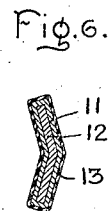
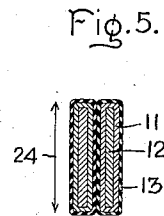
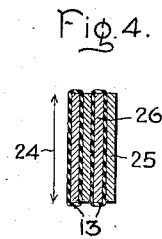
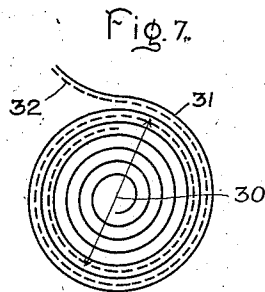
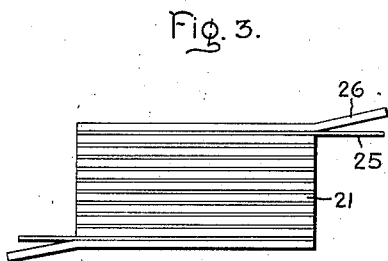
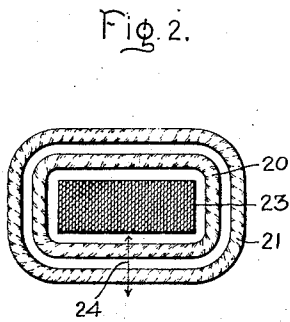
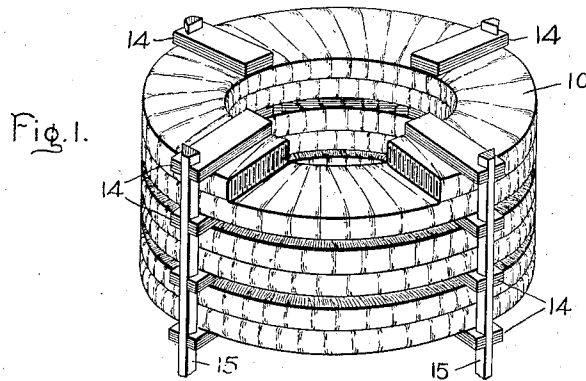


W. S. MOODY.
REINFORCEMENT FOR ELECTRICAL WINDINGS.
APPLICATION FILED FEB. 27, 1915.

1,331,077.

Patented Feb. 17, 1920.



Witnesses:
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UNITED STATES PATENT OFFICE.

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REINFORCEMENT FOR ELECTRICAL WINDINGS.

1,331,077.

Specification of Letters Patent.

Patented Feb. 17, 1920.

Application filed February 27, 1915. Serial No. 11,074.

To all whom it may concern:

Be it known that I, WALTER S. MOODY, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Reinforcements for Electrical Windings, of which the following is a specification.

My invention relates to windings for electrical apparatus particularly to those for transformers.

As is well known, currents flowing in adjacent conductors develop forces of attraction or repulsion between the conductors depending upon the relative directions of the currents. Where the conductors are assembled in coils of a considerable number of turns per coil, and the currents are of considerable value, these forces between coils reach high values. Particularly in large transformers, the forces are generally such as tend to shear the coils, and these are commonly necessarily so large and so arranged that they are not infrequently disrupted under heavy overloads and short-circuits even though supported in the best manner known prior to my invention.

In many large devices, other considerations, such as those of ventilation, require that the windings be supported against these large forces over only portions of the surfaces by supporting means engaging the windings at only a plurality of separated points. This obviously makes it especially difficult to suitably support the windings against disruptive forces of great values.

The object of my invention is to provide reinforcing means for such electrical windings. This reinforcement may be preferably either a strip of any suitably strong material as steel, laid in between successive turns, or a core of such material for the conductor of which the winding is composed. Preferably also the cross-section of the reinforcement is something like a rectangle and the reinforcement is so applied that the greater dimensions of the cross-sections are approximately parallel to the directions of the disrupting forces in order to secure the greatest strength in the desired direction for a given weight of material. The reinforcement may be applied throughout an entire coil or winding, or only to such parts of either as may be necessary in a given case.

In the accompanying drawings and the following description I have illustrated and described certain embodiments of my invention through which its general application will be understood. Figure 1 shows in perspective (partly in cross-section) a winding of a few disk coils in which my invention is embodied in its most preferred form. Figs. 2 and 3 illustrate in plan and elevation respectively another form of my invention embodied in a concentric coil winding. Figs. 4, 5 and 6, are enlarged details of certain embodiments of my invention in cross-section. Fig. 7 diagrammatically illustrates an embodiment of my invention in but a part of an entire coil.

The reinforcing means 12 is preferably applied as a core to the conductor 11 as illustrated in cross-section in Fig. 5, but it may be applied as a separate strip 25 closely interwound with the conductor 26 as shown in cross-section in Fig. 4. The usual insulation 13 is applied to the conductor. Either form may be used in either of the two common types of windings, the disk coil or the concentric coil types. Preferably the conductors and reinforcing strips are so laid that the forces tending to shear the coils are exerted in the directions of the arrows 24, Figs. 4, and 5, since in this way the strength of the materials is utilized to the best advantage as will be understood.

In Fig. 1 is illustrated a disk coil type of winding with my invention applied as a core for the conductor as in Fig. 5; I now believe my invention will find its greatest use in this arrangement. In this figure one of the coils 10 is opened to show the reinforcing means. The greater dimensions of the rectangular cross-sections of the conductor and reinforcing strip are in the general direction of the forces developed by the currents tending to shear the coils. The coils are separated in pairs by a common form of separator 14, the separators being connected by the usual rods 15. These separators being compressed between the pairs of coils, tend to transmit the stresses developed in any one coil to the outer coil of the winding and whatever coil supports (not shown) may be used.

In Figs. 2 and 3 is illustrated a winding of the common rectangular concentric coils 20 and 21 surrounding a core 23. Such coils are particularly weak near the centers of the

long sides. The reinforcing strip 25 is applied as in Fig. 4, as a separate strip closely interwound with the insulated conductor. As will be understood, the mutual forces of these two coils on each other are developed in the general directions of the arrows 24, that is, in the general direction of the greater dimensions of the cross-sections of the reinforcement.

Fig. 6 illustrates a modification of the winding of Fig. 5 wherein each conductor and reinforcement is bent into a V-shape so as to interlock with the immediately preceding and succeeding turns, thus rendering the coil stronger to the shearing stresses.

The reinforcement may be applied to the entire portion of each coil, or to only a part of each coil if such is sufficient. At times it occurs that the shearing stresses in a major portion of a coil substantially neutralize or balance each other, while the stresses in another part, as an annular portion at the outer edge of the coil, are entirely unneutralized. In such a case the application of the reinforcing means to but the part of the coil subject to the unneutralized stresses may be satisfactory. Fig. 7 represents diagrammatically a disk coil with the reinforcing means thus applied. This coil is adapted to be used between two other disk coils carrying currents instantaneously in the same directions, the diameter of one of which is substantially equal to the length of the line 30 and the diameter of the other being substantially equal to that of the coil illustrated. The portion of this coil of Fig. 7 which is within the diameter of the line 30 is subject to stresses which tend mutually to counteract each other; without this diameter the shearing stresses do not counteract each other. This portion of the coil is, therefore, provided with my improved reinforcing means. In this case the conductor 31 is interwound with a reinforcing strip 32 in a manner quite similar to that of Figs. 2, 3 and 4.

While I have described the principle of my invention and the best mode I have contemplated for applying this principle, other modifications will occur to those skilled in this art and I aim in the appended claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In an electrical apparatus the combination with a winding made up of a plurality of layers, and means engaging one or more

of said layers at a plurality of separated points for supporting said layer or layers against magnetic forces exerting lateral stresses on the conductor of said layers, of a strip of reinforcing material assembled with the conducting material of the turns of said layer or layers and extending in the directions of those turns.

2. In an electrical apparatus the combination with an electrical coil and means engaging said coil at a plurality of separated points for supporting said coil against magnetic forces exerting lateral stresses on the conductor of said coil, of reinforcing means extending in the direction of, and assembled with the conducting material of the turns of said coil, the dimensions of said reinforcing means in a direction approximately parallel to the directions of the lateral forces on said turns being greater than its dimensions in a direction perpendicular thereto.

3. In an electrical apparatus, the combination with an electrical coil and means engaging said coil at a plurality of separated points for supporting said coil against magnetic forces exerting lateral stresses on the conductor of said coil, of reinforcing means extending in the direction of, and assembled with the conducting material of the turns of said coil.

4. Electrical apparatus comprising a winding and means engaging said winding at a plurality of separated points for supporting said winding against magnetic forces exerting lateral stresses on the conductor of said winding, said winding comprising turns of a conductor provided with a core of reinforcing material.

5. Electrical apparatus comprising a winding and means engaging said winding at a plurality of separated points for supporting said winding against magnetic forces exerting lateral stresses on the conductor of said winding, said winding comprising turns of a conductor of a generally rectangular cross-section provided with a core of reinforcing material of a generally rectangular cross-section, the conductor being so arranged that the longer dimensions of the rectangular cross-section of the conductor and core are approximately parallel to said lateral stresses on the conductor.

In witness whereof, I have hereunto set my hand this 25th day of February, 1915.

WALTER S. MOODY.

Witnesses:

CHARLES R. BLAKELY,
WALTER C. SMITH.