June 17, 1947. E. V. AMY ET AL 2,422,458

FILTER DEVICE FOR ANTENNA SYSTEMS

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Fig. 1.

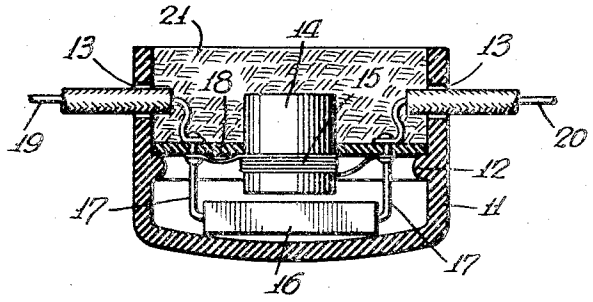


Fig. 2.

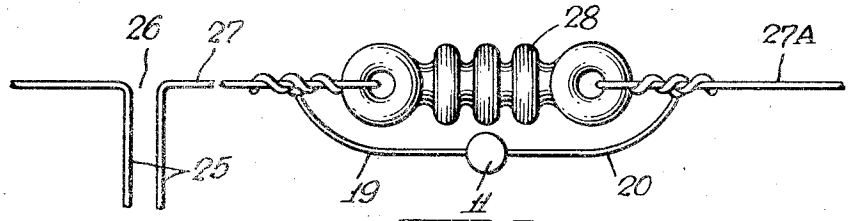


Fig. 3.

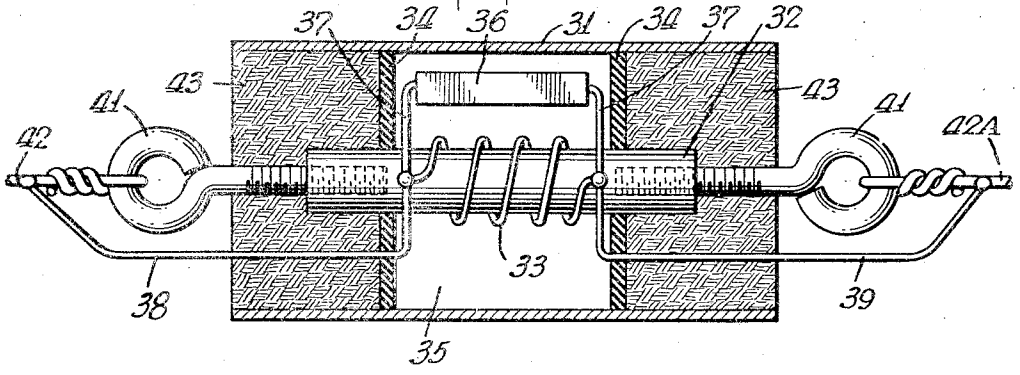
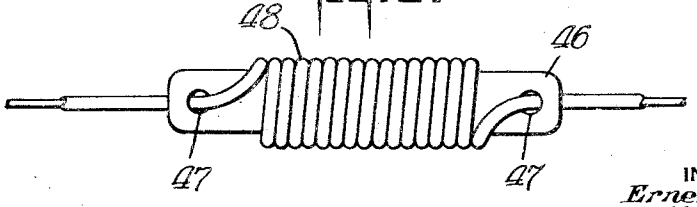


Fig. 4.



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Fig. 5.

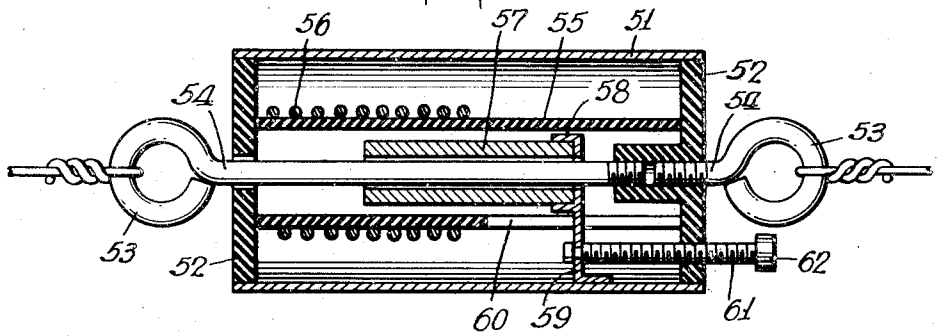


Fig. 6.

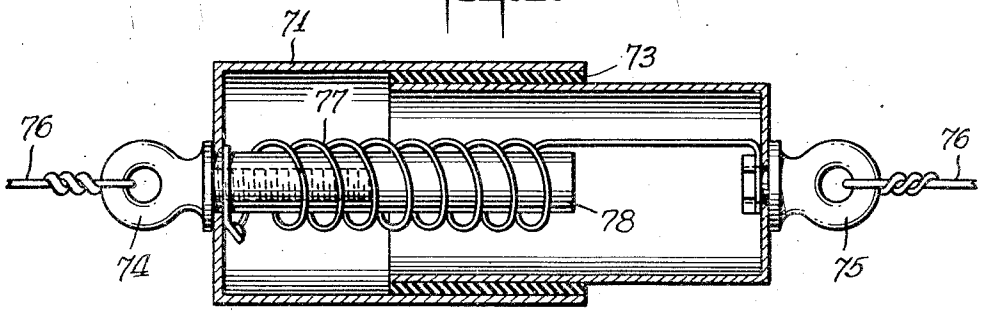
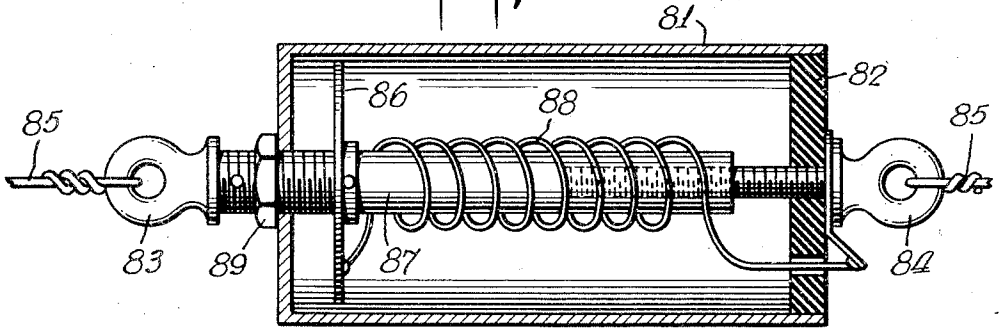


Fig. 7.



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FILTER DEVICE FOR ANTENNA SYSTEMS

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9 Claims. (Cl. 250—33)

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Our invention relates to antenna systems for use with radio receivers, and more particularly to devices for use in such systems whereby optimum antenna conditions are automatically obtained for different selected frequency bands. The invention is especially useful in receiving radio signals in the different bands greater than 1500 kilocycles.

This application is a continuation in part of our copending application Serial No. 152,884, filed July 10, 1937, now Patent No. 2,282,292, issued May 5, 1942.

According to the aforesaid application, a single antenna, desirably of the dipole type or functioning as such, is caused to automatically provide maximum signal pick-up for different frequencies or narrow bands of frequencies intermediate that for which the entire antenna provides maximum response. That is to say, a single dipole may be of a proper overall length to provide maximum voltage for twenty-five meter signals; and by the insertion of dividers, or length limiting devices, in the arms of the dipole, portions of the same antenna will provide maximum or optimum conditions for the reception of signals in the ten and the five meter bands respectively. Such dividers may be anti-resonant, resonant, or comprise inductively coupled elements. The present application pertains to the physical forms of such length limiting devices.

Among the objects of our invention are to provide a simple, compact, easily manufactured and assembled structure which can be readily installed by the general public without danger of improper connections or disturbing the functioning of the device.

Another object of our invention is to provide devices of the above character capable of functioning properly under all conditions of weather, climate, etc.

In certain of its forms, it is another object of our invention to provide such length limiting devices which are also capable of withstanding the strains and stresses of being an integral part of the aerial suspension system.

In certain other of its forms, it is a further object of our invention to provide for a ready adjustment of the electrical values of the device when it is connected in circuit, so as to compensate for minor corrections, and so that one device may be used in several different locations in an antenna.

Other features and advantages of our invention will be apparent from this specification taken in

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conjunction with the accompanying drawings, wherein—

Figure 1 is a vertical section through one of the devices embodying this invention, certain parts being shown in full lines to facilitate illustration.

Fig. 2 is a plan view of the device of Fig. 1, mounted in operative position.

Fig. 3 is a vertical section through a modified form of device, certain parts being shown in full lines to facilitate illustration.

Fig. 4 is an elevational view of another modified form of a device suitable for the purposes of some applications of the aforesaid antenna system.

Fig. 5 is a sectional view of still another modified form of device in which the electrical characteristics thereof are readily adjustable.

Figs. 6 and 7 are vertical sections through still other modified forms of device according to this invention, certain parts being shown in full lines to facilitate the illustration.

In most cases, the device is illustrated in the accompanying drawings on an enlarged scale so that the showing may be clearer.

Referring to Figs. 1 and 2 of the drawings, the cup-shaped casing 11 has an internal rib 12 extending around the side walls of the cup and spaced from the closed end thereof. The side walls are provided with a pair of holes 13 located opposite each other and adjacent the open end of the cup 11. A core 14 (preferably composed of powdered iron suitably compacted with an insulating and binding material to form what appears to be a solid bar) has a few turns of wire, forming a coil 15, wound thereon and near one of its ends. The core is centrally mounted in a disc 18, of paper or suitable insulation, which rests on top of rib 12 and divides the cup into a closed chamber and an open chamber.

A condenser 16 has a connecting and mounting lead wire 17 extending from each side thereof and bent upwardly, the ends passing through suitable apertures in the disc 18, so that the condenser and coil are mounted in the closed chamber in the casing 11. The ends of the coil 15 are soldered to the respective lead wires 17 so that, in this example, the coil and condenser are connected in shunt relation to each other in the circuit, these connections also being located within the closed chamber in the casing.

Lead wires 19 and 20 pass through the openings 13 in the cup 11 and respectively have one end connected to one of the wires 17, these connections being located on the opposite side of the disc 18, or in the open chamber of the casing.

To complete the device, the open chamber in the cup 11 is filled with wax or other suitable sealing compound which is weather resistant and which will protect the elements and the connections from the effects of moisture, ice and snow, that otherwise would affect its electrical values.

The device, construction as just described, may be mounted in place as shown in Fig. 2. A doublet antenna is diagrammatically illustrated in this figure, the down lead conductors 25 extending from the gap 26 thereof to a radio receiver (not shown); and the device of this invention is shown applied to only one arm of this doublet whereas, as will be understood from the aforesaid application, either or both arms may be provided with the dividers described in this application, or similar devices.

One arm of the doublet is divided in two branches 27 and 27A, the division occurring at a distance from the gap 26 corresponding to one quarter of the wave length of the mid-frequency of the narrow band of intermediate frequencies which it is desired to receive. An insulator 28 has the adjacent ends of the branches 27 and 27A connected thereto, the insulator being of one of the usual types used for mounting aerial wires, and designed to withstand the strain and stresses incident to supporting the weight of the antenna. The device of Fig. 1 is mounted alongside the insulator 28 and has its lead wires 19 and 20 connected respectively to the branches 27 and 27A of this arm of the dipole.

In this manner the branch 27 of the dipole, usually plus a corresponding portion of the other arm of the dipole, provides maximum signal pick-up for one frequency or narrow band of frequencies, while the branches 27 and 27A, usually together with another arm of the dipole of corresponding length, gives maximum signal voltage for another frequency or narrow band of frequencies; and the selection of the proper portions of the antenna to provide such results is entirely automatic.

One example of the device of Fig. 1 comprises a coil of ten turns of No. 35 D. S. C. wire wound on a ⅜ inch iron core, and a 25 micro microfarad condenser.

Referring to Fig. 3, the casing comprises a tube 31 of insulation material. A coil form 32, of wood or other material, and provided with a coil 33 midway its length, is mounted in a pair of discs 34 that are located on opposite sides of the coil 33. The discs are of a size to fit the interior of the tube 31 leaving a closed central chamber 35 on the interior of the tube between the discs, and open chambers at either end of the tube. A condenser 36 is mounted in the chamber 35 with its lead wires 37 connected across the ends of the coil 33, the condenser capacity being of suitable value corresponding to the value of inductance of the coil 33 for the particular application to be made. The wires 37 are sufficiently stiff to constitute the mounting for the condenser 36.

Lead wires 38 and 39 extend respectively from opposite ends of the coil 33, passing through suitable apertures in the discs 34 and outwardly beyond the ends of the tube 31.

An eye bolt 41 is screwed into each end of the coil form 32, the eyes thereof being located beyond the ends of the tube 31 and being adapted to receive respectively an end of the branches 42 and 42*a* of one arm of an antenna. The lead wires 38 and 39 are connected respectively to the branches 42 and 42*a*. Here, no separate insulator, such as 28 in Fig. 2 need be used, the construction being constructed to be sufficiently strong to take up the stresses and strains of supporting its proportionate share of the weight of the branches 42 and 42*a*.

To protect the apparatus from the elements, moisture, etc., the open ends 43 of the tube 31 are filled with paraffin, wax, or other suitable sealing material.

The circuit connections of the device of Fig. 3 itself and in the antenna system are the same as described in connection with Fig. 2.

Referring to Fig. 4, there is shown an insulator 46 having apertures 47 near each end thereof. This may or may not be a suspension type of insulator, as desired. Wire is wrapped around the insulator to form a coil 48 of suitable proportions for the particular application, the turns of the coil touching each other. The ends of the coil, or a suitable lead wire, extend outwardly through the apertures 47 for connection to the branches of an arm of a dipole type antenna. One such construction, suitable for use in the systems of the aforesaid application, consists of sixteen turns of No. 18 black enamelled, copper wire wound on a porcelain rod one-half inch in diameter. The distributed capacity of this coil is sufficient for the purposes of the circuit and appears in the circuit in shunt to the coil.

Referring now to Fig. 5, a metal tube 51 is closed at each end by a disc 52 of insulation material. A pair of eye-bolts 53 for receiving the ends of branches of an arm of a dipole in the manner indicated above have their shafts 54 extending centrally through the tube, the same being mounted in each of the end discs 52. Mounted between the discs 52 is a tubular coil form 55 of insulation material, upon which is wound a coil 56 of suitable value, the coils of the wire being arranged to have a distributed capacity sufficient for the purposes of the particular circuit connection. In order to vary the impedance value of the coil with its distributed capacity, an iron core 57, similar to core 14 of Fig. 1, is mounted inside the coil form 55 and arranged to slide upon the shaft 54. The end of the core 57 is received in a clamp 58 that is carried by an L-shaped arm 59 extending through a slot 60 in the coil form 55 and having its free end arranged to be guided on the interior of the tube 51. An adjusting screw 61 has one end thereof attached to the arm 59 and a knob 62 at its outer end. The screw 61 is adjustable in a suitable opening in one of the end discs 52. By turning the knob 62 the core 57 slides in and out of the coil 56 to vary its inductance and its distributed capacity.

Fig. 6 shows a construction of a divider wherein the condenser also serves as a housing for the divider. The housing comprises a pair of metallic, telescoping, closed end cylinders 71 and 72 separated by a collar 73 of suitable insulating material. The closed ends of the cylinders are provided with suitable connecting members 74 and 75 respectively to each of which may be connected the antenna wire 76. An insulator bar 78 is mounted within the housing, on which is wound the coil 77, the ends of which have pigtail connections to the cylinders 71 and 72 respectively. The housing forms the condenser, the capacity of which may be adjusted by sliding the two cylinders relatively to each other. When the desired value of capacity is obtained for the particular value of inductance, the two cylinders may be secured together in the adjusted position by

any suitable means, and an insulating and weather-proofing compound may be poured over the joint to seal the housing and to fix the adjustment of the capacity of the condenser.

Fig. 7 shows another construction of divider having an adjustable condenser. In this form a metallic closed end cylinder 81 is closed at its opposite end by a disc 82 of insulating material. Within the cylinder 81 is a post 87 of insulating material, the post being screw threaded at one end and being adjustable in the metallic end of the cylinder 81. At its outer end the post carries a mounting eyelet 83. At its opposite end the post is internally screw threaded to receive the shank of a mounting eye-bolt 84. The disc 86 is mounted upon the post 87 which disc extends parallel to the end of the metal housing 81 and to constitute therewith the opposite plates of a condenser. A coil 88 is diagrammatically illustrated as wound upon the core 87 and has one end connected to the metal disc 86 of the condenser. The opposite end of the coil passes through an aperture in the end disc 82 and is connected to a clip engaged by the eye-bolt 84.

The divider is mounted between the branches of the arm 85 of the antenna, and as will be apparent, the coil and condenser are in series circuit relation therewith. To adjust the value of the capacity the nut 89 is loosened which permits the disc or plate 86 of the condenser to be adjusted toward or away from the metal end disc of the housing 81 to thereby vary the capacity value thereof. Thereafter the lock nut 89 is tightened in place to hold the adjustment.

If desired the inductance and condenser may be mounted in separate cases which may be either metal or of dielectric material having low loss characteristics at the frequencies mentioned herein.

Modifications may be made in the arrangement and location of parts within the spirit and scope of my invention, and such modifications are intended to be covered by the appended claims.

I claim:

1. The combination with an antenna system of the dipole type having at least one arm divided into two branches, an insulator to which the two branches are connected to physically separate the same, of a filter comprising a housing, a magnetic core mounted therein, a coil wound about said core, a condenser in circuit with said coil, lead wires extending from said coil externally of said housing for connection respectively to the branches of said antenna arm, and means for closing said housing.

2. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna located intermediate its ends, said filter comprising a housing, a core mounted therein, a coil wound about said core and having a selected inductance value according to the frequency of the signal to be received by one portion of said antenna, a condenser having a similar selected value, circuit connections between the condenser and coil, lead wires from said connections extending outwardly beyond the ends of said housing for connection into the arm of the antenna intermediate its ends to separate the same into branches to provide maximum signal reception for signals of certain frequencies in a portion of said antenna and to automatically permit the entire antenna to function for the reception of other signals at separated frequencies.

3. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna located intermediate its ends, said filter comprising a housing, a core mounted therein, a coil wound about said core, a condenser, circuit connections between the condenser and coil, lead wires from said connections extending outwardly beyond the ends of said housing for connection into the arm of the antenna intermediate its ends to electrically divide the same into separate branches, the coil having a selected inductance value according to the frequency of the signal to be received by a portion only of said antenna and the condenser having a similar selected value, to provide maximum signal reception for signals of certain frequencies in a portion of said antenna and to automatically permit the entire antenna to function for the reception of signals of other frequencies, and means for suspending the filter between the branches of the arm of the antenna being divided thereby.

4. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising a housing, a core of insulation material mounted therein, a coil wound about the core, a condenser mounted in the housing and connected in circuit with said coil, means forming a closed chamber about said condenser and coil, lead wires connected to said coil and extending outwardly from the ends of said housing for connection into the arm of said antenna intermediate its ends, and means for sealing said housing against the entrance of moisture, dirt, and the like, into said chamber.

5. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising a housing, a pair of discs closing the housing at either end, a tubular coil form mounted between the discs, a coil wound about said form, a slot in the form, a magnetic core mounted inside the form, means for movably supporting said core, means adjustable from outside said housing for moving the core relatively to the coil, and lead wires extending from said coil externally of the housing for connection into the arm of said antenna.

6. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising a housing, a core mounted therein, a coil wound about said core and having a selected inductance value according to the frequency of the signal to be received by one portion of said antenna, a capacity in circuit with said coil having a similarly selected value, lead wires from said coil and extending outwardly beyond the ends of said housing for connection into the arm of said antenna intermediate its ends to separate the same into branches for the reception of certain signals and to automatically permit the entire antenna to function for the reception of other signals, and means whereby the value of the capacity in said circuit may be adjusted readily when the device is being installed.

7. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising an insulating enclosure, a core, a coil wound about said core, the coil having a selected inductance value, a capacity in circuit with said coil also having a selected value, and means for suspending said filter from and connecting the same intermediate the ends of said antenna arm, the values of said inductance and capacity and the location of the filter being chosen so that the antenna is electrically severed into separate branches to pro-

vide maximum signal pick-up for signals of certain selected frequencies by one portion of the antenna and automatically permit the entire antenna system to function for the effective reception of signals of other and separated frequencies.

8. In an entenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising an insulating enclosure, a core, a coil wound about said core, the coil having a selected inductance value, a capacity in circuit with said coil also having a selected value, and lead wires from said coil circuit and extending outwardly from said filter, the lead wires being connected into the arm of said antenna so as to electrically divide the same into separate branches, the values of said inductance and capacity and the location of the filter being chosen so that one branch of the system provides maximum signal pick-up for signals of certain selected frequencies, and automatically the entire system will function for the reception of signals of other and separated frequencies.

9. In an antenna system, the combination of an antenna of the dipole type, and a filter in an arm of the antenna, said filter comprising a housing, a core therein, a coil wound about said core, the coil having a selected inductance value, a capacity in circuit with said coil also having a selected value, and lead wires from said coil circuit and extending outwardly beyond said housing, the lead wires also being connected into the arm of said antenna so as to electrically divide the same into separate branches, the values of said

inductance and capacity and the location of the filter being chosen so that one branch of the system provides maximum signal pick-up for signals of certain selected frequencies, and automatically the entire system will function for the reception of signals of other and separated frequencies.

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