Aug. 1, 1939. M. E. McGOWAN 2,167,765

FILAMENT AND METHOD OF MAKING

Filed Dec. 4, 1936

Fig. 1.

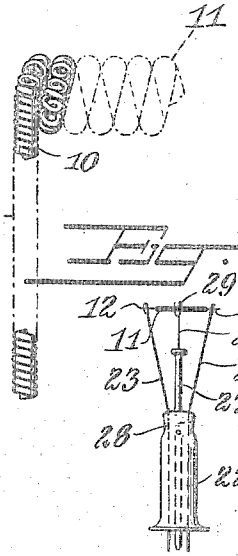


Fig. 2.

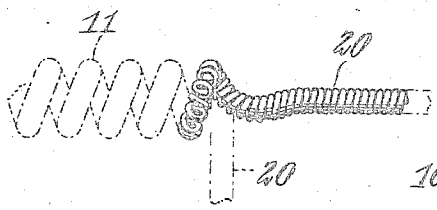


Fig. 3.

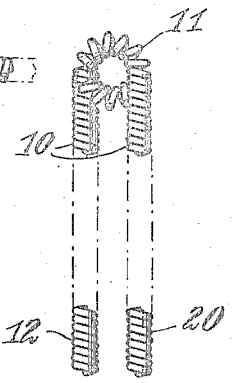


Fig. 9.

Fig. 8.

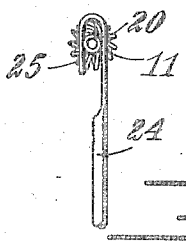
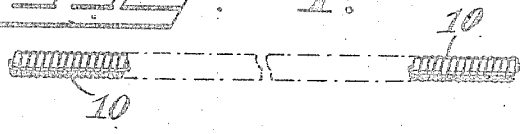


Fig. 7.

Fig. 4.



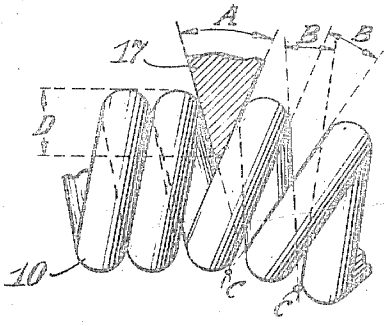
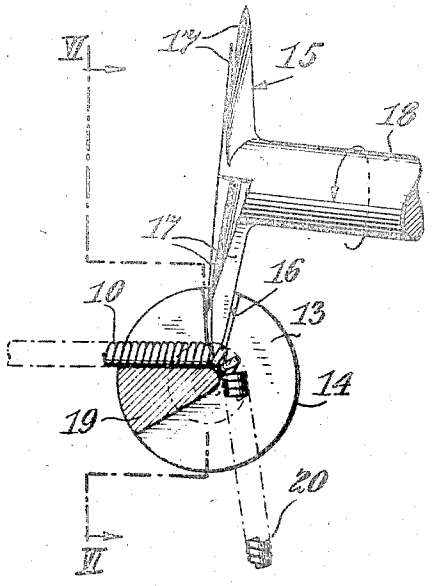
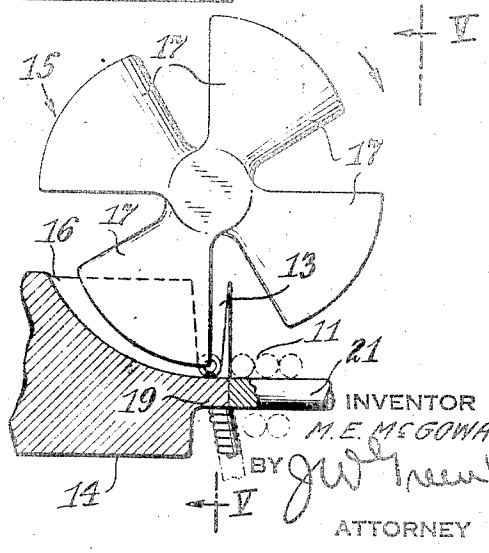


Fig. 5.

Fig. 6.





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2,167,765

UNITED STATES PATENT OFFICE

2,167,765

FILAMENT AND METHOD OF MAKING

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Application December 4, 1936, Serial No. 114,138

17 Claims. (Cl. 176—40)

This invention relates to concentrated filaments as light sources for incandescent electric lamps and a method of making.

In the Ekstedt Patent No. 1,670,499, dated May 22, 1928, and owned by the assignee of the present application, a machine is disclosed for making primary helically-wound coil filaments by means of a cavity diamond die without the employment of mandrels. In the Ekstedt Patent No. 1,703,995, dated March 5, 1929, and owned by the assignee of the present application, another wire coiling machine, for making concentrated filaments by means of a cavity die, is disclosed. Reference is also made to the Wadesten Patent No. 1,933,355, dated October 31, 1933, and owned by the assignee of the present application, which discloses a method of making such mandrelless coils employing a die formed of fusible material, such as glass, rather than a diamond as employed in practicing the inventions of the first two mentioned patents.

In the Beebe Patent No. 2,013,432, dated September 3, 1935, and owned by the assignee of the present application, a method is disclosed and claimed by which a primary helically wound coil, such as might be constructed in accordance with any one of the three patents first mentioned, is formed into a secondary coil by means operating to successively separate the turns of the primary coil to produce a continuous coiled-coil. In accordance with this patent, the primary coil may be operated on while rotating as it comes from the cavity die, or the helical primary coil may be fed from a source of supply as from a spool, in which event it would not be rotating and it would therefore only be necessary to actuate the secondary coil-forming blades in a definite time relation to the rectilinear path of movement of the primary coil.

In the Wadsten Patent No. 2,056,028, dated September 29, 1936, and owned by the assignee of the present application, there is disclosed a machine for making coiled-coils, which is adapted particularly for practicing the method described and claimed in the Beebe patent just referred to. In the Beebe application Serial No. 91,315, filed July 18, 1936, another machine for winding coiled-coils is disclosed, said machine in this case being particularly adapted to operate on filamentary material, in helical form, which is fed thereto from a source of supply such as a spool, whereby said material has a rectilinear movement only, as suggested in the Beebe Patent No. 2,013,432.

In all of the cases mentioned the helically formed filamentary material has its elements spaced from one another. On account of the cavity die method of formation and inherent characteristics of the filament wire, there are apt to be variations in the turns per inch and also, because of the space between adjacent turns, the coils are apt to become tangled with one another.

It is therefore an object of the present invention to manufacture coiled-coil filaments by making the primary coil filament tight wound; that is, each convolution in contact with the next one, and in winding said wound filament into a secondary coil, while simultaneously stretching the primary coil to produce the desired pitch or distance between successive turns, said secondary coil being preferably initially tight wound and subsequently stretched to produce the desired distance between turns.

Another object of my invention is the provision of a tight wound primary coil suitable for being rewound into a secondary coil.

A further object of my invention is to improve the manufacture of concentrated filaments for incandescent electric lamps by initially winding such filaments into tight helices, simultaneously winding said helices and stretching them to produce a tight wound secondary coil with tight wound straight terminals extending approximately tangent to the secondary turns, and subsequently bending said terminals to substantially axial position with respect to said secondary, while simultaneously stretching the secondary to produce the desired distance between adjacent turns.

Other objects and advantages of the invention, relating to the particular arrangement and construction of the various parts, will become apparent as the description proceeds.

Referring to the drawing illustrating my invention:

Fig. 1 is a greatly enlarged fragmentary view of an end portion of a coiled coil filament constructed in accordance with my invention.

Fig. 2 is a similar fragmentary view of the other end portion of the coiled coil filament of Fig. 1, when its terminal has been moved into a substantially axial position with respect to the secondary coil, and said secondary coil stretched to produce the desired distance between successive turns.

Fig. 3 is an end view of the coiled coil filament of Fig. 1.

Fig. 4 is an elevational view of a tight or close wound primary coil such as would be used in making the finished filament shown fragmentarily in Fig. 2.

Fig. 5 illustrates fragmentarily a machine for

manufacturing coiled coil filaments such as illustrated in Figs. 1 and 3, said view being taken on the line V—V of Fig. 6, looking in the direction of the arrows.

Fig. 6 is a view of the same machine, on the line VI—VI of Fig. 5, looking in the direction of the arrows.

Fig. 7 is a very greatly enlarged fragmentary view illustrating a portion of a primary coil, after certain turns have been stretched or spread to form a secondary coil, the tool effecting that operation being fragmentarily illustrated in position.

Fig. 8 is a fragmentary end view of the filament, illustrated in Fig. 2, and a connected leading-in conductor.

Fig. 9 is an approximately full size elevational view of a mount including a coiled coil filament constructed in accordance with my invention.

In practicing my invention I propose first to manufacture a tight wound primary helically coiled filament **10** such as illustrated in Fig. 4. Said filament may be made in a known manner by winding on a mandrel and subsequently eliminating the mandrel, or in accordance with the disclosure of any one of the Patents Nos. 1,670,499; 1,703,995; and 1,933,355, previously referred to.

Said primary coil filament is then formed, as by the means illustrated in Figs. 5 and 6, into a secondary coil **11** having straight tight wound primary coil ends **12** and **20** as illustrated in Figs. 1 and 3. Methods and machines for winding secondary coils from primary coils have been referred to in Patents Nos. 2,013,432, 2,056,028, and application Serial No. 91,315, all previously referred to, but for the purpose of making the present disclosure complete without the necessity for referring to previous work, I will now describe briefly one method of making the coiled coil filament in accordance with my invention.

The primary tight coil **10** is fed through a transverse notch **13** in a supporting arbor **14** beneath an impeller or separator **15**. The arbor also has a longitudinally extending approximately radial notch **16** providing clearance for the blades **17** of the impeller **15**, all as most clearly shown in Figs. 5, 6, and 7. The impeller **15** is mounted at one end of a shaft **18** and provided with a plurality of, in this case four, propeller-like or screw type blades **17** which, when the impeller is rotated, pass between successive turns of the coil **10** and spread them. This spreading is gradual, because of the spiral or gradually expanding shape of the sharp peripheral edge of each blade **17**, and causes the coil section to turn or be coiled into a secondary coil.

Inasmuch as the primary coil **10** is tight wound; that is, the spacing between successive turns is zero, the impeller **15** has a definite and accurate primary coil to deal with. It is not desired, however, that the primary coil, after being wound into a secondary, should have its turns contact with one another, as this would involve a short circuiting between turns. It is therefore necessary that the angle A of the impeller blade be large enough, and extend such a distance D between the turns of the primary coil, that the resultant angle B between adjacent turns, after passing beneath the impeller, has its vertex C outside of the outer surface of the primary coil. This, of course, means that there will be no touching between any portion of a primary turn and adjacent primary turn, after said turns have been spread to produce the secondary coil.

The impeller **15** rotates in the groove or notch **16** at one end of the arbor **14**, which arbor is supported in any desired manner. At the free end of the arbor, and adjacent to the groove **16**, is a cradle **19** in which the coil **10** rests during the secondary coil winding operation. The upper surface of the cradle **19** is defined by the groove or notch **13** which provides for the reception of the coil **10**. When the coil section is moved into position to be again coiled, it rests in the cradle and one end thereof may engage a stop (not shown) so as to initially bring the impeller over the section at a point a given number of turns from the end, thus leaving a portion **20** which is straight to be used to clamp the coiled coil to the lead wire of a lamp.

As shown most clearly in Fig. 5, the impeller **15** is positioned so that as each blade moves across the primary coil and between the turns thereof, its movement is in a plane substantially corresponding with the plane of separation between adjacent turns which the impeller blade passes therebetween. Each blade has a sharp or knife-like edge serving as a wedge to spread the turns, preferably forming a tight wound secondary coil, or one in which the secondary turns initially contact with one another.

As the secondary coil **11** begins to form, the one straight end coil **20** must move about the axis of the secondary coil **11**, and it is necessary to remove this straight end from the cradle **19** which may be done in any desired manner as by means of a guide blade (not shown). The straight end **20** is desirably guided from the cradle so that it rotates about the axis of the secondary coil as the latter is formed.

As the secondary coil issues from the cradle, it is desirably supported by a removable mandrel **21**. When the coil is complete, a straight section, as for example **12**, is left in the cradle to provide the other terminal for attachment to a lead wire. This straight end **12** may be removed from the cradle in any desired manner, as by means of an arm or sleeve (not shown) rotating about the arbor **14**, such as disclosed in the Beebe application Serial No. 91,315 referred to.

When the straight end **12** is lifted from the cradle **19** the mandrel **21** may be withdrawn, allowing the completed coil to drop into a chute (not shown) by which it may be guided into a receptacle (not shown).

The aforedescribed operation produces a coiled coil filament with straight, tight, or close wound end portions, and a tight or close wound secondary, as shown in Fig. 1, the ends, however, extending approximately tangentially to the circumference of the secondary coil and being approximately parallel with one another.

In order to produce the finished coil of Fig. 2, the straight tight wound ends **12** and **20** are moved from their parallel relationship in accordance with Figs. 1 and 3, to approximately coaxial relationship, as represented in Fig. 2, while at the same time secondary coil **11** is stretched so as to provide the desired distance between adjacent turns.

The coil, as shown in Fig. 2, is then incorporated in a mount **22**, desirably constructed as illustrated in Fig. 9, in which the straight, tight wound ends **12** and **20** are clamped between the ends of lead wires **23** and **24**, as shown in detail in Fig. 8. Each lead wire desirably has its end bent upon itself, as indicated at **25**, and embrac-

ing the adjacent filament end 12 or 20, as the case may be, to hold it tightly in position. The central portion of the filament may be held in position by means of a support 26, fastened to the top of the arbor 27 extending from the press 28, and encircling the coiled coil portion 11, as indicated at 29.

From the foregoing disclosure, it will be seen that I have improved on the method of making a coiled coil filament by making the primary coil filament tight wound, initially making the secondary coil tight wound, and finally stretching said secondary coil, while aligning the tight wound primary coil terminals, to provide the desired distance between adjacent secondary turns, but not stretching sufficiently to separate the primary turns of the substantially straight terminal portions.

Advantages of the invention will be apparent when it is considered that there can be no possible variation in the turns per inch when using a tight wound coil so that the impeller has a definite and accurate primary coil to deal with. A second and important advantage in having the primary coil tight wound is that when the secondary coil has been completed, the terminals, which are primary tight wound coils, act as relatively large hollow generally cylindrical conducting members and assure a more accurate secondary coil length and also a definite terminal length, which makes for a better lamp performance. A third advantage is that tight wound primary coils will have no tendency to become tangled with one another.

Although a preferred embodiment of my invention has been illustrated and described, it will be understood that modifications may be made within the spirit and scope of the appended claims.

I claim:

1. A filament for an incandescent electric lamp comprising merely a coiled-coil intermediate portion, with straight, generally parallel contact tight wound coil end portions.

2. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion with straight, generally parallel contact tight-wound coil end portions extending tangentially from the coiled portions with which they unite.

3. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion, the secondary of which is tight-wound, and straight generally parallel coil end portions extending tangentially from the coiled portions with which they unite.

4. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion with straight, generally parallel coil end portions extending therefrom, said end portions being tight-wound and each secondary turn of the intermediate portion having the primary turns thereof separated from one another.

5. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion, the secondary turns of which are tight wound, with straight generally parallel tight-wound coil end portions extending therefrom, each secondary turn of the intermediate portion having the primary turns thereof separated from one another.

6. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion with straight, generally parallel coil end portions extending therefrom, said intermediate portion having the secondary turns thereof stretched to provide uniform spacing therebetween, and the end portions bent to approximately align with one another.

7. A filament for an incandescent electric lamp comprising a coiled-coil intermediate portion with generally straight, tight-wound coil end portions extending substantially axially therefrom, the secondary turns of said filament being separated from one another and the primary turns between the straight end portions being separated from one another.

8. The method of making a concentrated light source for incandescent electric lamps comprising the step of winding a filament into a primary coil with an air core and no space between the turns thereof.

9. The method of making a concentrated light source for incandescent electric lamps comprising winding a filament into a primary coil with no space between the turns thereof, and forming a portion of said primary coil into a tight wound secondary coil.

10. The method of making a concentrated light source for incandescent electric lamps, comprising winding a filament into a primary coil with no space between the turns thereof, and winding said primary coil into a secondary coil, while stretching to space the primary turns of each secondary turn from one another.

11. The method of making a concentrated light source for incandescent electric lamps, comprising winding a filament into a primary coil with no space between the turns thereof, and winding an intermediate portion only of said primary coil into a secondary coil, while stretching to space the primary turns of each secondary turn from one another, leaving generally straight tight-wound end portions extending generally parallel to one another.

12. The method of making a concentrated light source for incandescent electric lamps comprising winding a filament into a tight-wound primary coil, coiling an intermediate portion only of said primary coil to produce a tight-wound secondary coil with end portions extending tangentially thereto and generally parallel with one another, and bending said end portions to approximately align with one another, while at the same time stretching said secondary coil to space the turns thereof.

13. The method of making a concentrated light source for incandescent electric lamps comprising winding a filament into a tight-wound primary coil, coiling an intermediate portion only of said primary coil to produce a tight-wound secondary coil with end portions extending tangentially thereto and generally parallel with one another, while stretching to space the primary turns of said intermediate portion only from one another, and bending said end portions to approximately align with one another, while at the same time stretching said secondary coil to space the turns thereof.

14. The method of making a concentrated light source for incandescent electric lamps comprising forming a filament into a tight-wound primary coil, winding said primary coil to produce a tight-wound secondary coil, while stretching to space the primary turns, and subsequently stretching said secondary coil to space the turns thereof.

15. The method of making a concentrated light source for incandescent electric lamps comprising winding a filament into a contact tight wound primary coil, coiling an intermediate portion only of said coil to produce a secondary coil,

with end portions extending generally parallel to one another, and bending said end portions to extend approximately axial of said secondary coil, while at the same time stretching said secondary coil to provide the desired spacing between the turns thereof.

16. The method of making a concentrated light source for incandescent electric lamps comprising winding a filament into a contact tight wound primary coil, coiling an intermediate portion only of said coil to produce a secondary coil, with end portions extending tangentially thereto, while stretching to space the primary turns of said intermediate portion only from one another, and bending said end portions so that they lie approximately axial of said secondary coil, while at the same time stretching said secondary coil to provide the desired spacing between the turns thereof.

17. A filament for an incandescent electric lamp comprising a coiled coil intermediate portion, the secondary turns of which are spaced a desired distance, with straight tight-wound coil end portions extending substantially axial thereof, each secondary turn of the intermediate portion having the primary turns thereof separated from one another.

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