

Aug. 4, 1942.

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2,292,161

MAGNETIC SHIELDING

Filed March 2, 1940

2 Sheets-Sheet 1

Fig. 1

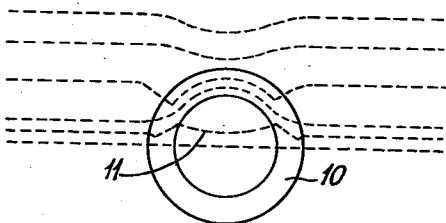


Fig. 3

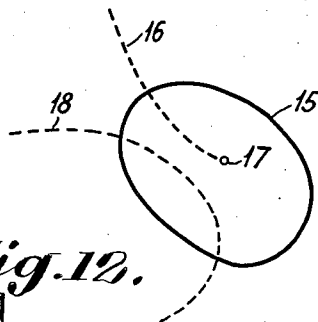


Fig. 2

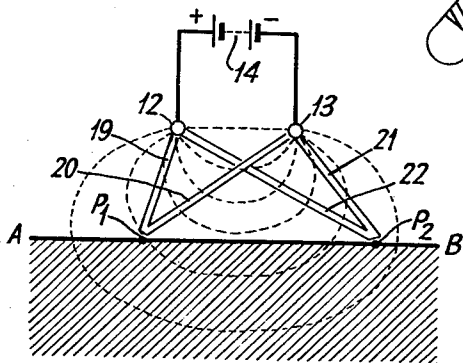


Fig. 12.

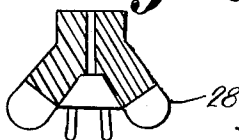


Fig. 5

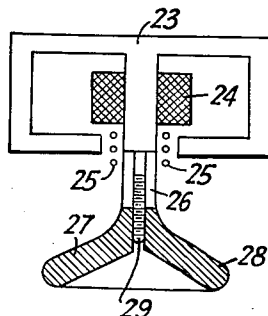
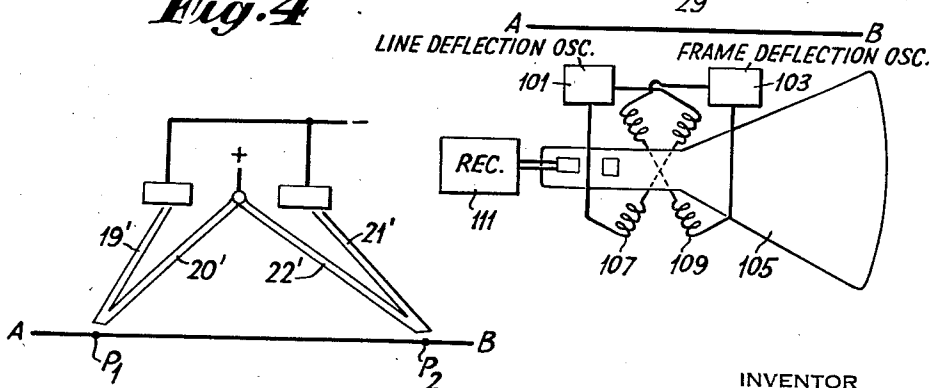


Fig. 4



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Fig. 6

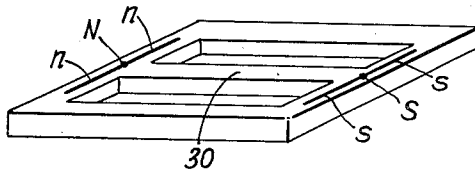


Fig. 7

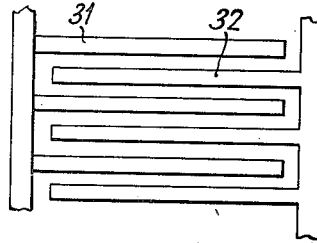


Fig. 9

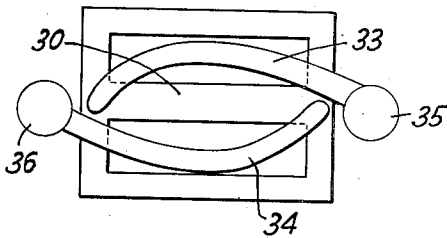


Fig. 8

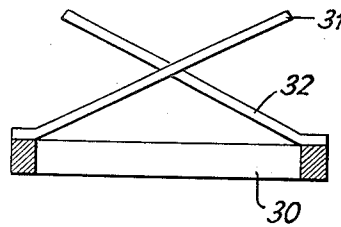


Fig. 10

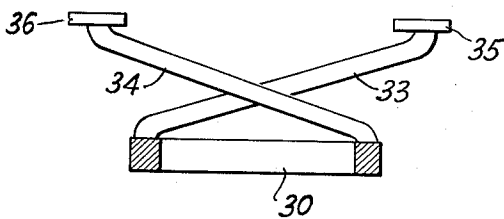
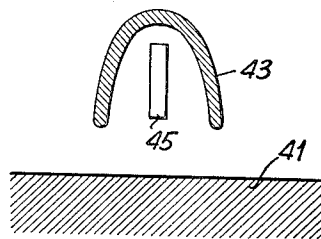


Fig. 11



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UNITED STATES PATENT OFFICE

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MAGNETIC SHIELDING

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4 Claims. (Cl. 250—27)

This invention relates to magnetic shielding and in particular, to magnetic shielding of cathode ray tubes from spurious fields set-up by associated magnetic apparatus, as for example, the shielding of a television cathode ray receiving tube from the magnetic field of a loud speaker reproducing the sound accompanying the video signals.

As is well known, cathode ray tubes are sensitive to magnetic fields which arise in the vicinity of the tube. This sensitivity manifests itself either by interacting with the focusing of a beam of electrons or by producing a spurious deflection of the focused beam or by both of these effects being present.

These two features are particularly objectionable in apparatus where it is necessary to have magnetic or electromagnetic equipment operate in the immediate vicinity of a cathode ray tube such as is the case in a television receiver. In such a receiver, for example, the magnetic field set up by the magnetising force of the speaker produces stray magnetic flux which interacts or affects the beam of electrons in the kinescope upon which a television picture is to be reproduced, since for compactness, it is necessary to have the speaker associated ordinarily in the same cabinet with the kinescope or cathode ray tube. It is necessary in order to provide some magnetic shielding between the tube and loud speaker to provide sharply focused high detailed pictures. This invention provides a highly efficient simple shielding means which prevents such interaction and, therefore, enables a much better picture from the standpoint of reproduction to be obtained.

Accordingly, it is one of the objects of this invention to provide improved picture detail in a television receiver incorporating an accompanying sound reproducer.

Another object of the invention is to provide improved shielding means between the loud speaker and television cathode ray tube.

Still another object of the invention is to provide a new method of magnetic shielding.

Other objects of the invention will become apparent upon reading the following detailed description in which reference will be made to the drawings which show in Fig. 1 the relationship between a cylindrical magnetic shield and magnetic lines of flux, Figs. 2, 3 and 4 are graphical illustrations of magnetic forces for explaining the invention, Fig. 5 shows a loud speaker incorporating the principles of the invention, while Figs. 55

6 through 12 show modifications of the embodiment shown in Fig. 5.

It is known in the prior art that a galvanometer, for instance, may be shielded from a magnetic field, say, that of the earth by surrounding or encasing the galvanometer by a very heavy iron cylinder. However, this fails to completely shield the instrument from the said field. In fact, the pattern of the field then prevailing will have a shape roughly as shown in Fig. 1, assuming that the field to be screened, in the absence of the iron cylinder 10, is homogeneous. After surrounding the galvanometer with the iron cylinder, the ensuing field has a form as indicated approximately by the dash-lines, and these lines, as indicated at 11, do not pass either outside the iron cylinder or inside the iron. The reason underlying the fact that shielding of a magnetic field by the ways and means conventionally suggested in the earlier art falls short of being a full success is that the permeability of all kinds of iron, is comparatively low for low field intensities compared with that of air. Moreover, the suggestion to shelter the device to be safeguarded from the actions of extraneous magnetic fields by the aid of a stout iron cylinder is not useful everywhere for reasons of space and weight as well as of cost.

Hence, the present invention provides improved ways and means of screening magnetic fields which prove particularly advantageous and efficient in the case of television receivers in which the cathode ray tube must be safeguarded from the effects of extraneous magnetic fields. More particularly speaking, the screening method here disclosed is completely successful. The basic idea of the invention is to mount in the vicinity of the stray field source, bodies or elements possessing higher permeance than air and being without inherent magneto-motive force, in such a way that the space traversed by the magnetic field outside the mounted body, is rendered free from field.

To demonstrate the fact that a space free from fields and their actions is actually feasible, reference shall here be made to the illustrative example of the electrolytic trough.

Referring to Fig. 2, 12 and 13 denote two electrodes confined within an electrolytic vat or trough and which are connected with a source of D. C. potential 14. In the electrolytic liquid, say, acidulated water the pattern of the current lines will be roughly as indicated by the dash lines. The problem outlined above, namely, of rendering a definite portion of the space free from field

actions, as applied to the electrolytic trough is that a certain portion of the liquid, say, the portion of the liquid below line A—B, as indicated by the shaded area, should not be traversed by any current. Now, what shall be shown first is that this stipulation will be fulfilled if, on the one hand, line A—B becomes an equi-potential surface, while, on the other hand, the shaded part of the space contains no positive or negative potential supplies, i. e., no "sources" or "sinks" for the electrolytic vat.

This is easily demonstrable by reference to Fig. 3. Referring to Fig. 3, 15 denotes an equi-potential surface closed upon itself. Inasmuch as the direction of the current inside the electrolyte throughout is at right angles to the equi-potential surfaces, it follows that a current tube 16 will be able only to traverse the equi-potential surface 15 at right angles. Since, moreover, each current tube must terminate at a source or sink, it follows, therefore, that inside the closed area 15 a source or sink must be provided for the current tube 16. Current paths or lines of the kind indicated by the dash-line 18, as will be noted, are evidently impossible since a definite current path is able to traverse one and the same equi-potential surface once. Now, inasmuch as it is an easy matter completely to eliminate and preclude sources 17 from the space shown by the hatching in Fig. 2 it will, as a matter of fact, be feasible to maintain the said shaded area actually and perfectly free from current paths, provided that the line A—B is made an equi-potential surface. This, as a matter of fact, is actually accomplished, as shall first be demonstrated for the points P₁ and P₂ on the line A—B. At the electrodes 12 and 13 are mounted rodlets indicated at 19 to 22, the conductivity of which shall be assumed to be considerably higher than that of the liquid or electrolyte. Now, it is clearly possible to so balance the thickness of the rod 20 in reference to the thickness of the rod 19, that at point P₁ any desired potential can be maintained between the potential values of the electrodes 12 and 13, while by a corresponding balance of the thickness of the rods 21 and 22, at point P₂, the same potential can be secured. With this end in view, rod 20 must be made stouter than rod 19, and rod 22 stouter than rod 21. It will be evident that, upon introducing the rods 19 to 22 into the liquid, the distribution or pattern of the current paths will no longer be the same as illustrated by the dash lines in Fig. 2. Still, and this must, for the time being be kept in mind, it is possible to obtain, as stated, the same potential at points P₁ and P₂.

Now, next an electrolytic vat shall be examined in which is disposed only one positive electrode and two paralleled negative electrodes. Also, in this instance, by corresponding rodlets 19' to 22', as can be seen from Fig. 4, the same potential is obtainable at the points marked P₁ and P₂.

The considerations made by reference to Figs. 2 to 4, as will be noted, hold good not merely for a current field inside an electrolytic trough, but also and similarly for a magnetic field inside a space which contains no magnetic poles of the nature of the source 17. In fact, all that is necessary to this end is to make the rods 19 to 22, or 19' to 22' of a kind of material possessing a higher permeability than air, to the end of rendering the line A—B to act as an equi-potential surface, in other words, to completely preclude

the magnetic field from the space indicated by the shading in Fig. 2. This results from the fact that the current field as well as the magnetic field, are a potential field. It will thus be an easy matter to preclude, on the same basis, the action of a stray or leakage field of a pot-type loudspeaker or a loudspeaker furnished with a double-U shaped iron yoke, from a space below the line A—B, Fig. 5.

Referring to Fig. 5, the yoke of an electro-dynamic loudspeaker is indicated at 23, its exciting winding at 24, and its moving or signal-current coil at 25. Fitted upon the central pole of the iron yoke is a tube piece 26 with female screw thread and consisting of non-magnetic material, and screwed on top of the said tube piece is a mushroom shaped iron body 27. The latter, as illustrated in Figure 5, may be a rotation body or else, as shown in Figure 12, merely comprise a median part of a solid of revolution to which is attached a great number of radial vanes or wings 28. The screw-thread of the non-magnetic tube piece 26 extends through the body 27. By the aid of an iron bolt 29 which is also threaded, a magnetic shunt may be established between the central pole and the iron body 27. It can be readily seen that the body 27 or 28 acts in the direction as the rods 20' and 22', Fig. 4. The rods 19' and 21', Fig. 4 are constituted in Fig. 5 by air gaps. By adopting an arrangement as shown in Fig. 5, it is, as a matter of fact, feasible in a perfect way to preclude the stray or leakage field of a loudspeaker from the space below line A—B. This has been demonstrated experimentally by the fact that the spot of a cathode-ray tube, when energizing and de-energizing the exciting winding 24, exhibits no shift in location.

By the adoption of the principle hereinbefore outlined, it would, for instance, also be feasible to preclude and neutralize the action of the stray or dispersion field of a transformer. This situation shall be explained by the aid of an iron-clad or shell-type transformer of the kind illustrated in Fig. 6. Suppose the transformer windings are wrapped upon the center limb 30, though they have been omitted in the drawings for the sake of greater clearness of illustration in Fig. 6. The sources and the sinks of the stray flux of such a transformer roughly may be supposed to be at the points N and S or else lines *n* and *s*. In the light of the above considerations, it will be readily understood that, if at the points marked *n* and *s* two comb-line iron bodies 31 and 32 are mounted so that they inter-engage or mesh without touching each other, as shown by the top view Fig. 7 and by side elevation Fig. 8, the stray field of the transformer will be precluded from a space located above Fig. 6.

In the same manner the leakage field may be shielded if upon the transformer shown in Fig. 6 and of which Fig. 9 shows a top view and Fig. 10 a lateral elevation, two iron bodies 33, 34 are mounted which are furnished with pole-shoes 35, 36 and which, in the fashion of a double-threaded screw, extend in relation to each other in a half revolution.

If the problem is to preclude the stray field of a transformer, which may be conceived to be a bar-type magnet and which is disposed in reference to the space to be kept free from field action, in a way as shown in Fig. 11, recourse could be had to a pot or basket type iron body within which the transformer would be mounted so that the entrance and outlet point of the

leakage field turned away from the space to be freed from field actions is made to face the bottom of the pot or basket structure, while the opening of the basket or pot is made to face the space to be free from the field.

Having described my invention, what I claim is:

1. In combination, electromagnetic apparatus having an axis of symmetry, a cathode ray tube apparatus positioned in the vicinity of said electromagnetic apparatus, means including a shielding member coaxially positioned with said electromagnetic apparatus to produce a uni-potential plane of electromagnetic force perpendicular to said axis of symmetry and intermediate said shielding member and said cathode ray tube apparatus, said shielding member being shaped to change the direction of the lines of flux from said electromagnetic apparatus to a path at right angles to said axis.

2. In combination, electromagnet apparatus having an axis of symmetry, a cathode ray tube apparatus positioned in the vicinity of said electromagnetic apparatus, means including a shielding member of higher permeability than the medium between said electromagnetic apparatus and said cathode ray tube apparatus coaxially positioned with said electromagnetic apparatus to produce a uni-potential plane of electromag-

netic force perpendicular to said axis of symmetry and intermediate said shielding member and said cathode ray tube apparatus, said shielding member being shaped to change the direction of the lines of flux from said electromagnetic apparatus to a path at right angles to said axis.

3. The method of shielding apparatus from a source of electromagnetic flux having an axis of symmetry which includes the steps of interposing magnetic material intermediate said source and said apparatus to produce a unipotential plane of electromagnetic force intermediate the material and said apparatus and positioning said magnetic material to direct the lines of force of the flux from said source along the path at right angles to the said axis.

4. The method of shielding apparatus from a source of electromagnetic flux having an axis of symmetry which includes the steps of interposing magneto-motive force-free magnetic material intermediate said source and said apparatus to produce a unipotential plane of electromagnetic force intermediate the material and said apparatus and positioning said magnetic material to direct the lines of force of the flux from said source along the path at right angles to the said axis.

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