁ throughout this period.

Owing to the return coupling through condenser C₃, valve V₂ is held open so long as the highly positive excursion persists, and so current flow through resistance R₂ and the consequent cut-off of valve V₁ is similarly maintained.

A further feature of the invention is the method of coupling two electric circuits for the transmission from one to the other, with only a small degree of distortion, of signals comprising current changes amounting substantially to discontinuities, which method consists in coupling said circuits through a transformer having between the windings an electrostatic screen maintained at constant potential, whereby the capacity between the windings is reduced to a low value. This decreases the tendency to the production of spurious oscillations in the secondary circuit when the discontinuities occur.

This feature of the invention is exemplified by the provision of an earthed electrostatic screen in transformer T₁, which decreases the tendency to the production of spurious oscillations in the output circuit when flyback occurs.

The generator for the supply of saw-tooth deflection currents to the coils 8 of Figure 1 for television frame scanning is preferably also of the type in which a saw-tooth voltage is developed across a condenser intermittently charged or discharged through a thermionic valve for flyback, the condenser voltage being applied to the grid of an output valve having the deflector coils in its output circuit and having a return coupling from its output circuit to the said thermionic valve. The electromagnetic deflection system being such that very little electromagnetic or electrostatic pick-up by coils 8 from coils 7 can occur, the appearance of spurious synchronising signals in the frame scanning generator resulting from flyback of the line scanning generator can be avoided. Preferably, in order to decrease this danger still further, a low-pass filter is included in the return coupling.

We claim:

1. A cathode ray tube provided with a cathode and a magnetic focussing system surrounding the neck of the tube comprising an annular member having an internal diameter greater than the diameter of said neck for producing a magnetic field axially of said member, said annular member being provided at the end opposite the cathode with an annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular member, and said annular member being provided at the end nearer the cathode with a movable annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular member, said movable annular ferro-

magnetic pole piece being mounted for radial movement with respect to the axis of the tube and said annular member.

2. A cathode ray tube provided with a cathode and a magnetic focussing system surrounding the neck of the tube comprising an annular member having an internal diameter greater than the diameter of said neck for producing a magnetic field axially of said member, said annular member being provided at the end opposite the cathode with an annular ferro-magnetic pole piece surrounding the neck of the tube having an external diameter greater than said annular member, and said annular member being provided at the end nearer the cathode with a movable annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular member, said movable annular ferro-magnetic pole piece being mounted for radial movement with respect to the axis of the tube and said annular member.

3. A cathode ray tube provided with a magnetic focussing system comprising an annular member surrounding the neck of said tube for producing a magnetic field axially of said annular member and an annular member positioned externally of said tube in said magnetic field formed of ferro-magnetic material and movably mounted for adjustment relative to said annular member in a plane perpendicular to the axis of said first mentioned member.

4. A cathode ray tube provided with a cathode and a magnetic focussing system surrounding the neck of the tube comprising an annular permanent magnet having an internal diameter greater than the diameter of said neck for producing a magnetic field axially of said permanent magnet, said annular permanent magnet being provided at the end opposite the cathode with an annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular permanent magnet, and said annular permanent magnet being provided at the end nearer the cathode with a movable annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular member, said movable annular ferro-magnetic pole piece being mounted for radial movement with respect to the axis of the tube and said annular member.

5. A cathode ray tube provided with a cathode and a magnetic focussing system surrounding the neck of the tube comprising an annular permanent magnet having an internal diameter greater than the diameter of said neck for producing a magnetic field axially of said permanent magnet, said annular permanent magnet being provided at the end opposite the cathode with an annular

ferro-magnetic pole piece surrounding the neck of the tube having an external diameter greater than said annular permanent magnet, and said annular permanent magnet being provided at the end nearer the cathode with a movable annular ferro-magnetic pole piece surrounding the neck of the tube having an internal diameter less than said annular permanent magnet, said movable annular ferro-magnetic pole piece being mounted for radial movement with respect to the axis of the tube and said annular member.

6. A cathode ray tube provided with a magnetic focussing system comprising an annular permanent magnet surrounding the neck of said tube for producing a magnetic field axially of said annular permanent magnet and an annular member positioned externally of said tube in said magnetic field formed of ferro-magnetic material and movably mounted for adjustment relative to said annular permanent magnet in a plane perpendicular to the axis of said permanent magnet.

7. A cathode ray tube provided with a magnetic focussing system comprising an annular permanent magnet surrounding the neck of said tube for producing a magnetic field axially of said annular permanent magnet, an annular member formed of ferro-magnetic material positioned externally of said tube in said magnetic field and movably mounted for adjustment relative to said annular permanent magnet in a plane perpendicular to the axis of said permanent magnet and means for clamping said annular member in adjusted position.

8. A cathode ray tube provided with a magnetic focussing system surrounding the neck of said tube comprising an annular magnet surrounding said neck for producing a magnetic flux axially of said tube, a movable annular pole piece for said magnet exteriorly surrounding said tube neck adjacent the end of said magnet nearest the cathode, mounting means for said movable annular pole piece to provide for radial adjustment of said movable annular pole piece relative to said annular magnet, a second annular pole piece exteriorly surrounding said tube neck at the end of said magnet opposite the cathode having an aperture of greater diameter than said tube neck, the edge of said aperture being formed into conical shape and means for supporting said tube neck by said second annular pole piece comprising a cylindrical wedge of semi-rigid material positioned intermediate said tube neck and said conical shaped edge.

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