May 14, 1940. H. P. PRATT 2,200,678

METHOD OF AND APPARATUS FOR SHIELDING RADIO INSTRUMENTALITIES

Original Filed Aug. 7, 1926 2 Sheets-Sheet 1

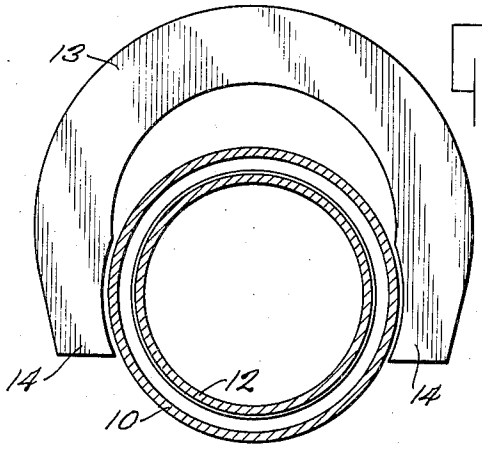


Fig. 1.

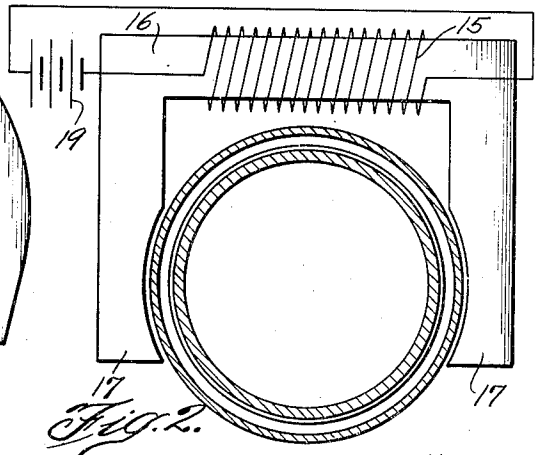


Fig. 2.

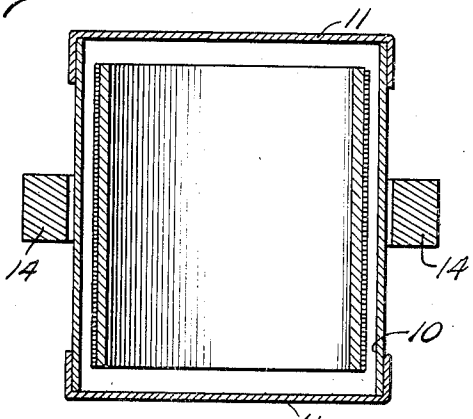


Fig. 3.

Fig. 5.

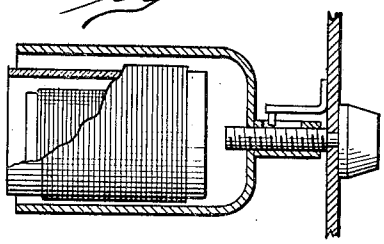
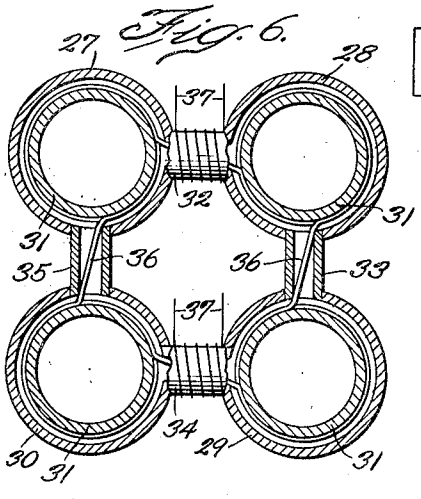


Fig. 6.



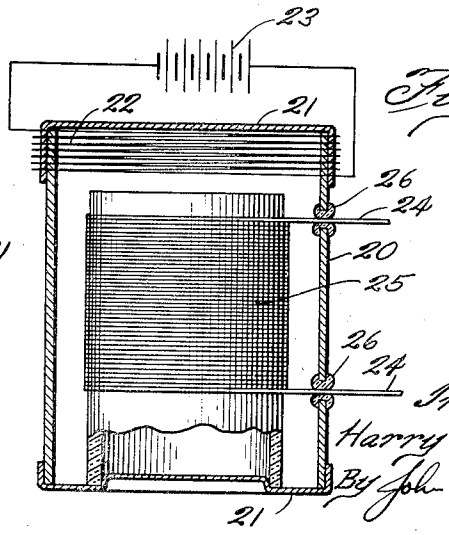


Fig. 4.

Inventor:
Harry P. Pratt
By John E. Faulconer
Atty.

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METHOD OF AND APPARATUS FOR SHIELDING RADIO INSTRUMENTALITIES

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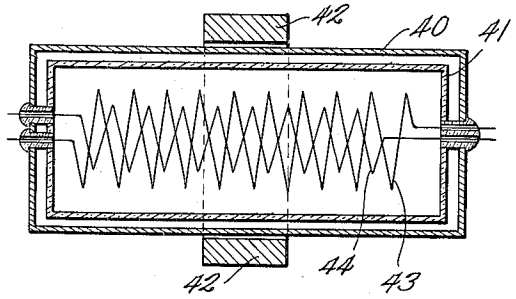


Fig. 7.

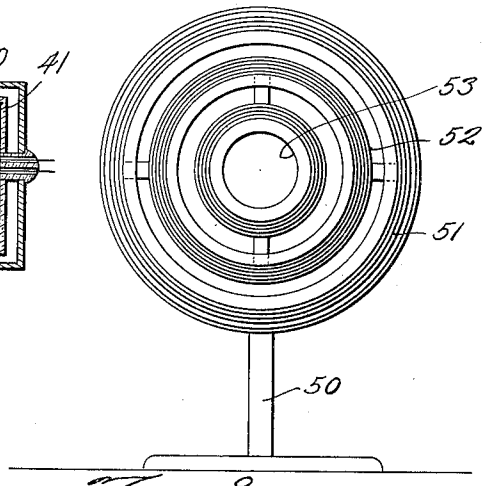


Fig. 8.

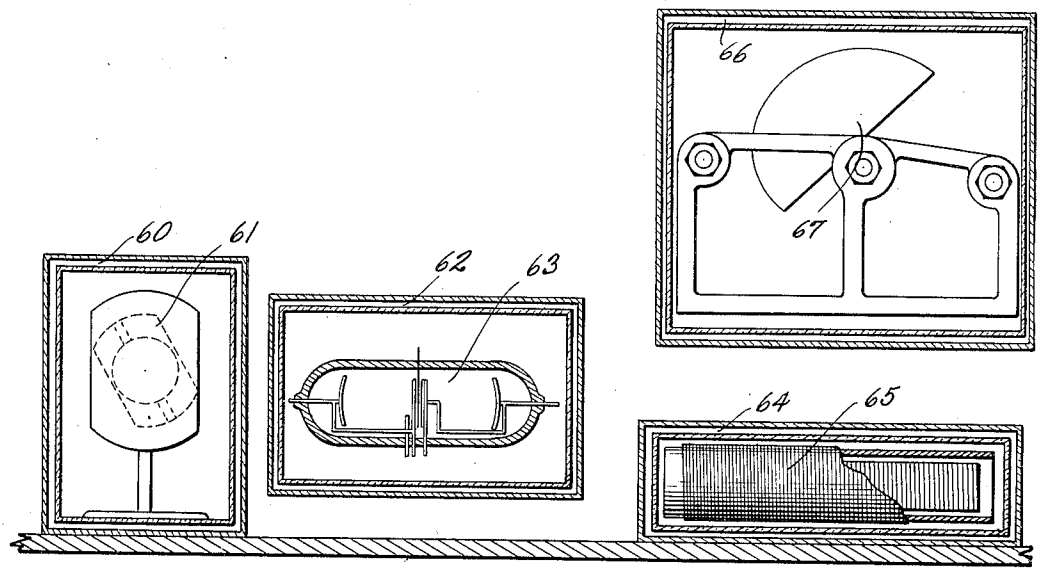


Fig. 9.

Inventor:
Harry P. Pratt
By John E. Gardner
Atty.

Patented May 14, 1940 2,200,678

UNITED STATES PATENT OFFICE

2,200,678

METHOD OF AND APPARATUS FOR SHIELDING RADIO INSTRUMENTALITIES

Harry P. Pratt, Chicago, Ill., assignor, by mesne assignments, to Harry Preston Pratt, William Frederick Grower, Henry Asa Allen, Howard Thompson Ballard, and George Squires Herrington, trustees acting as Pratt Radio Trust

Original application August 7, 1926, Serial No. 127,769. Divided and this application December 30, 1935, Serial No. 56,662

2 Claims. (Cl. 250—16)

My invention relates to an improvement in a method for protecting the coils and other parts of a radio set from inductive action between the different pieces of apparatus and also from outside electro-magnetic and electro-static disturbances.

It is well known that there is an inductive action between the different pieces of radio apparatus, especially the coils of the set. Also the set is affected by electrical oscillations as shown by the fact that many sets will respond to the radio oscillations even when the antenna is disconnected therefrom.

There are two types of electrical forces which operate to affect the instrumentalities of a radio set. These disturbances may be either electro-magnetic or electro-static. A shield which will operate to shield the radio apparatus from the disturbances of one character, will oftentimes be ineffective to shield the set from disturbances of the other type.

Attempts have been made to shield the coils of a radio apparatus by providing a thin metallic shell of copper, aluminum, or any non-magnetic material about the part to be protected. It has been found, however, that this expedient is only partially successful, as some of the magnetic lines penetrate the shell and affect the inclosed apparatus notwithstanding. Also this expedient does not operate efficiently to shield the apparatus from the electro-static disturbances.

One of the objects of the present invention is, therefore, the provision of a method to more thoroughly protect the coils and other radio apparatus from electro-magnetic disturbances.

Another object of the invention is the provision of means to also protect the apparatus from electro-static disturbances.

In order to carry out the present invention, I create an electrical field in the form of an envelope or envelopes about the device or devices or instrumentality of a radio set to be shielded. This created field may either be electro-magnetic in character or electro-static in character, or both. If electro-magnetic in character, it will serve to shield the instrumentality from magnetic disturbances and if electro-static, it will serve to shield the instrumentality from electro-static disturbances. For best results the electrical field should be electro-magnetic and electro-static, forming a double valve, each field having a different rate of change.

One of the features of the invention is the provision of a metallic shell or shield arranged in a magnetic field, as for instance the keeper of a permanent magnet, so that the magnetic lines of forces transverse the shell and create a magnetic shield through which the external electro-magnetic oscillations cannot penetrate.

Another of the features of the invention is the provision of a shield of non-magnetic material which may be employed, if desired, in conjunction with the electro-magnetic shield, just above referred to, so as satisfactorily to protect the apparatus from both electro-magnetic and electro-static disturbances.

This application is a division of my application Serial No. 127,769, filed August 7, 1926, Patent 2,026,060, issued December 31, 1935.

The electro-static shield, just referred to, may, if desired, be positioned immediately within the electro-magnetic shield, either in intimate contact therewith, or slightly separated therefrom, or it may be otherwise arranged.

The electro-magnetic lines of force to which radio and other apparatus are subjected operate very materially to affect the apparatus. Certain magnetic emanations are of such force and direction that in striking the electro-magnetic shield of thin metallic material they penetrate the shield and affect the apparatus positioned therein. It has been shown, however, that if the metallic shell is placed in a magnetic field, as above described, the electro-magnetic lines encountering the shield will be caught by the lines of force traversing the shield and carried around with them; thus acting more efficiently to protect the apparatus within the shell, from outer electrical disturbances.

It is believed the further disclosure of the invention will be understood most readily from a detailed description thereof, taken in connection with the accompanying drawings, in which:

Fig. 1 is a section through one form of applicant's device where the shield is magnetized by means of a permanent magnet;

Fig. 2 is a similar view of a modification, in which the shield is magnetized by means of a coil mounted about the connecting leg of the U-shaped member;

Fig. 3 is a view through the coil and shield of Figure 1 and shows the relation of the magnet poles to the shield;

Fig. 4 shows another modification, in which a coil is provided about one end of the shield, the said coil being in series with a source of electrical energy;

Fig. 5 shows a cup-shaped adjustable shield which may be moved back and forth over the coil;

Fig. 6 shows a plurality of coils, each surround-

ed by an individual shield, the shield being joined into an endless series by the connecting tubular conduit members, preferably of polarized or magnetic material;

Fig. 7 shows a shield structure similar to that of Fig. 1, but with an electro-static shield provided in addition to the electro-magnetic shield;

Fig. 8 schematically indicates a selective receiving coil structure, such as shown in applicant's application, Serial No. 46,692 filed July 29, 1925, and abandoned.

Fig. 9 shows a number of pieces of apparatus of a radio receiving set each surrounded by a double shield, one a magnetic shield and the other an electro-static shield.

Referring now to the drawings, in which like reference characters indicate the same parts in the several views, 10 is a cylinder of sheet metal preferably of magnetic material, having the end caps or covers 11. Within the closure or shield 10, 11 is positioned a coil or coils 12. This coil structure 12, may, if desired, comprise the usual primary and secondary and means for adjusting one of the coils in relation to the other. As this coil structure is old and well known, it is not shown in detail in the present drawings. There is provided in connection with the shield 10 a permanent magnet 13, between the poles 14 of which the cylinder 10 is positioned, as clearly disclosed in Figs. 1 and 3. The magnet 13 operates to set up lines of force in the shield 10, 11, which lines of force operate in connection with the metal cylinder and end caps to form a medium through which the stray electro-magnetic lines in the atmosphere can pass with great difficulty.

Where the coil is protected merely by a shield of thin magnetic material, it is found certain of the magnetic lines will pass through this shield and enter the coil or coils producing a disturbing effect. When, however, the shield is slightly magnetized, at least to the extent of equalizing that of the disturbing force, these entering magnetic lines are caught by the magnetic current existing in the shield and carried around with it so that they may be absorbed thereby and seldom, if ever, enter the apparatus within the shield. However, it is essential that the strength of the magnetic field within which the shield is positioned shall be properly proportioned, for if too strong the magnetic lines set up thereby may saturate and enter the shield and disturb the apparatus therein and if too weak the shielding effect above referred to will not be sufficient to protect it.

Fig. 2 discloses an apparatus similar to that shown in Fig. 1, except the magnetic lines are set up by means of the coil 15 positioned above the intermediate member 16 of the U-shaped bar, between the ends or poles 17 of which the shield 18 is positioned. The coil 15 will be arranged in series with a suitable source of electrical energy diagrammatically indicated at 19.

Fig. 4 shows another modification of applicant's invention, which consists of the cylinder 20 having the end caps 21, one end of the cylinder being surrounded by a coil 22 which is in series with a source of current indicated at 23. The conductors 24 leading to the coil or coils 25 within the shield 20 are provided with insulating collars 26, at the points where they pass through the shield 20.

Fig. 6 shows a series of shields which may be similar to that shown in Figs. 1 and 3, except that the permanent magnet is omitted. Within the shields 27, 28, 29 and 30 are pieces of radio apparatus, which in the present illustration, are diagrammatically indicated as coils 31. From a reference to Fig. 6 it will be noted that the shields 27 and 28 are joined by conduit 32, shields 28 and 29 are joined by conduit 33, shields 29 and 30 by conduit 34 and shields 30 and 31 by conduit 35. The conductors 36 which connect the pieces of apparatus each to the other will preferably pass through these conduits. About the conduits 32 and 34 are arranged the coils 37 which will be wound in the same direction and arranged in series with a source of electrical energy (not shown). It is to be understood that the several shields shown in this figure, as well as the conduits joining them, are preferably all of magnetic material, or material subject to polarization. Therefore, the coils 37 operate to set up a magnetic field, the lines of which will pass in general throughout the whole shield structure, operating effectively to protect the apparatus within the shield and also the conductors passing through the conduits 32 to 35, inclusive.

While in Fig. 6 a series of coils are shown within the shields 27 to 30, inclusive, it is to be understood that other apparatus may be positioned within these shields with beneficial effects.

In Fig. 7 is shown a double shield comprising a magnetic shield 40 within which is an electro-static shield 41. The shield 40 is formed of sheet metal, preferably of magnetic material, such as described in connection with Fig. 1 and has associated therewith a magnet, the poles of which are shown at 42. This magnet may be either a permanent magnet, as disclosed in Fig. 1, or an electro-magnet, such as disclosed in Fig. 2. The inner shield 41 will be formed from dielectric, such as glass, mica, Bakelite or the like.

It has been found that the electro-static lines of force will often penetrate the magnetic shield even though the shield is impervious to the electro-magnetic lines, and in like manner the electro-magnetic lines will pass through the electro-static shield. Therefore, in order to protect the apparatus from both the electro-static and the electro-magnetic lines, a double shield, similar to that shown in Fig. 7 should be provided. Within the shields 41 and 42 of this figure are shown a pair of coils 43 and 44. However, it is to be understood that any piece of apparatus which is injuriously affected by the stray electro-magnetic or electro-static waves may be protected by a shield, such as here shown.

It has been found that there is a hysteresis effect in dielectric materials upon the application of electro-static fields similar to magnetic hysteresis in iron. In fact, any material whether it is metallic, magnetic or insulating when placed in an alternating electrical field displays this phenomenon in varying degrees depending upon the class and kind of material. By employing a double shield as in my present invention, one of magnetic and one of dielectric material, the rate of change of the hysteresis field in the two materials is entirely different so that somewhat of a valve action is secured by the two shields together. In other words, there is an electrical field set up in the dielectric material by reason of this hysteresis effect and this electrical field has an entirely different rate of change than the electrical field set up in the magnetic shield so that more complete shielding is obtained. A number of shields of various materials will further minimize the effect though I have found the two indicated serve all practical purposes.

A more complete explanation of this dielectric

hysteresis is given in a book entitled "Radio Physics Course," by Alfred A. Ghirardi, second edition, on page 190, sections 130–131.

In Fig. 8 is shown a selective receiving coil structure composed of 3 coils, each of which may be rotated. Referring to this figure **50** indicates a supporting stand on which the coil **51** is pivotally supported to rotate about a vertical axis. The middle coil **52** is pivotally supported from the frame of coil **51** to rotate about a horizontal axis and the innermost coil **53** is pivotally supported on the frame of coil **52** to rotate about an axis at right angles to the axis of rotation of coil **52**. This axis, however, will change its position as the coil **52** is rotated in respect to coil **51**.

Fig. 9 represents a series of different radio instrumentalities, each of which is enclosed by a double shield, one shield being of an electrostatic character which may be made from non-magnetic material, and the other shield being of magnetic material. No magnet or other means for externally energizing the magnetic shield is shown in this view. This is for the reason that the coils, transformers and tubes of a radio receiving set are capable of setting up a magnetic field in the magnetic shield of their own accord, which is sufficient to overcome stray electro-magnetic influences. Within the shield **60** is diagrammatically illustrated a coil structure **61**, such as shown in Fig. 8. Within the shield **62** is shown a vacuum tube **63**, such as disclosed in applicant's application Serial No. 628,962 filed March 31, 1923, Patent 2,010,463, issued August 6, 1935. Within the shield **64** is shown a coil structure **65**, which, if desired, may comprise a plurality of coils either fixed in relation to each other, or relatively movable and within the shield **66** is shown a condenser **67** which may be of any well known construction.

Experiments have clearly demonstrated that the several different instrumentalities of a radio circuit are injuriously affected by the stray electro-magnetic and electro-static waves and the system is also affected by articles brought adjacent to the different instrumentalities. For instance, it is a common occurrence to find that the mere moving of the hand toward or from the equipment which is commonly accredited to "body capacity" and may be likened to the discharge of static accumulations, will change the tuning of a receiving set, and as above explained, the electrical oscillations thrown out by the pieces of apparatus themselves affected the adjacent apparatuses.

By enclosing each of the several major parts or instrumentalities of the radio apparatus in a separate shield, the equipment is almost absolutely protected, not only from the stray electrical oscillations arriving from outside sources, but also from the waves set up by the instrumentalities of the set. For the most delicate radio equipment it is very desirable to provide a double shield, such as shown in Figs. 7 and 9. However, with less powerful apparatus, a single shield of magnetic material may be found sufficient.

A shield consisting of any magnetic material may be employed with beneficial results. However, a shield, consisting of nickel, chromium and iron in parts of about sixty five (65) percent nickel, ten (10) percent chromium and twenty five (25) percent of iron, has been found to give very good results.

While in the drawings each of the radio instrumentalities is shown as provided with a separate shield, in certain cases, a plurality of instrumentalities may be positioned within the same shield if insulated from other instrumentalities which would injuriously affect them.

The shield partitions dividing each instrumentality from the next may be common to adjacent instrumentalities, as for instance, where the elements are positioned within a trough-like shield and the separate devices within the member are separated from each other by partitions which may be either slidably inserted or fixed in position. Various modifications of this character will readily suggest themselves to one skilled in the art. It is, therefore, to be understood that the applicant contemplates many modifications and the invention, therefore, should be limited only by the scope of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In an apparatus for electrically shielding a radio instrumentality the combination with a shield of magnetic material surrounding the instrumentaliy of a further shield of dielectric material for increasing the shielding effect placed immediately within said magnetic shield but spaced from said instrumentality.

2. In an apparatus for electrically shielding a radio instrumentality the combination with a shield of magnetic material surrounding said instrumentality of a further shield of dielectric material for increasing the shielding effect placed immediately within said magnetic shield but spaced therefrom and spaced from said instrumentality.

HARRY P. PRATT.