The invention relates to a coil core manufactured from soft-magnetic and permanent-magnetic materials in which the permanent magnetic material serves for bias magnetization of the soft-magnetic material.

A coil core is already known which consists of several layers of ferrite material in which the material of one of the layers has permanent magnetic properties so that there-with the remaining (soft-magnetic) part of the coil core can be biased. However, the manufacture of sintered cores built up from layers of different materials meets serious objections due to the different coefficients of thermal expansion of the said materials. Complicated shapes of the core cannot be manufactured or are difficult to manufacture according to this known method.

In the coil core according to the invention the abovementioned drawbacks are avoided. In fact, said core consists of a mixture of soft-magnetic and permanent-magnetic materials in powder form homogeneously distributed in a solid binder, preferably rubber or a synthetic material.

For the manufacture of the coil cores according to the invention soft-magnetic and permanent-magnetic materials in powder form are thoroughly mixed together with a binder and are then formed into a body by moulding, injection moulding or rolling, the binder being then hardened. In this manner it is possible to manufacture coil cores of a complicated shape in a simple manner.

The coil cores are preferably constructed as solid coil formers. According to another embodiment of the invention, the coil cores are constructed as bodies moulded or injection-moulded close around the coil winding.

As a result of the homogeneous mixing of the soft-magnetic and the permanent-magnetic materials, the soft-magnetic material can be better subjected to bias magnetisation than is the case in the known coil cores built up from layers of soft-magnetic and permanent-magnetic material.

When in manufacturing a coil core according to the invention a d.c. magnetic field is applied while the permanent magnetic particles can move freely to a certain extent with respect to one another so that the permanent-magnetic particles are directed parallel to said d.c. magnetic field with their easy axis of magnetisation, the particles of the permanent-magnetic material in the core after solidification of the binder are fixed in a magnetically oriented condition.

As soft-magnetic and permanent-magnetic materials are preferably chosen ferrites, for example, soft-magnetic manganese-zinc ferrite or nickel-zinc ferrite and permanent-magnetic bariumhexaferrite and/or strontiumhexaferrite respectively. Other soft-magnetic material may also be used, such as, carbonyl iron or iron powder. As permanent-magnetic materials are further to be considered the known permanent-magnetic steel alloys or manganese-bismuth alloys.

The quantity of soft-magnetic material in the coil cores according to the invention preferably is at least 50% by weight, in particular approximately 70-80% by weight, of the total quantity of ferromagnetic material present in the core. It has surprisingly been found that, in spite of the comparatively low content of permanent-magnetic material, it is yet possible to subject the soft-magnetic material sufficiently to bias magnetisation.

The weight ratio of the total quantity of ferromagnetic material and the quantity of binder preferably lies approximately between 4:1 and 9:1. In accordance with the quantity and the nature of the binder the resulting coil cores are more or less flexible.

It is to be noted that flexible bodies consisting of either only a soft-magnetic material or only a permanent-magnetic material with a binder are already known per se. Flexible bodies are also known already which are built up from a permanent-magnetic and a soft-magnetic layer each consisting of a magnetic powder with a binder. In this case, however, the soft magnetic layer (consisting of soft iron) only serves for the magnetic short-circuiting of the permanent-magnetic layer. Such a laminated body may serve only as a sticking magnet. On the contrary, the invention relates to a ferro-magnetic coil core having a high magnetic permeability and an operating point which, by bias magnetisation, is shifted to the point where the hysteresis loop has a bend which indicates that the magnetic saturation is reached there.

In order that the invention may readily be carried into effect, a few examples will now be described in greater detail with reference to the drawing, in which:

FIGURE 1 is a longitudinal cross-sectional view of a coil construction with coil core according to the invention.

FIGURE 2 is the side elevation of the coil construction shown in FIGURE 1.

FIGURE 3 is a longitudinal cross-sectional view of another coil construction with coil core according to the invention.

FIG. 4 is the plan view of the coil construction shown in FIGURE 3.

The coil construction shown in FIGURES 1 and 2 comprises a coil core 1 in the form of a coil former provided with flanges on which a coil winding 2 is provided the ends of which are connected to the eyelets 3 secured in the coil core 1. The coil core 1 consists of a homogeneous mixture of powdered soft-magnetic and permanent magnetic material, preferably ferrites, and a solid binder, for example, a thermoplastic or thermo-hardening resin. The powdered starting material has been given the shape of the coil core 1 as shown by moulding.

The permanent-magnetic material, for example, barium-hexaferrite, produces a bias magnetisation of the soft-magnetic material (which consists, for example, of manganese-zinc ferrite). This coil construction consequently may be used as a linearity control for television receivers and is distinguished from the known linearity controls by its simplicity, in fact it consists of only two parts, the coil core 1 and the winding 2. If required, to increase the adjusting range of the linearity control shown in FIGURE 1, another soft-magnetic core 4, preferably likewise consisting of manganese-zinc ferrite, is movably arranged in the cavity 5 of the coil core 1.

In the coil construction shown in FIGURES 3 and 4, an annular coil winding 6 is entirely surrounded by a coil core 7 which likewise consists of a homogeneous mixture of powdered soft-magnetic and permanent-magnetic materials with a solid binder. The starting mass consisting of the ferromagnetic materials and the binder was injection-moulded around the winding 6 after which the binder was hardened. The ends 8 of the winding 6 are secured to the connection members 9 projecting beyond the core body.

What is claimed is:

1. A coil core manufactured from soft-magnetic and permanent-magnetic materials in which the permanent-
magnetic material serves for bias magnetization of the soft-magnetic material, characterized in that the coil core consists of a mixture of soft-magnetic and permanent-magnetic materials in powder form homogeneously distributed in a solid plastic binder.

2. A coil core as claimed in claim 1, characterized in that the particles of the permanent-magnetic material present therein are magnetically oriented.

3. A coil core as claimed in claim 2, characterized in that the quantity of soft-magnetic material present therein is at least 50% by weight of the total quantity of ferromagnetic material in the core.

4. A coil core as claimed in claim 3, characterized in that the weight ratio of the total quantity of ferromagnetic material and the quantity of binder lies approximately between 4:1 and 9:1.

5. A coil core as claimed in claim 4, characterized in that said core is constructed as a solid coil former.

6. A coil core as claimed in claim 5, characterized in that the said core is constructed as a body moulded close around a coil winding.

7. A coil core as claimed in claim 6, characterized in that the soft-magnetic and permanent-magnetic materials are ferrites.

References Cited

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