June 11, 1968 F. RUEMPELEIN 3,388,329

COIL FOR MOVING-COIL INSTRUMENTS AND METHOD OF PRODUCING THE SAME

Filed March 26, 1965

Fig.1

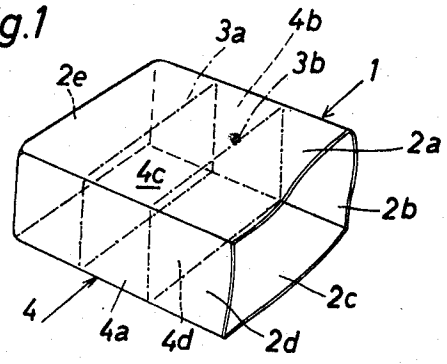


Fig.2

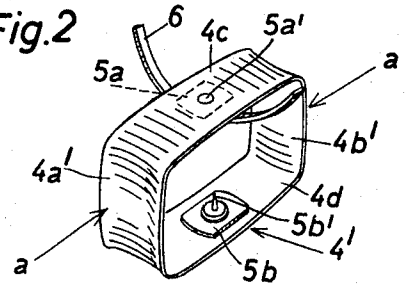
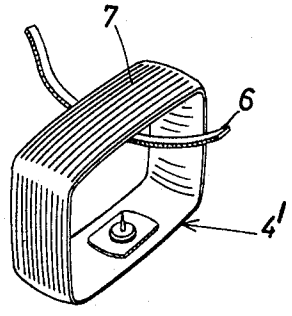


Fig.3



INVENTOR.
FRITZ RÜMPELEIN

BY

Michael J. Striker
Attorney

United States Patent Office 3,388,329 Patented June 11, 1968

3,388,329

COIL FOR MOVING-COIL INSTRUMENTS AND METHOD OF PRODUCING THE SAME

Fritz Ruempelein, Munich, Germany, assignor to Agfa Aktiengesellschaft, Leverkusen, Germany

Filed Mar. 26, 1965, Ser. No. 442,891
Claims priority, application Germany, Apr. 24, 1964, A 45,860
13 Claims. (Cl. 324—154)

ABSTRACT OF THE DISCLOSURE

The frame of the coil for moving-coil instruments is constituted by an annulus of sheet metal having a rectangular outline. The walls of one pair of opposed frame walls are concave on the outside so that they resemble troughs and prevent lateral shifting of convolutions which are wound around the frame. The frame is produced by deforming two opposed walls in a sleeve-like blank of rectangular outline.

The present invention relates to coils for electrical measuring instruments, and more particularly to improved supporting frames for the convolutions of coils which may be utilized in moving-coil instruments of exposure meters for photographic cameras or the like. The invention also relates to an improved method of producing the frames which are used in such coils.

In accordance with the presently prevailing practice, supporting frames for use in the coils of moving-coil instruments are produced by subdividing a hollow cylindrical body into ring-shaped blanks of desired length and by thereupon bending the marginal portions of each blank radially outwardly so as to form annular flanges. In a separate operation, the thus flanged blanks are deformed into frames of rectangular outline and are introduced into a winding machine which applies the convolutions of an insulated conductor whereby the convolutions are held against lateral displacement by circumferentially complete flanges at both axial ends of the frame.

A serious drawback of such methods is that the production of rectangular frames requires too many steps and must be carried out in complicated and costly machines. Furthermore, and since the ring-shaped blanks are flanged prior to transformation into frames of rectangular cross-sectional outline, the flanges develop jagged edges or serrations which are likely to damage the insulation on the conductor or to break the wire.

Accordingly, it is an important object of the present invention to provide a novel and improved method of mass-producing supporting frames for use in the coils of moving-coil instruments according to which a rectangular frame can be produced in a small number of operations but is nevertheless capable of preventing any shifting of convolutions just as reliably as any conventional frame of which I have knowledge at this time.

Another object of the invention is to provide a method of the just outlined characteristics according to which all such parts of the frame which serve to prevent lateral shifting of convolutions in a fully assembled coil are free of serrations, ragged edges and similar irregularities which might damage or destroy the windings.

A further object of the invention is to provide a method of producing metallic supporting frames for use in the coils of moving-coil instruments according to which the frame blank must undergo much less deformation than the blank of a frame which is produced in accordance with the presently prevailing practice but is still capable of properly retaining and locating the convolutions of a fully assembled coil.

An additional object of the invention is to provide a

novel rectangular supporting frame for use in the coil of an electrical moving-coil instrument.

Another object of the invention is to provide a frame of the just outlined characteristics which may be mass-produced in conventional machinery and which may be produced in any desired size to be useful in highly sensitive as well as in less sensitive electrical measuring instruments.

A concomitant object of the invention is to provide a coil which embodies a frame of the above outlined characteristics.

Still another object of the present invention is to provide a moving-coil exposure meter or another electrical measuring instrument which embodies a coil having an improved frame which is produced in accordance with my method.

Briefly stated, one feature of my invention resides in the provision of a method of producing a frame for the coil of a moving-coil instrument or a similar apparatus. The method comprises the steps of forming a tubular body of metallic stock and of rectangular cross-sectional outline whereby the axial length of the body exceeds the desired axial length of the frame, severing the body in one or more planes which are normal to the longitudinal extension thereof to form at least one sleeve-like frame blank having an axial length corresponding to the desired axial length of the frame and two pairs of opposed flat walls, and deforming one pair of such walls so that each thereof resembles a concavo-convex (U-shaped) trough with the concave side facing outwardly whereby the troughs define shallow longitudinally extending channels adapted to accommodate and to prevent lateral shifting of convolutions in an insulated conductor which is to be wound around the walls of the resulting frame.

The walls of the other pair may be connected with suitable bearing elements by means of which the coil is installed in a moving-coil instrument. Such bearing elements may comprise a pair of coaxial arbors whose bases are soldered or otherwise rigidly secured to the inner sides of the other pair of walls. The length of trough-shaped walls is preferably less than the length of the other pair of walls.

The frame can also support suitable terminals which may be used as conductors of electric current and/or as pointers, and such terminals may be soldered to the walls of the frame.

The tubular body which is to be severed to yield one or more frame blanks may be produced by upsetting, cold-forming, drop-forging or by resorting to any other suitable process.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved coil itself, however, both as to the method of producing its frame and the method of assembling the same, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a substantially cup-shaped tubular metallic body which is about to be subdivided to yield one or more rectangular frame blanks;

FIG. 2 is a perspective view of a finished frame; and

FIG. 3 is a perspective view of a partly finished coil which embodies the frame of FIG. 2.

Referring to the drawings, FIG. 1 illustrates a tubular body 1 consisting of metallic material and having a cross section which resembles the cross section of a finished supporting frame. This tubular body is formed by resorting to an extruding, drop forging, stamping or other suitable operation. The body 1 comprises four comparatively thin panels or side walls 2*a*, 2*b*, 2*c*, 2*d* and a bottom wall

2e. It is clear that the bottom wall 2e is not an essential component of the body 1 and, in the present instance, has been obtained in response to deformation of a billet by the ram of a press which has penetrated into the cavity of a suitably configurated mold. Thus, and depending on the exact nature of the operation which results in the formation of the tubular body 1, this body may be open at one or both ends.

In the next step, the body 1 is subdivided to yield one or more frame blanks 4 each of which comprises two pairs of flat opposed walls 4a, 4b and 4c, 4d. The length of the walls 4c, 4d exceeds the length of the walls 4a, 4b. The planes in which the tubular body 1 is subdivided are indicated by phantom lines 3a, 3b. The frame blank 4 is then inserted into a press which preferably deforms only the walls 4a, 4b in such a way that each of these walls resembles a substantially U-shaped concavo-convex trough 4a', 4b' (see FIG. 2) whose concave side faces outwardly whereby each of these troughs 4a', 4b' defines a longitudinally extending shallow channel which will accommodate the convolutions of an insulated conductor 7 shown in FIG. 3. The directions in which the walls 4a, 4b are deformed to be respectively converted into troughs 4a', 4b' are indicated by arrows a shown in FIG. 2.

Prior to convoluting the conductor around the walls 4c, 4d and troughs 4a', 4b', the inner sides of the walls 4c, 4d are connected with the bases 5a, 5b of two bearing elements here shown as needle-like arbors 5a', 5b' which extend into suitable hole jewels (not shown) of a moving-coil instrument in which the finished frame 4' is put to actual use. The arbors 5a', 5b' are coaxial with each other and their bases 5a, 5b may be soldered to the inner sides of the flat walls 4c, 4d.

One or more sheet metal strips 6 may be soldered to the walls of the frame 4' before the conductor 7 is convoluted therearound. Such strips 6 may be used as terminals for connection to electric leads and/or as pointers which cooperate with the scale of the moving-coil instrument.

The conductor 7 is convoluted in a suitable winding machine of familiar construction, and its convolutions are held against lateral movement because portions of each such convolution extend into the channels bounded by the concave outer sides of the troughs 4a', 4b'. When the walls 4a, 4b are transformed into troughs 4a', 4b', they undergo as little deformation as is permissible to still avoid lateral shifting of the convoluted conductor. At any rate, the deformation of the walls 4a, 4b is substantially less than the deformation of marginal portions in conventional supporting frames wherein such marginal portions must form circumferentially complete flanges at both axial ends of the frame. Also, and since the troughs 4a', 4b' are formed in the last step preceding winding of the conductor 7, their surfaces remain smooth and cannot damage or destroy the insulation of the conductor.

It was found that, by using a frame which was produced in accordance with my present invention, the number of rejects during winding of conductors 7 is negligible, i.e., the frame is unlikely to damage or to destroy the insulation around the conductor or the wire within the insulation. Furthermore, and because I start with a tubular body 1 of rectangular cross-sectional outline, the number of steps necessary to complete the production of a frame 4' is considerably less than the number of steps needed to produce a flanged frame of conventional design.

Of course, the tubular body 1 of FIG. 1 may be produced in such lengths that it yields two, three or a very large number of frame blanks 4. Also, in some instances, I may decide to deform only one of the walls 4a, 4b or to deform three or all four walls of the blank 4'.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An annular one-piece frame of substantially rectangular outline for use in the coil of a moving-coil instrument or the like, said frame consisting of metallic sheet material and comprising two pairs of opposed walls, the walls of one of said pairs being flat so as to facilitate attachment of other elements to said flat walls and the walls of the other pair resembling troughs of concavo-convex outline with the concave sides facing outwardly so that each such trough defines a shallow longitudinally extending channel adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around said walls.

2. An annular one-piece frame of substantially rectangular outline for use in the coil of a moving-coil instrument or the like, said frame consisting of metallic sheet material and comprising two pairs of opposed walls, the walls of one of said pairs being flat so as to facilitate attachment of other elements to said flat walls and the walls of the other pair resembling troughs of concavo-convex outline with the concave sides facing outwardly so that each such trough defines a shallow longitudinally extending channel adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around said walls, and bearing means secured to the inner sides of said one pair of walls.

3. A frame as set forth in claim 2, wherein said bearing means comprises a pair of coaxial arbors each having a base rigid with one wall of said one pair.

4. An annular one-piece frame of substantially rectangular outline for use in the coil of a moving-coil instrument or the like, said frame consisting of metallic sheet material and comprising two pairs of opposed walls, the walls of one of said pairs being flat so as to facilitate attachment of other elements to said flat walls and the walls of the other pair resembling troughs of concavo-convex outline with the concave sides facing outwardly so that each such trough defines a shallow longitudinally extending channel adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around said walls, and a pointer fixedly secured to one of said walls.

5. A frame as set forth in claim 4, wherein said pointer is rigid with one wall of said one pair of walls.

6. An annular one-piece frame of substantially rectangular outline for use in the coil of a moving-coil instrument or the like, said frame consisting of metallic sheet material and comprising two pairs of opposed walls, the walls of one of said pairs being flat so as to facilitate attachment of other elements to said flat walls and the walls of the other pair resembling troughs of U-shaped cross section having concave sides facing outwardly so that each such trough defines a shallow longitudinally extending channel adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around said walls.

7. A coil for moving-coil instruments or the like, comprising an annular one-piece frame of substantially rectangular outline and consisting of comparatively thin metallic sheet material, said frame including two pairs of opposed walls, the walls of one of said pairs being substantially flat so as to facilitate attachment of other elements to said flat walls and the walls of the other pair resembling troughs of U-shaped cross section having outwardly facing concave sides so that each such trough defines a shallow longitudinally extending channel; and a series of convolutions of an electrical conductor surrounding said walls and having portions accommodated in said channels whereby the walls of said other pair prevent lateral shifting of such convolutions.

8. A coil as set forth in claim 7, wherein the length of the walls of said one pair exceeds the length of said trough-shaped walls.

9. A method of producing a one-piece frame for use in the coil of a moving-coil instrument or the like, comprising the steps of forming a sleeve-like blank of rectangular outline having two pairs of opposed flat walls; and deforming only one pair of such flat walls into the shape of a concavo-convex trough with the concave side facing outwardly so that the walls of said one pair define shallow longitudinally extending channels adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around the resulting frame while the walls of the other pair of walls remain flat and therefore can be easily connected to other elements.

10. A method of producing a one-piece frame for use in the coil of a moving-coil instrument or the like, comprising the steps of forming a tubular body of rectangular cross-sectional outline whose axial length exceeds the desired axial length of the frame; severing said body in planes which are normal to the longitudinal extension thereof to form at least one sleeve-like frame blank of rectangular outline having two pairs of opposed flat walls and an axial length corresponding to the desired axial length of the frame; and deforming only one pair of such flat walls into the shape of a concavo-convex trough with the concave side facing outwardly so that the walls of said one pair define shallow longitudinally extending channels adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around the resulting frame while the walls of the other pair of walls remain flat and therefore can be easily connected to other elements.

11. A method of producing a one-piece supporting frame for use in the coil of a moving-coil instrument or the like, comprising the steps of forming a tubular metallic body of rectangular cross-sectional outline whose axial length exceeds the desired axial length of a frame; severing said body in a plurality of parallel planes to subdivide the same into a plurality of frame blanks whose axial length corresponds to the axial length of a finished frame and each of which comprises two pairs of opposed flat walls; and deforming only one pair of walls on each of said blanks into the shape of U-shaped troughs having outwardly facing concave sides so that each trough defines a shallow longitudinally extending channel bounded by smooth surfaces adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around the walls of the resulting frame to form therewith a finished coil while the walls of the other pair of walls remain flat and therefore can be easily connected to other elements.

12. A method of producing a one-piece supporting frame for use in the coil of a moving-coil instrument or the like, comprising the steps of forming a sleeve-like frame blank of rectangular outline having two pairs of opposed flat walls; deforming only one pair of said walls into the shape of a concavo-convex trough with the concave side facing outwardly so that such troughs define shallow longitudinally extending channels adapted to accommodate and to prevent lateral shifting of convolutions in a conductor which is to be wound around said walls to form therewith a coil while the walls of the other pair of walls remain flat; and attaching a bearing element to the inner side of each of said flat walls of said other pair of walls.

13. A method as set forth in claim 12, wherein said bearing elements are soldered to the respective flat walls.

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LARAMIE E. ASKIN, *Primary Examiner.*

T. J. KOZMA, *Assistant Examiner.*