

COIL CONSTRUCTIONTECHNICAL FIELD

This invention relates to a bifilar coil construction.

BACKGROUND ART

5 British patents GB 1520030 and GB 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
10 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 use a bifilar coil for signal
separation purposes. The two windings of the coil are
15 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
20 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
25 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.

5 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
10 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
15 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
20 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.

25 DISCLOSURE OF THE INVENTION

According to one aspect of the present invention

therefore there is provided a bifilar coil construction comprising first and second windings of common direction characterised in that the windings are separately formed windings disposed bodily alongside each other.

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

The bifilar coil construction is particularly suited to use in a signal separating device for use with a motor vehicle window heating element.

10 Thus, and in accordance with a second aspect of the present invention there is provided a signal separating device for use with a motor vehicle window heating element, said device having a pair of first terminals for connection to the heating element a pair of second terminals for
15 connection with the motor vehicle d.c. power supply for the heating element, an antenna terminal for connection to the antenna circuit of motor vehicle radio transmitting and/or receiving apparatus, and a bifilar coil construction having first and second windings of common direction interposed
20 between the pair of first terminals and the pair of second terminals so as to permit passage of d.c. current from the power supply to the heating element whilst blocking passage of radio signals from the heating element to the d.c. power supply, the antenna terminal being connected between the
25 heating element and the bifilar coil, characterised in that the windings of the bifilar coil construction are separately

formed windings disposed bodily alongside each other.

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

The separate windings of the bifilar coil construction of the invention may comprise two cylindrical (or generally
10 cylindrical) windings which are of slightly different diameters so that the first winding can fit closely within the second winding, the turns of the first winding therefore being spaced radially inwardly of the turns of the second winding.

15 Thus, and in accordance with a third aspect of the present invention, there is provided a method of manufacturing the bifilar coil construction of the first aspect of the invention wherein the first winding is formed as a cylindrical (or generally cylindrical) coil, the second
20 winding is formed as a separate cylindrical (or generally cylindrical) coil having an internal diameter greater than the external diameter of the coil of the first winding, and the first winding is fitted within the second winding.

Preferably the said internal and external diameters are
25 closely similar so that the outer surface of the first winding contacts or is in close proximity to the inner

surface of the second winding for maximum space saving.

With this method, the windings can be formed easily and conveniently, even with thicker gauge wire, especially because the ends of the windings are fed into the adjacent
5 end turns as single wires whereby bends or curves between the ends and the turns can be readily accommodated. Since the winding turns are radially spaced the axial bulk can be kept to a minimum, and the fact that the said bends or curves of the ends occur in single, rather than twin wires
10 can also assist in this respect.

With inner and outer windings, the overall coil structure is of generally cylindrical form and it is possible (and preferred) to use a conventional core having inner and outer cylindrical parts, respectively within and
15 around the coil structure, joined by integral end plates. The core may be a pot core and may be formed in two sections which are clamped together by an axially extending clamping device such as a nut and bolt. Appropriate slots may be provided for the connection ends.

20 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
25 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.

5 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.

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

Alternatively, the separate windings may comprise two spiral (or helical) windings disposed one on top of the other. This results in a 'flat', or reduced axial bulk, 15 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, and in accordance with a fourth aspect of the 20 present invention there is provided a method of manufacturing the bifilar coil construction of the first aspect of the invention wherein the two windings are formed as spiral or helical coils, and said coils are disposed axially one on top of the other.

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

The resulting coil structure of the fourth aspect of the invention can be provided with a core structure generally of like form to that described above in connection with the third aspect of the present invention, it being understood
5 that the coils have central apertures therein to receive the central part of the core.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described further by way of example only and with reference to the accompanying drawings
10 in which:

- Fig. 1 is a simplified diagram of one form of a signal separating device including a bifilar coil construction according to one embodiment of the invention;
- 15 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
20 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.

25 BEST MODE OF CARRYING OUT THE INVENTION

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
5 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
10 usual dash board 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 bifilar coil 8 having two windings 9, 10 of common direction or hand which are
15 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 bifilar coil construction 8. Other components for matching, tuning,
20 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 bifilar coil construction comprises two separate windings 9, 10 each of say 5 turns of a thick gauge copper
25 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 outersurface 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 above mentioned 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 in to (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.

5 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.

10 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.

15 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.

20 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
25 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.

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CLAIMS

1. A bifilar coil construction comprising first and second windings of common direction characterised in that the windings are separately formed windings (9, 10) disposed
5 bodily alongside each other.
2. A coil construction according to claim 1 characterised in that the separate windings (9, 10) comprise first and second generally cylindrical windings of different diameters whereby the first winding (9) fits closely within the second
10 winding (10) with the turns of the first winding spaced radially inwardly of the turns of the second winding.
3. A coil construction according to claim 2 characterised in that the outer surface of the first winding (9) contacts the inner surface (10) of the second winding.
- 15 4. A coil construction according to claim 1 characterised in that the separate windings comprise two spiral or helical windings disposed one on top of the other.
5. A coil construction according to claim 4 characterised in that the windings are of common diameter and are disposed
20 in contact with each other.
6. A coil construction according to any one of claims 1 to 5 characterised by the provision of a core (15, 16) having inner and outer cylindrical parts (17, 18) respectively within and around the coil structure.
- 25 7. A coil construction according to claim 6 characterised in that the cylindrical core parts (17, 18) are joined by



integral end plates (19).

8. A coil construction according to claim 7 characterised in that the core is a pot core formed in two sections (17, 18) which are clamped together by an axially extending clamping device (22).

9. A coil construction according to claims 2 or 3, or any one of claims 6-8 when dependent thereon characterised in that each winding (9, 10) has final top and bottom turns which terminate in respective bent ends with straight terminal end portions (13, 14 and 11, 12) which project alongside the coil in the axial direction of the coil.

10. A coil construction according to claim 9 characterised in that the bottom said terminal end portion (11 or 12) projects downwardly freely away from the coil, and the top said terminal end portion (13 or 14) projects downwardly freely from the coil alongside and spaced from the outersurface thereof.

11. A coil construction according to claims 9 or 10 characterised in that the terminal end portions (13 or 14, and 11 or 12) are spaced circumferentially from each other.

12. A coil construction according to any one of claims 9-11 characterised in that at least one of the top and bottom bent ends is stepped sideways so that the top terminal end portions (13, 14) of the two windings (9, 10) are spaced apart from each other, as also are the bottom terminal end portions (11, 12).



13. A coil construction according to any one of claims 9-12 when dependent on any one of claims 6-8 characterised in that the core (15, 16) has top and bottom radially extending slots (20) through which the top bent ends and the bottom bent ends respectively project.

14. A signal separating device for use with a motor vehicle window heating element, said device having a pair of first terminals for connection to the heating element (3, 4), a pair of second terminals (5, 6) for connection with the motor vehicle d.c. power supply for the heating element, an antenna terminal (7) for connection to the antenna circuit of motor vehicle radio transmitting and/or receiving apparatus, and a bifilar coil (8) having first and second windings (9, 10) of common direction interposed between the pair of first terminals (3, 4) and the pair of second terminals (5, 6) so as to permit passage of d.c. current from the power supply to the heating element whilst blocking passage of radio signals from the heating element to the d.c. power supply, the antenna terminal (7) being connected between the heating element and the bifilar coil, characterised in that the bifilar coil (8) is a coil construction according to any one of claims 1 to 8.

15. A method of manufacturing the coil construction of any one of claims 1-3 or 6-8 when dependent thereon wherein the first winding (9) is formed as a generally cylindrical coil, the second winding (10) is formed as a separate generally



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cylindrical coil having an internal diameter greater than the external diameter of the coil of the first winding (9), and the first winding (9) is fitted within the second winding (10).

5 16. A method of manufacturing the coil construction of claims 4 or 5 or 6-8 when dependent on 4 or 5 wherein the two windings are formed as spiral or helical coils, and said coils are disposed axially one on top of the other.

10 17. A coil construction according to claim 1 substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

18. A signal separating device according to claim 14 substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

15 19. A method according to claim 15 substantially as hereinbefore described with reference to the accompanying drawings.

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