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APPARATUS FOR MAKING CORES OF MAGNETIC MATERIAL FOR ELECTROMAGNETIC COILS

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FIG. 1

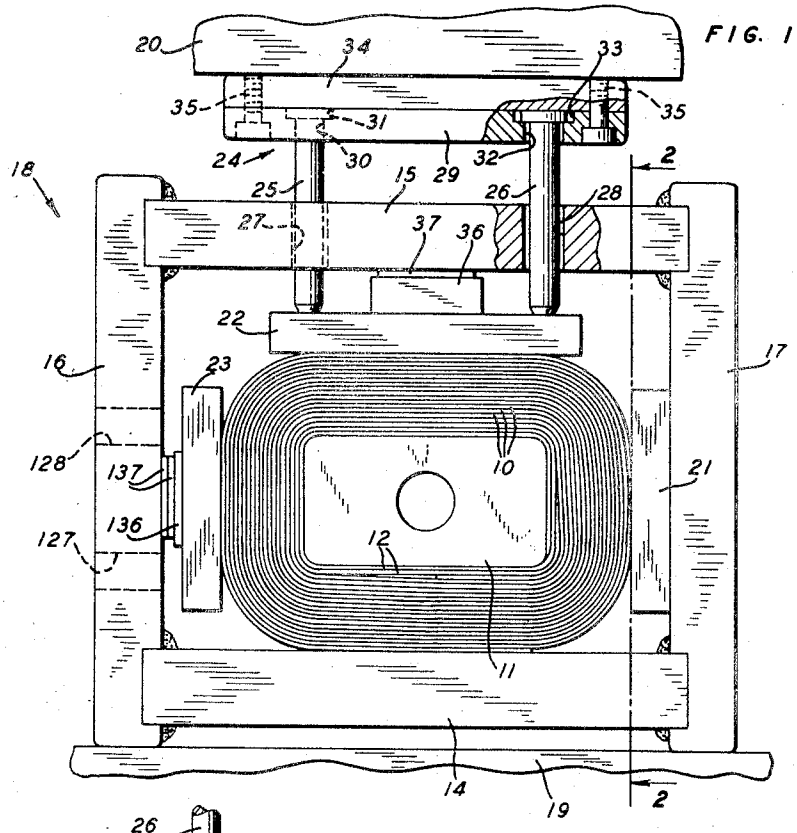


FIG. 2

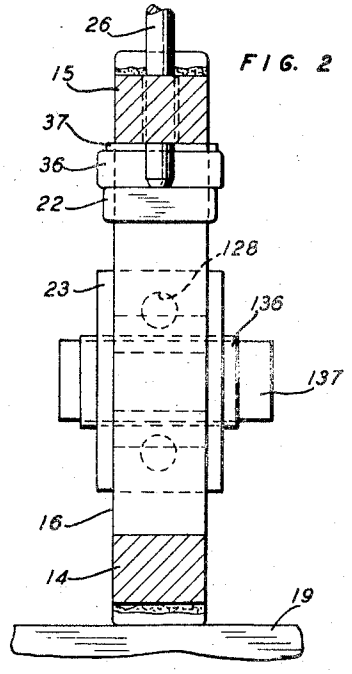
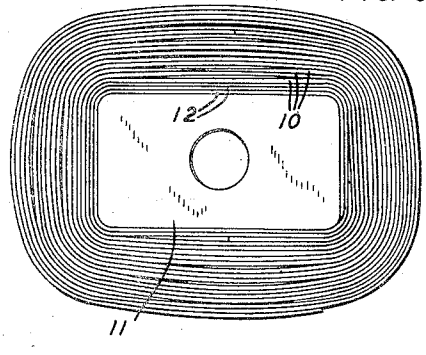


FIG. 3



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APPARATUS FOR MAKING CORES OF MAGNETIC MATERIAL FOR ELECTROMAGNETIC COILS

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1 Claim. (Cl. 266—5)

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This invention relates to an apparatus for making cores of magnetic material for electromagnetic coils and more particularly to an apparatus for making laminated coils of magnetic alloys whose high magnetic characteristics produced by heat treatment and annealing are damaged by even a slight measure of cold working after annealing.

A very useful type of magnetic core for electromagnetic coils is made by winding a flat strip or ribbon of suitable magnetic alloy flatwise on itself in successive coils about a suitably shaped arbor until the desired cross-sectional area is attained. Such a core then is an unbroken annulus or ring, which will be circular, square, oblong or have some other polygonal form according to the shape of the arbor used. The magnetic path of such a core is continuous around the core and is laminated transversely, both desirable characteristics. If the core is to be circular, elliptical, or otherwise without flattened straight portions, there may be but little difficulty in making it generally as described. However, if, as may frequently be the case, the core is to have the form of a square or oblong with rounded corners and straight sides it may be difficult to achieve satisfactorily straight sides and still retain or develop the magnetic characteristics of the material satisfactorily. This is particularly so when the ribbon from which the core is wound is made of one of the various high nickel alloys of iron generally called Permalloy. When such a ribbon is wound on a rectangular mandrel or former the successive turns will lie snugly on each other around the corners of the mandrel, but will tend, because of the elasticity of the material of the ribbon, to arch away from the mandrel along its straight faces.

An object of the present invention is to provide an apparatus for making wound ribbon cores of magnetic material in annular shape with straight portions in which the straight portions will consist of closely opposed individually straight portions of the ribbon having no inherent tendency to curve.

With the above and other objects in view the invention may be embodied in a device for use in making magnetic cores which comprises a frame having two parallel, spaced, rigid bars, one of the bars being formed with a pair of parallel spaced bores therethrough directed axially toward the other bar, in combination with a separate and removably applicable pressure tool having driving pins thereon to slide freely

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through the said bores of the one bar to squeeze a core positioned against the other bar.

The particular method of making magnetic cores hereinafter disclosed and described forms no part of the present invention being disclosed and claimed in copending application Serial No. 551,240, filed August 25, 1944, (Patent No. 2,416,989, granted March 4, 1947), by the same inventor as a division of the present application.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof taken in connection with the accompanying drawings in which the same reference numerals are applied to identical parts in the several figures and in which

Fig. 1 is a view in front elevation with parts broken away of a device constructed in accordance with the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Fig. 3 is a detached view of a mandrel and magnetic ribbon wound thereon before being compressed in the device of Fig. 1.

In making one form of laminar magnetic core in accordance with the invention, a flat ribbon 10 of suitable magnetic material, e. g. Permalloy, is wound, as shown in Fig. 3, flatwise in successive turns on a mandrel 11 of suitable heat resisting material, e. g. a ceramic such as porcelain or Lavite. In this instance the mandrel is a rectangular oblong with rounded corners and with straight sides between the rounded corners. A turn or two of paper tape 12 are wound on the mandrel and the metal ribbon 10 is wound over this. When the ribbon is wound on the mandrel, since the alloy of the ribbon has more or less elastic stiffness, the turns will spring in some such fashion as is indicated in Fig. 3, departing more and more as the winding continues from the desired flat sided form.

The core as wound and shown in Fig. 3 is then laid, in the position shown in Fig. 1, on the lower crossbar 14 of a rectangular, rigid, metal frame, generally indicated at 18, standing on the bed 19 of a press whose ram 20 is shown at the top of Fig. 1, but is not shown in Fig. 2. A pillow block 21 is inserted between one end of the coil (the right end in Fig. 1) and the adjacent upright member of the frame (upright 17 in Fig. 1). A pillow block 22 is laid on the upper side of the wound core. The pressure tool generally indicated at 24 is placed in position. This tool has two vertical parallel driving pins 25 and 26 which pass through corresponding bores 27 and 28 in the upper crossbar 15 of the frame 18, the

bores being materially larger than the pins. The pin 25 is held in a lower crosshead member 29 in a closefitting bore 30 counterbored at 31 to receive and retain the head of the pin. The pin 26 is loosely supported and retained in an oversized bore 32 having an oversized counterbore 33 for the head of the pin. An upper crosshead member 34 is secured on the lower crosshead member 29 by screws 35, 35. The flat heads of the pins 25 and 26 bear flatly against the member 34 and are held in place thereby, the pin 25 rigidly and the pin 26 with some freedom to shift laterally if the spacing of the bores 27 and 28 varies slightly from frame to frame. The ram 20 of the press is then brought down on the tool 24 and acts through the pillow block 22 to squeeze the upper and lower sides of the wound core flat as shown in Fig. 1. One or more suitable spacing blocks 36 and shims 37 are then inserted between the pillow block 22 and the crossbar 15. The ram 20 is raised and the tool 24 removed, the block 22 being retained in position to hold the sides of the core flat by the block or blocks 36 and shim or shims 37.

The frame 18 is then turned 90° clockwise to stand on the upright 17, now resting horizontally on the press bed 19. The tool 24 is replaced under the ram with its pins 25 and 26 passing respectively through corresponding bores 127 and 128 in the bar 16 of the frame and pressing against a pillow block 23 placed against what was the left end and is now the top end of the core. The ram 20 is then brought down as before and the ends of the core squeezed flat between the block 23 and the block 21. One or more spacing blocks 136 and shims 137, 137 are inserted between the block 23 and the frame bar 16. The ram is retired, and the tool 24 removed. The core is then held locked in the frame with its sides and ends flat as shown in Fig. 1.

The frame with the core thus locked in place and in proper shape within it is then heat treated as necessary to develop the desired magnetic characteristics of the metal of the core. For example, in the case of one kind of Permalloy ribbon, the treatment consists in heating to about 1975° F. for about an hour and then cooled slowly. One result of this is to develop

in the metal a very high magnetic permeability, another is to burn out and wholly remove the paper coils 12 between the mandrel 11 and the ribbon 10 thus making the mandrel easily removable from the finished core; and a third is to anneal all internal stresses in the ribbon so that the turns will remain flat and snug along the straight portions of the core. The burning away of the paper also releases the pressures on the spacing blocks and shims, so that ordinarily, when the assembly has cooled enough to handle, the finished core and the spacer blocks and shims can be taken out of the frame with the fingers.

What is claimed is:

A device for use in making magnetic cores which comprises a frame having two parallel, spaced, rigid bars, one of the bars being formed with a pair of parallel spaced bores therethrough directed axially toward the other bar, in combination with a separate and removably applicable pressure tool having driving pins thereon to slide freely through the said bores of the one bar to squeeze a core positioned against the other bar and a block to be placed between the said members and the core to transmit pressure therebetween, together with removable means to be placed between the block and the said bar having the holes therein to maintain pressure on the core when the tool is removed.

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