United States Patent
Sato et al.

METHOD FOR ELIMINATING NOISE OF AN ELECTRIC APPLIANCE AND DEVICE THEREFOR

Inventors: Masaaki Sato; Shiniche Saitou, both of Tokyo, Japan
Assignee: Olympus Optical Co., Ltd., Toyko, Japan
Filed: Apr. 30, 1970
Appl. No.: 33,363

Foreign Application Priority Data
May 10, 1969 Japan..........................44/42895

U.S. Cl........................................333/79, 310/51, 310/71, 333/73 S
Int. Cl...............................H01H 7/14
Field of Search......................333/97, 84 M, 73 S; 321/10;
310/51, 71, 72

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Primary Examiner—Herman Karl Saalbach
Assistant Examiner—Saxfield Chatmon, Jr.
Attorney—Otto John Munz

ABSTRACT
Method and device for eliminating noise of an electric appliance such as a tape recorder. The input lead wires of an electric motor incorporated in the electric appliance are made to have a predetermined length depending upon the factors such as the capacity of the motor so that the electromagnetic noise generated by the commutator and the brushes of the motor is compensated for by the length of the input lead wires thereby permitting the noise of the electric appliance is eliminated. The input lead wires are made of a printed circuit and located in any desired position in the electric appliance such as on the outer surface of the housing of the motor and on the inner surface of the casing of the electric appliance thereby permitting the same to be made extremely compact.

18 Claims, 11 Drawing Figures
Fig. 5

Fig. 6

Fig. 7

Fig. 8
METHOD FOR ELIMINATING NOISE OF AN ELECTRIC APPLIANCE AND DEVICE THEREFOR

BACKGROUND OF THE INVENTION

The present invention relates to a method of eliminating noise of an electric appliance such as a tape recorder (referred to as "electric appliance" hereinafter) caused by an electric motor incorporated in the electric appliance and a device for carrying out the method described above.

An electric motor incorporated in an electric appliance, particularly a so-called micromotor used in a miniature tape recorder, tends to generate noise in the electric appliance due to the electromagnetic noise generated by the commutator and the brushes of the motor.

Heretofore, an electric circuit for an electric appliance has been proposed in order to improve the quality of the sound generated by the electric appliance by reducing the electromagnetic noise generated by the motor incorporated therein. The electric circuit comprises at least one choke coil connected in series in the input lead wires of the motor and a capacitor connected in parallel to the motor across the input lead wires so that a filter circuit is formed.

In such an electric circuit, however, the space required to arrange the choke coil and the capacitor therein is relatively great, so that it can not be incorporated in a miniature electric appliance such as an ultraminiature tape recorder in which the available space is extremely limited.

Therefore, a device has long been desired which can eliminate noise of an electric appliance without requiring a considerable space therein for incorporating the device.

The present invention is based on the finding from the results of various tests carried out by the present inventors for eliminating noise of an electric appliance caused by the electromagnetic noise of the electric motor incorporated therein.

In accordance with the results of the tests made by the present inventors, it was found that noise of an electric appliance can be substantially completely eliminated by providing input lead wires of the electric motor of the electric appliance having a predetermined length depending upon the factors such as the capacity of the motor.

The above described predetermined length of the input lead wires varies in accordance with the factors such as the capacity of the motor and it may be provided in either one of the input lead wires or may be divided into two portions forming the respective input lead wires. The lead wires may be located in any desired place in the electric appliance requiring only the minimum space thereby permitting the electric appliance to be made extremely compact.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a novel and useful method for eliminating noise of an electric appliance such as a tape recorder caused by an electric motor incorporated therein, which can be carried out by the minimum number of elements requiring only the minimum space in the electric appliance.

Another object of the present invention is to provide a novel and useful device for carrying out the method described above.

The above objects are achieved in accordance with the present invention by a method characterized by forming a length of the input lead wires of the motor incorporated in the electric appliance by a thin strip of electrically conductive material having a predetermined length depending upon the factors such as the capacity of the motor and by a device characterized by the input lead wires of the motor incorporated in the electric appliance having a predetermined length determined in accordance with the factors such as the capacity of the motor.

Other objects of the present invention will be apparent by reading the following description in connection with the accompanying drawings.

FIG. 1 is a diagram showing an example of the prior art electric circuit for eliminating noise of an electric appliance caused by an electric motor used therein;

FIG. 2 is a schematic perspective view showing an embodiment of the device for eliminating noise of an electric appliance constructed in accordance with the present invention;

FIG. 3 is a developed plan view of the device of FIG. 2;

FIG. 4 is a diagram showing the relationship between the noise level and the length of input lead wires of the motor applied to the device of the present invention;

FIGS. 5 to 7 are developed plan views showing various embodiments of the device of the present invention, respectively;

FIG. 8 is a schematic perspective view similar to FIG. 2 but showing the device having a shielding cover located around the device of the present invention;

FIG. 9 is a developed plan view showing a further embodiment of the device of the present invention;

FIG. 10 is a cross-sectional view showing a further embodiment of the arrangement of the device of the present invention;

and FIG. 11 is a schematic plan view showing a still further embodiment of the arrangement of the device of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 showing the prior art device for eliminating noise of an electric appliance, choke coil 1 is connected in series in one of the input lead wires of electric motor M lead from electric source E while choke coil 12 is connected in series to the other of the input lead wires of motor M. Capacitor C is connected in parallel to motor M across the input lead wires as shown. Since choke coils 1, 12, and capacitor C have relatively large size, the space required for arranging the choke coils and the capacitor is too great to be provided in a miniature electric appliance such as an ultraminiature tape recorder in which the available space is considerably limited.

In accordance with the finding of the present inventors, noise level of the electric appliance caused by the electromagnetic noise of the motor incorporated therein is considerably reduced by merely making the length of the input lead wires of the motor longer to a certain amount and the noise level is then gradually reduced as the length of the input lead wires is made still longer until the noise is substantially completely eliminated when the length of the input lead wires reaches a predetermined length as clearly shown in FIG. 4. A test showed that noise is practically completely eliminated by providing 2 meters of the length of the input lead wires for a D.C. electric motor of 0.4 watt.

Referring to FIG. 2 showing an embodiment of the present invention, motor 1 of an electric appliance such as a tape recorder mounts around its housing input lead wires 2 having a predetermined length determined in accordance with the capacity of motor 1. Input lead wires 2 are made of printed circuits, for example, secured to electrically non-conductive sheet 3 made of a material such as polyester resin and sheet 3 is wound around the housing of motor 1. As shown in FIG. 3, lead wires 2 comprise a pair of strips 4a, 4b of electrically conductive material located on sheet 3 in meandering form with each of strips 4a, 4b terminating at terminals 5a, 5b and 5c, 5d, respectively. Strips 4a, 4b may be formed by printed circuits formed on sheet 3. Terminals 5a, 5d are connected to terminals 6a, 6b of electric source 5 while terminals 5b, 5c are connected to the terminals of motor 1 so that strips 4a, 4b are connected in series to the input of motor 1, respectively. The sum of the lengths of strips 4a, 4b is made at least equal to the above described predetermined length. Either of strip 4a or strip 4b may be dispensed with insofar as the total length of the remaining one is made at least the above described predetermined length.
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mined length. The above described construction of the present invention requires very little space and can be conveniently incorporated in the miniature electric appliance while it permits noise of the electric appliance caused by electromagnetic noise of motor 1 to be completely eliminated. Thus, the electric appliance can be made very compact.

FIGS. 5 to 7 show various modifications of the device of the present invention. In FIG. 5, each of a pair of strips 4a, 4b is in the spirally wound rectangular form and located on base sheet 3 made of a material such as polyester, Mylar sheet (Trade Name of products manufactured by E.I. du Pont de Nemour & Co. Inc.).

In FIG. 6, strips 4a, 4b are arranged in zig-zag form on sheet 3 in parallel to each other.

FIG. 7 shows the location of strips 4a, 4b in which each of strips 4a, 4b has going and returning portions arranged in parallel to each other and wound spirally in rectangular form so that terminals 5a, 5b; 5c, 5d of each of strips 4a, 4b are located adjacent to each other for convenience of the electric connection to electric motor 1 and electric source 6.

FIG. 8 shows shielding cover 7 located around electrically conductive strips 4 shown in FIG. 2. Shielding cover 7 prevents leaking magnetic flux from propagating out of motor 1 while magnetic noise generated by electrically conductive strips 4 in the meandering form is prevented from propagating outwardly.

FIG. 9 shows a further modification of the arrangement of electrically conductive strips 4a, 4b. Strips 4a, 4b extend lengthwise of sheet 3 repeatedly in one direction from one end to the other end thereof and thence in the opposite direction to the one end.

Sheet 3 need not be pliable but may be made relatively rigid depending upon the manner it is arranged in the electric appliance.

FIG. 10 shows an alternative arrangement of sheet 9 on which electrically conductive strips 4a, 4b are located. Sheet 9 is attached to the inner surface of casing 10 of the electric appliance.

FIG. 11 shows sheet 9 attached to one end surface of motor 1.

Alternatively, electrically conductive strips 4a, 4b may be located in an available area of a base plate of a printed circuit used in the electric circuit of the electric appliance.

Electrically conductive strips 4a, 4b may be formed by evaporating electrically conductive material into an electrically non-conductive base sheet or plate.

Further, electrically conductive strips 4a, 4b may be bonded to the base plate.

We claim:

1. An electric appliance such as a tape recorder with an electric motor generating electromagnetic noise comprising a shell with lead-in wires as an integral part of said shell, at least one of the input lead wires to the motor elongated in proportion of 2 meters of lead wire to the motor's voltage of 0.4 watts, whereby the noise is proportionally reduced while the inclusion of an LC circuit is avoided.

2. Device according to claim 1, said appliance provided with a base plate of a printed circuit of the electric circuit, said length of the input lead wires provided on a portion of said base plate.

3. Device according to claim 1, wherein said length is divided into two portions provided in the respective input lead wires.

4. Device according to claim 1, wherein said length of the input lead wires is provided on the outer surface of the housing of said motor in the meandering manner.

5. Device according to claim 1, said motor provided with a non-conductive base, said length of the input lead wires being provided on at least one side of said non-conductive base sheet in the meandering manner.

6. Device according to claim 5, wherein said base sheet is located on the outer surface of the housing of said motor.

7. Device according to claim 5, wherein said base sheet is located in the casing of said electric appliance.

8. Device according to claim 1, wherein the improvement comprises a shielding cover provided on said length of the input lead wires.

9. Device according to claim 1, said appliance having a printed circuit formed on an electrically non-conductive base sheet, wherein said length of the input lead wires is made in printed circuit.

10. Method for eliminating noise of an electric appliance such as a tape recorder caused by an electric motor incorporated in said electric appliance, comprising the step of forming a length of at least one of the input lead wires of said motor by a strip of an electrically conductive material having a length, determined in proportion of 2 meters of lead wire to 0.4 watts capacity of said motor so as to eliminate the electromagnetic noise generated by said motor.

11. Method according to claim 1, wherein the improvement comprises the step of dividing said length into two portions provided in the respective input lead wires.

12. Method according to claim 1, wherein the improvement comprises the step of forming said strip in a printed circuit in a thin electrically non-conductive sheet.

13. Method according to claim 12, wherein the improvement comprises the step of locating said thin electrically non-conductive sheet on the outer surface of the housing of said motor.

14. Method according to claim 13, wherein the improvement comprises the step of providing a shielding cover on said printed circuit.

15. Method according to claim 12, wherein the improvement comprises the step of locating said thin electrically non-conductive sheet in the casing of said electric appliance.

16. Method according to claim 1, said appliance including a base plate with a printed electric circuit, wherein the improvement comprises the step of forming said thin strip on said base plate.

17. Method according to claim 1, said appliance including a base plate, wherein the improvement comprises the step of forming said strip by evaporating electrically conductive material on said base plate.

18. Method according to claim 1, wherein the improvement comprises the step of forming said strip by bonding an electrically conductive wire to a base plate.