Feb. 3, 1948. H. E. SOMES 2,435,242

METHOD OF MAKING GEAR HEATING COILS

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Fig. 1.

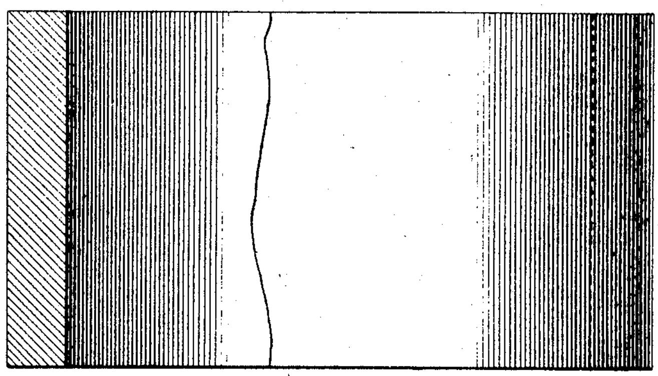

Fig. 2.

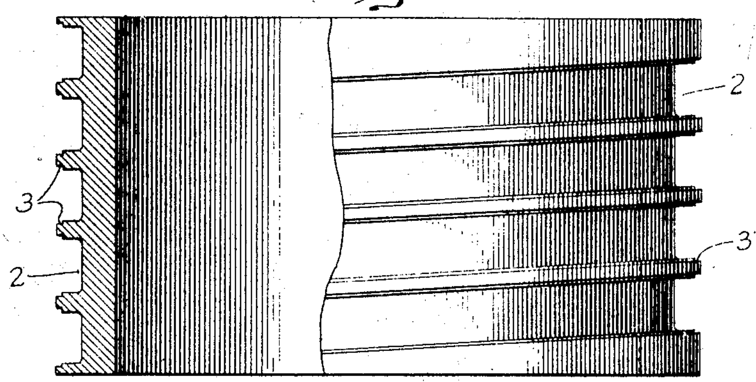

Fig. 3.

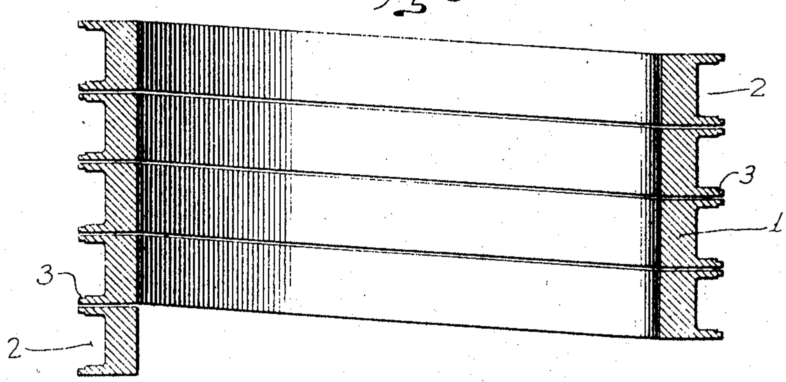

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Fig. 4.

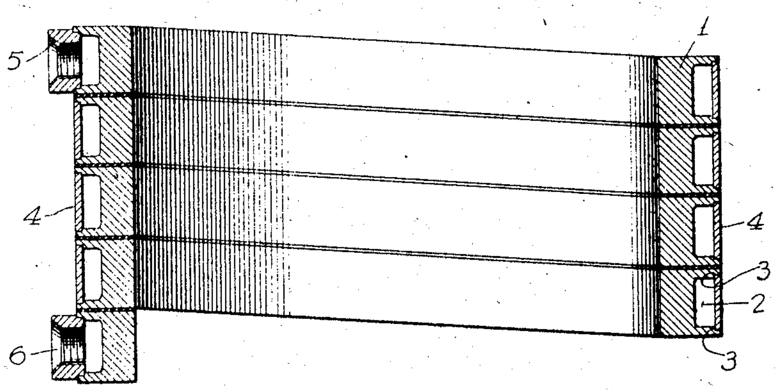

Fig. 5.

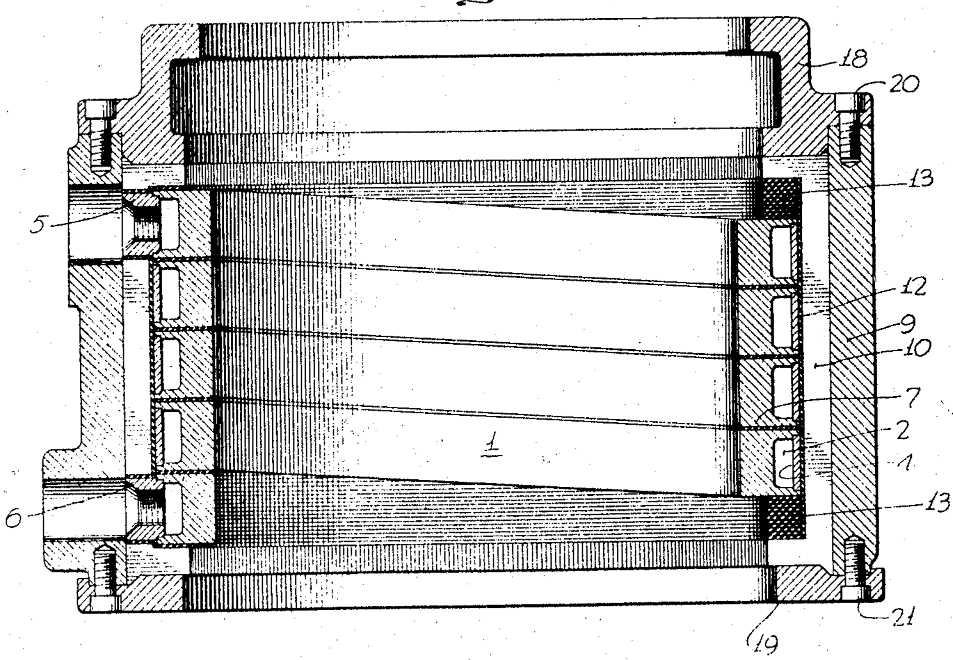

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Fig. 6.

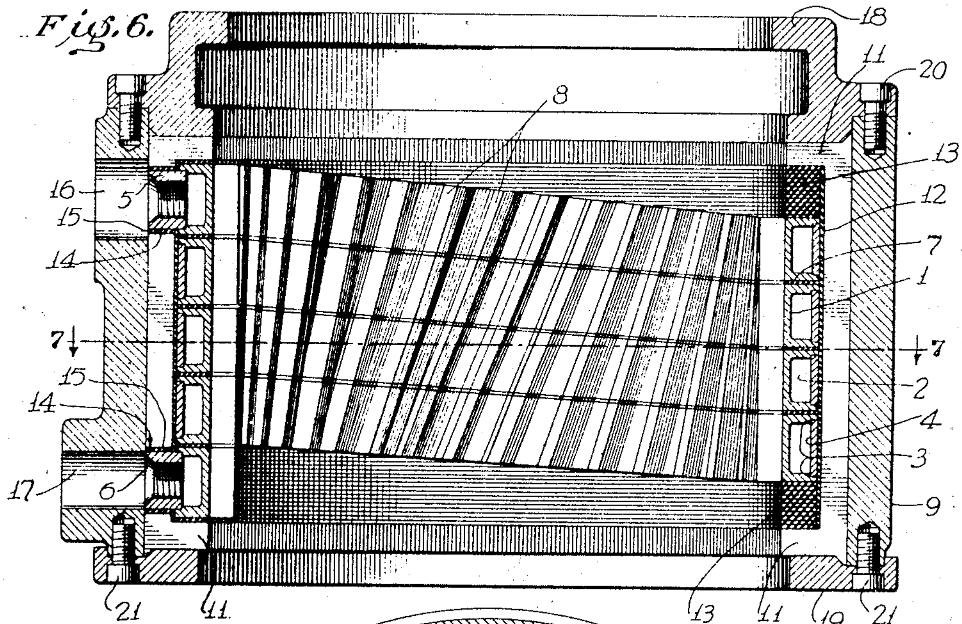
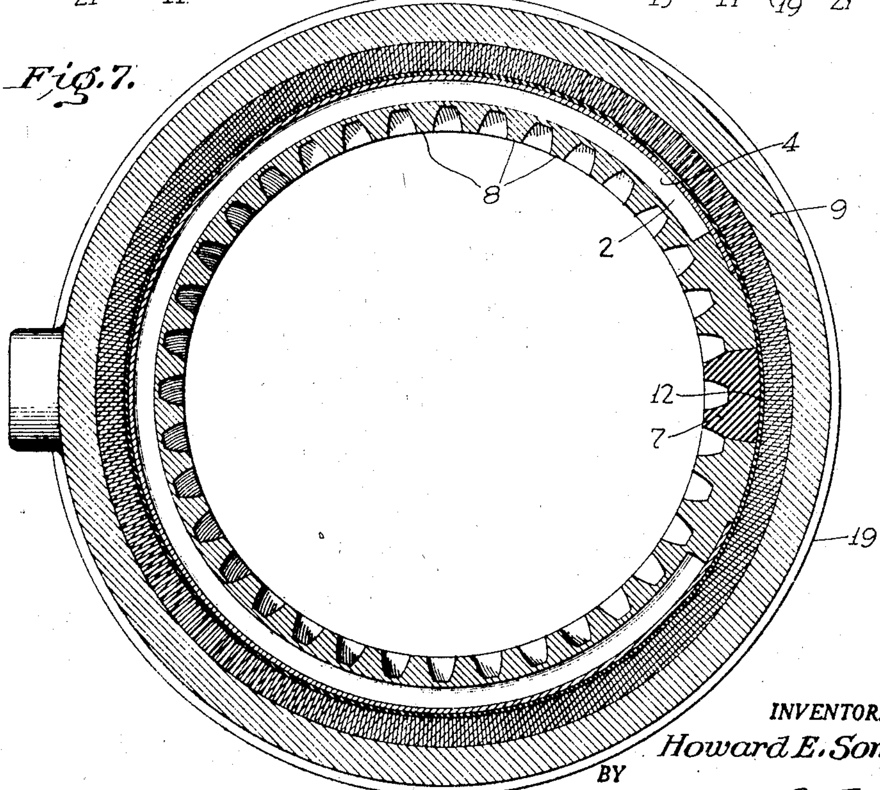


Fig. 7.



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING GEAR HEATING COILS

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6 Claims. (Cl. 29—155.56)

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This invention relates to the method of making an inducing coil, particularly a coil for use in the heat treating of gears and other toothed structures.

Heretofore, it has been one practice in the induction heat treatment of gears and toothed members to utilize a multiturn coil of uniform cross-section arranged in concentric relation with the gear or toothed member. In such practice, it is not possible to heat the teeth to a uniform depth.

One of the objects of the present invention is to provide a multi-turn inducing coil of improved construction wherein the coil is provided with toothed portions complemental to a toothed surface to be heat treated.

Another object is to provide a new and efficient method of forming an inducing coil with toothed portions.

A further object is to provide a method of producing a multi-turn coil from an annular blank of metal.

With the above and other objects in view which will be apparent from the following description to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and procedure to be hereinafter described with reference to the accompanying drawings, and then claimed.

In the drawings which illustrate a suitable embodiment of the invention;

Figure 1 is a side elevation of the blank, partially in section, from which the coil is formed;

Figure 2 is a view of the blank as it appears after the first forming operation;

Figure 3 is a similar view of the blank after it has been cut to spiral form;

Figure 4 is a view showing the spiral formation and the coil cooling passage closed in;

Figure 5 is a sectional view showing the spiral formation of Figure 4 positioned within the coil holder;

Figure 6 is a view similar to Figure 5 but showing the teeth formed in the coil; and

Figure 7 is a transverse section taken substantially on line 7—7 of Figure 6.

Referring to the accompanying drawings in which like numerals refer to like parts throughout the several views, and, first, to Figures 6 and 7 in particular, the inducing coil 1 is in the form of a spiral winding having its ends terminating at one side substantially in alignment with each other. The coil is formed with a continuous external channel 2, the sides of which are formed with shoulders 3 to receive a spiral closure strip 4

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which closes in the channel to provide a passage for the circulation of a cooling medium through the coil. At the ends, the channel 2 is provided with inlet and outlet connectors 5 and 6, respectively, brazed or otherwise secured thereto, which connections open into the channel or cooling medium passage. The closure strip ends are brazed to the connectors 5 and 6.

The turns of the coil are electrically insulated from each other by a strip 7 of suitable insulation material.

The particular coil shown for illustration is adapted for inducing heating currents in an external spiral gear (not shown) and to this end is provided with spiral teeth 8 complementary to the teeth of the gear to be heated thereby.

The support for the coil 1 includes an annular sleeve or casing 9 which surrounds an annulus 10 of taper ground laminations of suitable magnetic material, the annulus having an internal recess which in effect provides radially inwardly extending pole portions 11. The coil is disposed within this recess and is electrically insulated from the bottom of the recess by an insulating strip 12 and from the pole portions 11 by built-up insulation strips 13. The annulus of laminations is formed with apertures 14 through which the connectors 5 and 6 extend, the connectors being electrically insulated from the laminations by suitable insulation 15. The casing 9 is provided with openings 16 and 17 which we aligned with the connectors 5 and 6 for the reception of conduits (not shown), which in use are connected with the connectors 5 and 6 to conduct a cooling medium thereto and therefrom.

Suitable annular end plates 18 and 19 are secured by screws 20 and 21, respectively, to the end faces of the casing whereby to hold the annulus 10 of laminations and thereby the coil 1 firmly in position within the casing.

Since the teeth 8 are at least substantially complemental to the teeth of the gear to be heated and the teeth of one coil turn form continuations of those in the next adjacent turn or turns, it is obvious that the teeth in the adjacent turns should be formed in such manner as to be properly aligned with each other.

In the forming of the coil, a tubular blank (Figure 1) of suitable electrically conductive material is first selected and machined to proper thickness. This blank is first machined externally to provide the spiral channel 2 and the edge shoulders 3 (Figure 2).

In the next operation, the blank is machined to proper dimensions and spirally severed around the ridge between adjacent channels (Figure 3) to form the turns of the coil 1.

Following this operation, the connectors 5 and 6 are brazed or otherwise suitably secured to the coil at the channel ends and then the spiral strip 4 is brazed or otherwise suitably secured in place in seated engagement with the shoulders 3 to close the channel 2 and thereby form the cooling medium passage (Figure 4). Also at this time the insulation strip 7 is disposed between the coil turns.

The unit of Figure 4 and the laminated element 10 are then assembled together and disposed within the annular casing 9 (Figure 5), after which the annular end plates 18 and 19 are secured by the screws 20 and 21, respectively, to the casing 9 to securely clamp the coil assembly in position.

With the coil 1 thus securely clamped in position, the spiral teeth 8 are then cut by means of a suitable tooth forming operation in the inner face of the coil 1. Since the coil is securely clamped and the coil turns are rigidly held against relative movement, the teeth formed in each turn will be in accurate and proper alignment with each adjacent turn.

It will be seen from the foregoing that a method has been provided which is particularly advantageous in forming a multi-turn coil having teeth or projecting portions at one surface thereof.

While the coil itself is shown as provided with spiral teeth, the same may be provided with axial teeth for heating spur gears. The coil is of particularly advantageous construction inasmuch as through its complementary or substantially complementary contour, that is, complementary with respect to a toothed surface to be heated, it provides a means whereby a gear or the like may be inductively heated to a uniform depth not only throughout the tooth faces but also the tips of the teeth and the surfaces between the teeth as well.

The invention is equally as applicable to coils for heating internally toothed structures.

It is to be understood that various changes may be made in the construction and procedure described without departing from the spirit and substance of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. The method of forming a multi-turn inducing coil which consists in spirally severing an annular blank of electrically conductive material into multi-turn formation to form a cylindrical helix having inner and outer circumferential surfaces, rigidly holding the coil turns against relative movement, and then machining teeth in one circumferential face of the coil across a plurality of turns whereby the tooth elements of adjacent turns are in accurate alignment.

2. The method of forming a multi-turn inducing coil which consists in spirally severing an annular blank of electrically conductive material into multi-turn formation to form a cylindrical helix having inner and outer circumferential surfaces, disposing insulating material between the coil turns, rigidly mounting the coil

on a supporting member to hold the turns accurately in position, and then machining teeth in one circumferential face of the coil so mounted across a plurality of turns whereby the tooth elements of adjacent turns are in accurate alignment.

3. The method of forming a multi-turn inducing coil which consists in machining a spiral channel in one circumferential surface of an annular blank of electrically conductive material and spirally severing the blank between adjacent channel turns into multi-turn formation to form a cylindrical helix having inner and outer circumferential surfaces, and while securely holding the coil against relative movement between its turns forming teeth in the other circumferential surface thereof across a plurality of turns whereby the tooth elements of adjacent turns are in accurate alignment.

4. The method of forming a multi-turn inducing coil which consists in machining a spiral channel in one circumferential surface of an annular blank of electrically conductive material, closing in the open side of said channel, cutting the blank through its wall along a path between adjacent channel turns to form the blank to cylindrical helical coil formation, inserting insulating material between adjacent coil turns, securely mounting the coil on a support with the surface opposite the channeled surface exposed, and then forming spaced teeth in said opposite surface across a plurality of turns whereby the tooth elements of adjacent turns are in accurate alignment.

5. The method of forming an annular hollow multi-turn inducing coil which consists in machining a spiral channel in one circumferential surface of an annular blank of electrically conductive material, severing the wall of the blank between adjacent channel turns to provide a multi-turn coil formation, and then closing in the open side of the channel to provide a closed passage.

6. The method of providing a multi-turn inducing coil having spaced teeth in one circumferential surface thereof, which consists in forming an element of electrically conductive material into a multiturn cylindrical helix of annular shape, disposing insulation material between the coil turns, mounting the coil so insulated on a support having contact with one circumferential surface thereof and with the coil turns held against a relative axial movement, and then forming spaced teeth in the opposite circumferential surface of the coil across the several turns, whereby the tooth elements of adjacent turns are in accurate alignment.

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