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(54) Coil construction

(57) A bifilar soil construction is used for isolating radio signals picked up by a motor vehicle window heating element from the power supply circuit for the heating element. The coil construction has two separate windings (9, 10) which are arranged bodily alongisde each other. In one embodiment there is an inner cylindrical winding (9) within and in contact with an outer cylindrical winding (10), and a two part pot core (15, 16) is clamped within and around the windings 9, 10). In another embodiment, the coils are flat, and disposed one on top of the other.

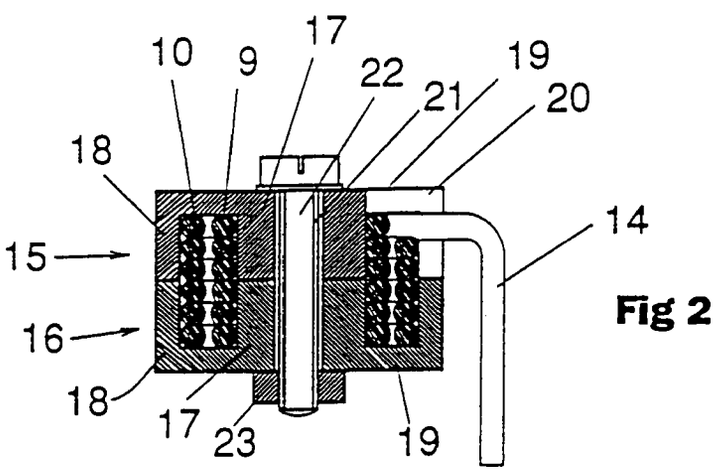

Fig 2

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Description

This invention relates to a coil construction for a signal separating device.

GB-A-1520030 and GB-A-1600987 describe signal separating devices which act to isolate the d.c. power supply circuit for the heating element of an electrically heated motor vehicle window from the antenna circuit of a radio receiver or transmitter connected to the heating element, so that the heating element can be used simultaneously for heating purposes and as a radio transmitting or receiving antenna.

The described devices uses a bifilar coil for signal separation purposes. The two windings or the coil are connected respectively between opposite ends of the heating element and positive and negative terminals of the d.c. power supply circuit, whereby the coil can present a high blocking impedance to radio signals with a low resistance for d.c. currents. Signal separation can therefore be effected in a particularly convenient and efficient manner.

Conventionally, bifilar coils are manufactured by machine-winding two side-by-side wires together around a former. This results in two windings which are wound in a common direction, which have a common diameter and axial length, and the turns of which lie axially next to each other. For signal separation purposes as mentioned above, the windings are enclosed within a pot core structure (ferrous ceramic structure) with ends of the windings projecting axially downwardly through openings in the structure for connection purposes.

Present trends are towards the use of higher current consumption motor vehicle window heating elements, say 30 amps or more, and there is therefore a requirement for bifilar coils with thicker gauge windings. However, with the above mentioned conventional construction, thicker gauge windings result in increased axial bulk which is undesirable. An axially compact construction is desirable to permit easy mounting at a required position close to the motor vehicle window so as to minimise tuning problems due to lead inductance and capacitance. Also, with the conventional construction, the projecting connection ends of the windings follow a curved or bent path where they feed into the adjacent end turns and, in the case of axially side-by-side thicker gauge wires this adds considerably to the axial bulk and also can be difficult to achieve or control with conventional winding equipment.

An object of the present invention is to provide a bifilar coil construction which can be easily and conveniently manufactured, and with which axial bulk can be minimised, even with thicker gauge wires.

According to a first aspect of the present invention therefore there is provided a signal separating device as set forth in Claim 1.

With this arrangement, an axially compact construction can be readily manufactured, even with thicker gauge wires.

The signal separating device may include other components as appropriate for example including capacitors, diodes, chokes, matching circuitry for matching the heating element to the antenna circuit of the radio apparatus, and tuning circuitry to give efficient operation at different frequency bands (am, vhf).

In one embodiment each winding has final top and bottom turns which terminate in respective bent ends with straight terminal end portions which project alongside the coil in the axial direction of the coil. Preferably, the bottom said terminal end portion projects downwardly freely away from the coil, and the top said terminal end portion projects downwardly freely from the coil alongside and spaced from the outersurface thereof. Preferably also, the terminal end portions are spaced circumferentially from each other.

In a particularly preferred embodiment, at least one of the top and bottom bent ends is stepped sideways so that the top terminal end portions of the two windings are spaced apart from each other, as also are the bottom terminal end portions.

The core may have top and bottom radially extending slots through which the top bent ends and the bottom bent ends respectively project.

The separate windings comprise two spiral windings disposed one on top of the other. This results in a 'flat', or reduced axial bulk, construction and the ends of the windings can be readily separately turned up or down or otherwise bent to form connections without unduly axially displacing the turn structure of the windings.

Thus, the present invention may be constructed by a method wherein the two windings are formed as spiral, and said coils are disposed axially one on top of the other.

Preferably, the coils are of common diameter and are disposed in contact with each other.

A signal separating device will now be described further by way of example only and with reference to the accompanying drawings in which:

Fig. 1	is a simplified diagram of one form of a signal separating device including a bifilar coil construction;
Fig. 2	is a sectional view through the bifilar coil construction on the line A-A of Fig. 4;
Figs. 3 and 4	are views from below and above of the construction of Fig. 2;
Fig. 5	is a side view of the outer winding of the coil construction.
Figs. 6 and 7	are views from above and below of the two windings of the coil construction; and
Fig. 8	is a sectional view on the line B-B of Fig. 6.

The signal separating device shown is for use with a conventional heated rear window of a motor car to enable this to be used as a receiving antenna for a car

radio.

The device comprises a housed circuit 1 which is fixed close to the heated window 2 e.g. beneath the rear parcel shelf or within the roof lining.

The housed circuit 1 has five terminals 3, 4, 5, 6, 7, two of which 3, 4 are connected to the heating element 2 of the window, another two of which 5, 6 are connected to d.c. positive and earth of the car d.c. power supply via the usual dashboard switch, and the other of which 7 is connected by a shielded cable to the car radio antenna input circuit.

The housed circuit 1 includes a double wound coil 8 having two windings 9,10 of common direction or hand which are interposed respectively between d.c. positive and earth and the two ends of the heating element 2.

The antenna terminal 7 is linked to the heating element 2 between the heating element 2 and the double wound coil 8. Other components for matching, tuning, assistance in isolation, balancing of the signals at the ends of the heating element etc. may be incorporated but are not all shown here.

The double wound coil comprises two separate windings 9, 10 each of say 5 turns of a thick gauge copper wire capable of carrying said 30 amps without overheating and without significant voltage loss due to resistance.

Each winding coil 9, 10 has a bottom turn which terminates in a downwardly bent end 11, 12 projecting freely away from the coil parallel to its axis. Each coil also has a top turn which terminates in a downwardly bent end 13, 14 projecting freely from the coil alongside and spaced from the outer surface of the coil parallel to its axis.

The inner coil 9 has an outer diameter which is very slightly smaller than the inner diameter of the outer coil 10. The end 11 of the inner coil is bent directly downwardly whereas the ends 13, 12, 14 of the inner and outer coil are stepped to one side before being bent downwardly.

The inner coil 9 is fitted within the outer coil 10 so that they are closely in contact with each other. The bottom projecting ends 11, 12 are alongside each other but are spaced apart due to the abovementioned stepping. A similar arrangement applies to the top projecting ends 13,14.

Due to the fact that the end 11 is bent directly downwards whereas the other ends 12-14 are stepped as described, it will be understood that the coil 9 can be quickly and easily inserted into the coil 10 after winding without any further bending or forming of the ends 11-14.

The coils so far described can be readily formed with a conventional winding machine since it is a single wire which is being wound. In particular, the ends 11, 12, 13, 14 can be readily bent and fed into (or fed out of) the associated end turn in a particularly simple and accurate manner, and without requiring undue axial distortion or displacement of the end turn, even with the thick gauge wire.

The resulting coil construction 8 has reduced axial bulk due to the radial spacing of the turns of the two windings 9, 10 and due to the above mentioned reduced displacement of the end turns.

The coil construction 8 is accurately shaped and configured and so it can be easily assembled with a conventional pot core, as shown in the drawing.

The pot core is formed in two halves 15, 16 each consisting of an inner hollow cylinder, 17, an outer hollow cylinder 18 and an end plate 19. These cylinders 17, 18 and the end plate 19 are formed integrally in one piece from a ferrous ceramic structure.

There is a gap in the outer cylinder 18 and the end plate 19 forming a radial slot 20, and there is a central hole 21 in the end plate 19.

The core halves 15, 16 are assembled top and bottom around the coil construction with the radial slots 20 offset to receive the projecting ends 11, 12, 13, 14. The halves 15,16 are clamped in position tightly in contact with each other with a bolt 22 passed through the holes 21 and the inner cylinders 17 and engaging a nut 23.

It is of course to be understood that the invention is not intended to be restricted to the details of the above embodiment which are described by way of example only.

Reference is made to European Patent Application No. 93905538.0, from which the present case was divided, which has claims directed to a signal separating device, embodiments of which are described above and illustrated in Figures 1 to 8.

Claims

1. A signal separating device for use with a window heating element of a motor vehicle, the signal separating device having a first pair of terminals for connection to the heating element, a second pair of terminals for connection to d.c. power supply for the heating element, and an antenna terminal for connection to radio transmitting and/or receiving apparatus, **characterised in that** the separating device includes a coil assembly having first and second separate spiral coil windings wound in the same direction, disposed axially one on top of the other, the windings having the same number of turns as one another.

2. A signal separating device according to claim 1 in which the coils are disposed in contact with one another.

3. A signal separating device according to claim 1 or claim 2 in which the antenna terminal is connected intermediate the heating element and the double-wound coil.

4. A signal separating device according to any preceding claim further comprising circuit components for matching, tuning, assistance in isolation of signals.

5. A signal separating device according to any preceding claim in which the heating element is connected in series between the two windings.

6. A signal separating device according to any preceding claim in which each coil winding is formed from wire, at least one end portion of which projects axially of the winding.

7. A signal separating device according to claim 6 in which at least one of the said end portions is radially displaced from the coil winding by a radial portion of wire.

8. A signal separating device according to any preceding claim further comprising a magnetic core having inner and outer cylindrical parts respectively within and around the coil structure.

9. A signal separating device according to claim 8 in which the core is a pot core formed in two sections which are clamped together by a extending clamping device which extends axially of the coil structure.

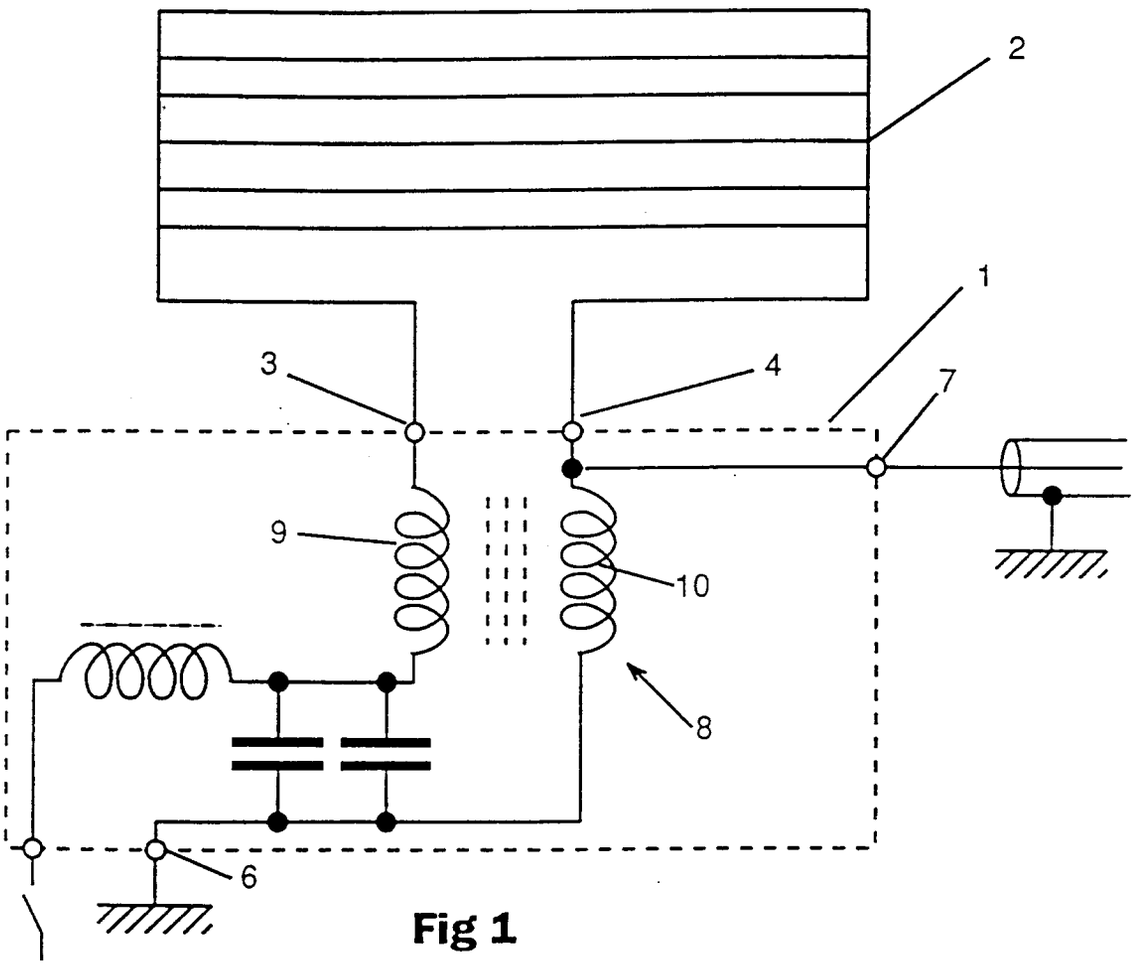

Fig 1

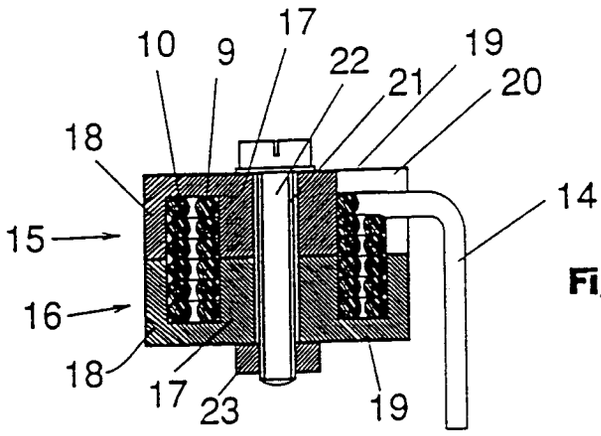

Fig 2

Fig 3

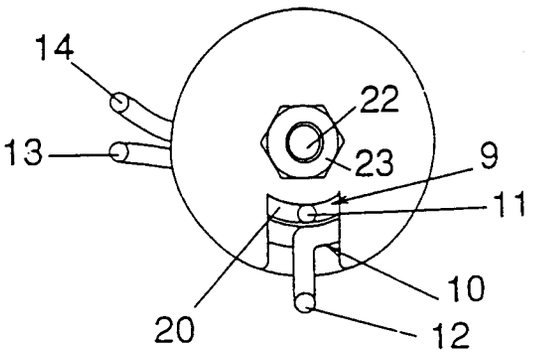

Fig 4

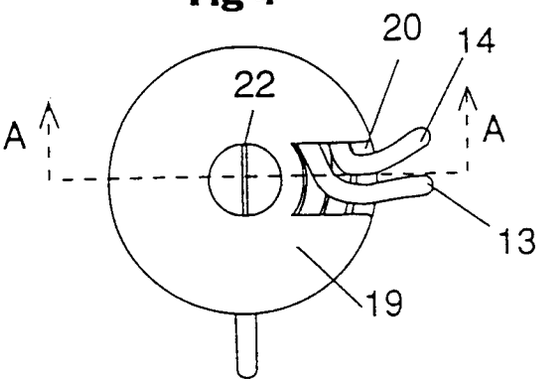

Fig 5

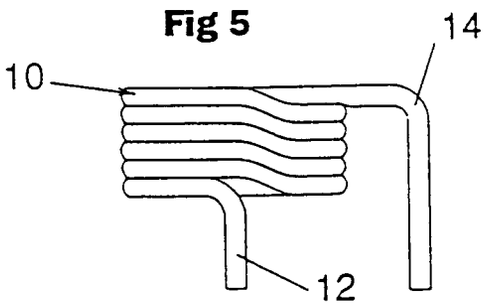

Fig 6

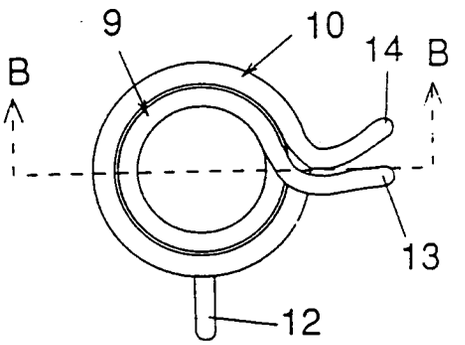

Fig 7

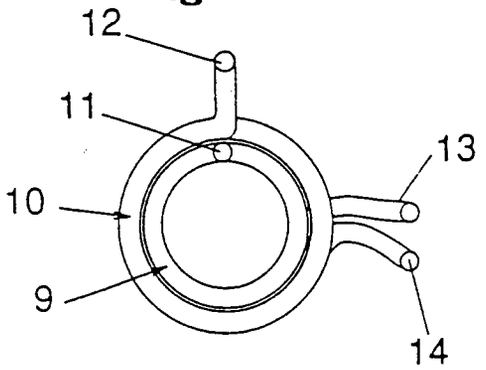

Fig 8