

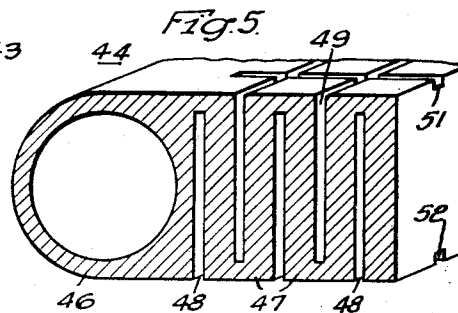
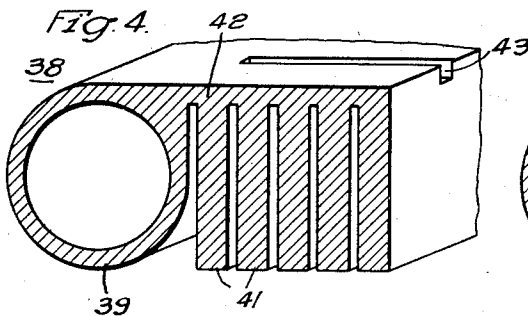
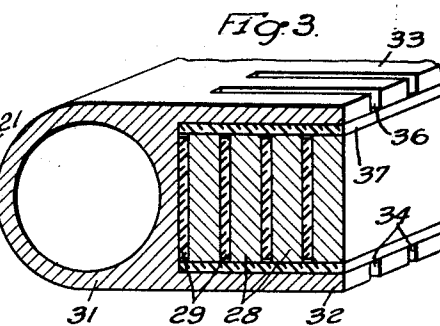
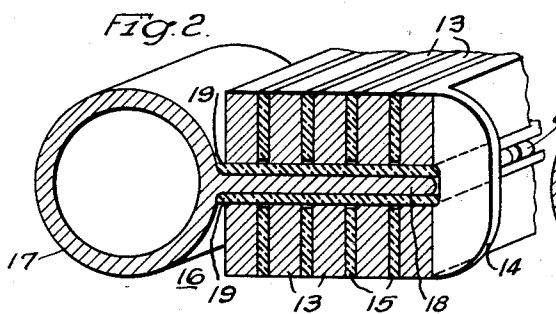
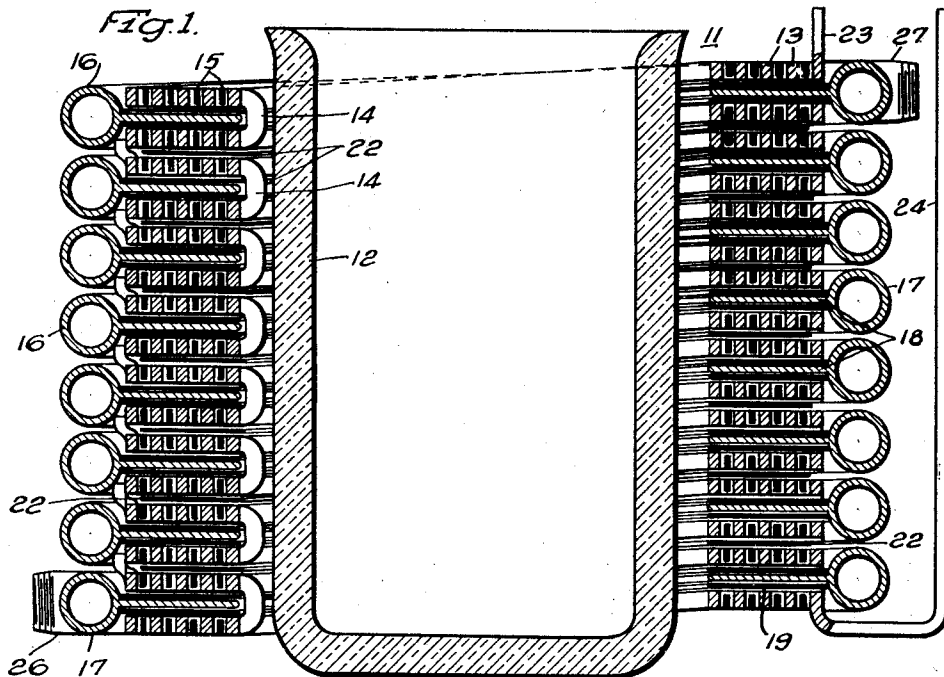
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INDUCTOR COIL

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INDUCTOR COIL

Application filed April 20, 1929. Serial No. 356,706.

My invention relates to inductive heating and particularly to inductor coils therefor.

An object of my invention is to provide a relatively compact and highly efficient inductor coil for inductive heating of various kinds of materials.

Another object of my invention is to provide a single highly efficient cooling means for a plurality of conductor portions which shall embody means for reducing inductive heating of such portions.

In practicing my invention, I provide an inductor coil comprising a plurality of turns of current-carrying portions of solid metal, electric-insulating material therebetween and a single cooling means therefor comprising a fluid-traversed conduit of metal having a fin portion extending laterally thereof and in operative engagement with a part of the peripheral surface of the conductor portions.

The fin portion is preferably laterally slotted in order to reduce the eddy-current loss therein.

Referring to the single sheet of drawings,

Figure 1 is a view, in vertical section, through an inductor coil embodying my invention, and a crucible surrounded by it.

Fig. 2 is a view, in sectional perspective, on an enlarged scale, of a portion of the inductor coil of Fig. 1.

Fig. 3 is a sectional perspective view of an inductor coil of modified form embodying my invention, and

Figs. 4 and 5 are sectional perspective views of still other modifications of inductor coils embodying my invention.

In Figs. 1 and 2 of the drawings, I have illustrated an inductor coil 11 as embodying a plurality of layers located in spaced relation around a crucible 12, each layer comprising a plurality of laterally-superposed individual turns of a solid conductor 13. The conductor 13 may be of any dimension and shape but I prefer to make it oblong in lateral section although, of course, it may be of square section.

Each layer comprises any suitable or desired number of turns, here shown as 5 in

number. In winding the perspective layers, it is obvious that it is necessary to begin with the inner turn, then to wind outwardly to form each layer after which two adjacent layers are connected at some suitable point, as by a bridging member 14, connected to the side of the inner turns in order that the fluxes generated by all of the turns of all of the layers may be added together. Any suitable or desired connector 14 may be employed to electrically connect adjacent turns of the adjacent layers, and any suitable and desired method of winding the coils may be employed.

The individual turns of each layer are separated by electric-insulating material 15 of any suitable or desired kind, and the adjacent pairs of layers of the inductor coil are spaced apart a proper distance to receive therebetween a portion of a cooling means 16. The cooling means 16 is made in two co-extensive parts, one of these being a tubular portion 17 and the other being a relatively thin fin 18, preferably integral with the conduit or tubular portion 17. The fin 18 is made relatively thin and of such width laterally of the member 16, as to be substantially co-extensive with the thickness or the radial extent of each of the layers of the inductor coil. Strips 19 of electric insulating material are located between the conductor portions 13 and the fin 18, as is clearly shown in Fig. 2 of the drawings.

It is apparent that eddy currents will be induced in the fin 18 of the metallic element 16 and I, therefore, provide means for reducing the eddy current losses caused therein by the alternating-current flux generated by the inductor coil, this means embodying a plurality of laterally extending slots 21 in the fins 18. Any desired number of slots 21 may be provided in the fins 18, whereby it is possible to greatly reduce the eddy current losses in that portion of the cooling means. I prefer to make the cooling means 16 of a metal that is non-corrosive and of relatively high electrical resistance such as an alloy of copper and nickel, usually known as Monel metal, or a ferrous alloy having a relatively high electrical re-

sistance and a relatively high resistance to corrosion.

It may be noted that the outside diameter of the tubular portion 17 may be made substantially the same as the space occupied by two adjacent layers, both of which are cooled by the single cooling means. I have found, that when the conduit portion 17 is traversed by a suitable cooling fluid, such as water, a highly efficient heat-withdrawing means is provided whereby heat is drawn from the fin 18 and, therefore, from the conductor portions 13.

A relatively thin annular or helical strip of electric-insulating material 22 is provided which may either be in one piece or in a plurality of pieces and is located between adjacent pairs of layers in the manner shown in Fig. 1 of the drawings.

Any suitable means (not shown) for anchoring the inductor-coil layers may be provided but as this forms no particular part of my invention, I have not deemed it necessary to illustrate and describe the same in detail.

I have illustrated, schematically only, terminals 23 and 24 for the current-traversed conductor portions and I have illustrated end portions 26 and 27 for the fluid-traversed cooling means, and, more particularly, for the conduit portion 17, in order to permit of connecting therewith a suitable source of supply of a cooling fluid, such as water.

Referring more particularly to Fig. 3 of the drawings, I have there illustrated one modification of a plurality of conductor portions cooperating with a single cooling means. Conductor portions 28 are separated by strips 29 of electric-insulating material and the conductor portions and the electric-insulating material portions are located within a cooling means embodying a conduit portion 31 and two co-extensive fins 32 and 33 extending laterally from the conduit portion 31 and integral therewith. Slots 34 and 36 are provided in the respective portions 32 and 33 to extend laterally from the portion 31 and are of substantially the same length as the thickness of the assembled members 28 and 29. Strips 37, of electric-insulating material are located between the fins 32 and 33 and the conductor portions 28. The conductor portions 28 may be electrically connected in parallel-circuit relation in order to provide a relatively large area of metal conductor to be traversed by an electric current of relatively low voltage.

Referring more particularly to Fig. 4 of the drawings, I have there illustrated a structure in which the current-conducting portions and the cooling means are substantially integral. A metallic element 38, of elongated form and of substantially rectangular shape in lateral section, embodies a conduit portion 39 and current-conducting portions 41

which are spaced from each other either by air or by a suitable electric-insulating material located in the slots between them. The slots extend from one edge of the initially solid portion of the member 38 to within a short distance of the other face in order to provide an integral portion 42 to connect all of the portions 41 to the cooling portion 39. A plurality of slots 43 extend laterally in the portion 42, the depth being just sufficient to meet the other slots separating the portions 41.

Referring more particularly to Fig. 5 of the drawings, I have there illustrated a composite element 44 comprising a cooling portion 46, of substantially tubular shape, and an initially solid metal portion 47 which is provided with a plurality of longitudinally-extending slots 48 extending from one face thereof and a plurality of intermediate spaced longitudinally-extending slots 49 extending from the other face. The general effect is that of a zig-zag conductor, the integral portions of which are separated either by air or by some other electrical insulating material, a small web portion only connecting the current-conducting portions to the cooling portion thereof.

Laterally-extending slots 51 and 52 are provided at spaced intervals in each face in order to reduce the eddy-current losses in the otherwise integral portions constituting the web portions hereinbefore mentioned.

It is obvious that the structure shown in Figs. 1 and 2 provides a plurality of turns of conductor per layer, while the structures shown in Figs. 3 to 5 inclusive, can be used only as a plurality of parallel-connected conductor portions or, in other words, each layer will comprise a single turn only and be therefore, better adapted to a low-voltage source of supply. However, it is obvious that changes may be made in the dimensions of the current-conducting portions and suitable and co-operating changes in the cooling means in order to adapt the structure to any suitable or desired dimensions of material to be heated, such as a crucible or a mass of metal, as well as to adapt it to a convenient source of supply of electric energy.

The device embodying my invention thus provides an inductor-coil structure in which a plurality of conductor portions, be they connected in series-circuit relation or in parallel-circuit relation, are cooled by a single highly efficient cooling means, which is of such shape as to provide a fluid-traversed portion and a solid portion in operative engagement with a part of the surface of the conductor portions, in order that a highly efficient withdrawal of the heat from the conductor portions may be effected. A part of the structure of the cooling means is further provided with means for reducing the eddy-current loss therein in order that the losses in

the inductor-coil structure may be kept at as low a value as is practicable.

Since various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, I desire that only such limitations shall be placed thereon as are imposed by the prior art or are set forth in the appended claims.

I claim as my invention:

1. An inductor coil comprising a plurality of adjacently-located current-transversed conductor portions of solid metal, electric-insulating material therebetween, a single cooling means for all of said conductor portions, said means embodying a strip portion of metal co-extensive with the conductor portion and in operative engagement with a part of the surface of each of said conductor portions, a conduit portion integral with the strip portion and electric-insulating material between the strip portion and the conductor portions and means embodied in the strip portion of the cooling means for reducing eddy-current losses therein.

2. An inductor coil comprising a plurality of adjacently-located current-traversed conductor portions of solid metal, electric-insulating material therebetween, a single cooling means for all of said conductor portions, said means embodying a strip portion of metal co-extensive with the conductor portion and in operative engagement with a part of the surface of each of said conductor portions and means embodied in the strip portion of the cooling means for reducing eddy-current losses therein.

In testimony whereof, I have hereunto subscribed my name this 17th day of April, 1929.

PORTER H. BRACE.