

June 22, 1948.

S. C. MILLER  
BRAID SHIELDING  
Filed April 16, 1946

2,443,632

FIG. 1.

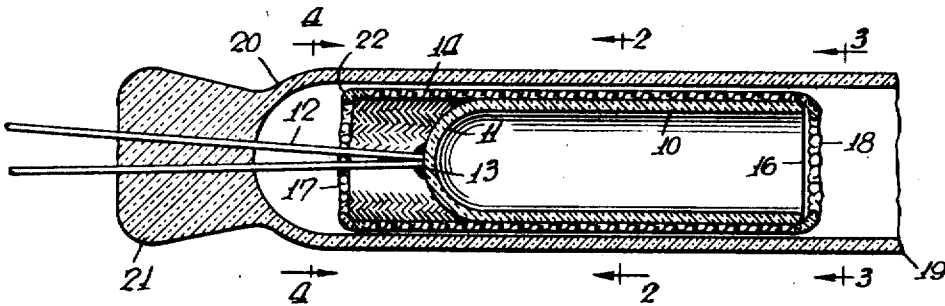


FIG. 3.

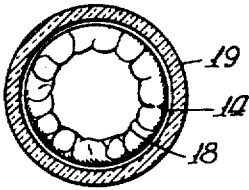


FIG. 2.

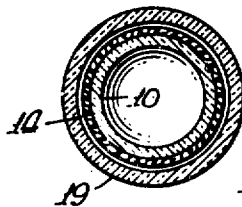


FIG. 5.

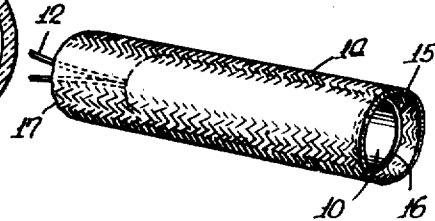


FIG. 4.

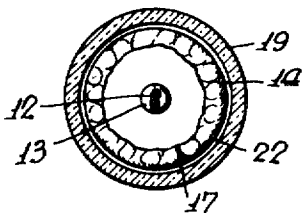
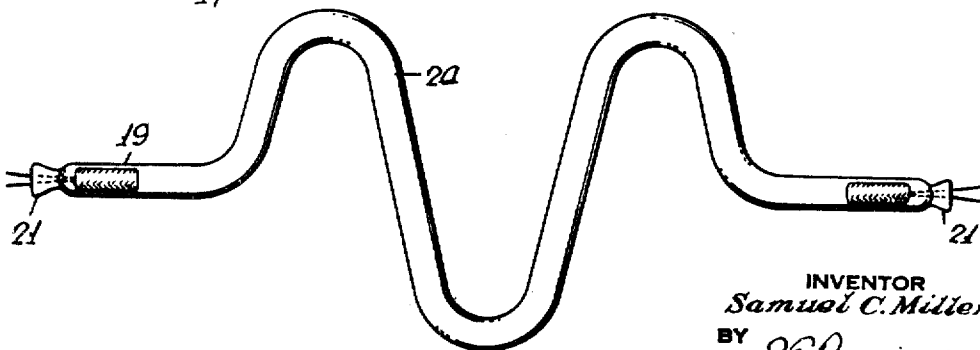


FIG. 6.



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## UNITED STATES PATENT OFFICE

2,443,632

## BRAID SHIELDING

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Application April 16, 1946, Serial No. 662,420

13 Claims. (Cl. 176-126)

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This invention relates to electrodes for luminous tubes; more particularly my invention relates to the production of the electrode assembly for gaseous electric discharge devices to produce the so-called neon tube illuminant. Still more particularly my invention relates to a method of producing and assembling electrodes for gaseous electrical discharge illuminants.

In accordance with my invention set forth in the Patent 2,310,983 of February 16, 1943, I have produced an electrode for luminous tubes of the gaseous electrical discharge variety involving non-sputtering qualities by shielding the rim or edge of a metallic electrode shell with a ceramic collar embodying some features of the Lohman Patent 1,739,513. In said patent as well as in my Patent 2,375,808 of May 15, 1945, certain advantages are secured in the employment of the ceramic shield, especially in respect of a protective coating of electron emitting material over other devices known to me for protecting the rim or edge of the shell electrode.

Notwithstanding the benefits of the electrode as described with the ceramic collar shielding, difficulties are likely to be encountered in the processing of the tube assembly which involve such high temperatures as may cause the shell electrode to sag from its coaxial position to a position where it may contact the glass envelope to perforate or crack the same. It has accordingly been found desirable for commercial expediency and manufacture to interpose or wrap mica sheeting in the space between the electrode and the glass envelope. The procedure of protecting the rim of the electrode and the insulation by a spacer of mica introduces no inconsequential cost. These elements of cost are still further increased by manufacturing problems, taking into account different shapes and sizes of electrodes.

It is accordingly an object of my invention to provide a non-sputtering electrode in which the rim of the electrode shell is shielded during operation and an effective spacer is employed to minimize the detrimental effects of a sagging electrode during processing. It is a still further object of my invention to provide an electrode construction for luminous tubes and gaseous electrical discharge devices which lends itself readily to rapid production for a wide variety of sizes of electrode shells.

It is still further an object of my invention to provide a simple inexpensive electrode construction combining non-sputtering and spacer means

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and a method of assembly effecting substantial economies in labour and materials.

To attain these objects and such further objects as may appear herein or be hereinafter pointed out, I make reference to the accompanying drawing forming a part hereof in which—

Figure 1 is a fragmentary longitudinal section of an electrode assembly in accordance with my invention;

Figure 2 is a section taken on the line 2-2 of Figure 1;

Figure 3 is a section taken on the line 3-3 of Figure 1;

Figure 4 is a section taken on the line 4-4 of Figure 1;

Figure 5 is a perspective elevation of a section of braid employed prior to assembly;

Figure 6 is an elevation of an assembled luminous tube in accordance with my invention.

In accordance with my invention I seek to improve prior methods devised by me and known to me for attaching protective means to shield the rim of the electrode shell and to act as a spacer between the electrode shell and the glass envelope. Where I have used a ceramic collar as a rim protective agent by spinning the electrode onto the ceramic collar to effect union, considerable care is required to correlate the sizes of the ceramic collars to the shell, not to speak of the care involved in the spinning operation. This use of the ceramic collar does not eliminate the need for a spacer such as thin sheets of mica. This requires rehandling labour adding a substantial item of cost.

I have found that I may coordinate the properties of glass wool braid or fiber-glass braiding to effect substantial economies. I have found that a heavy mesh fiber-glass braid may be sleeved over an electrode to accommodate itself to shells of a wide range in sizes. This material in the position where it is sleeved on the electrode may be then heated to shield only the rim of the electrode shell.

I have found that for shells of a size of approximately three-eighths of an inch in diameter, I may use a braid of fiber-glass which is designated as five-sixteenths of an inch braid. A heavy mesh fiber-glass braid is preferred. A tubular section of this braid, if sleeved over an electrode, can be made to accommodate itself for a close fit. Stretching the braid compresses it firmly about the shell. Compressing the separate ends of the sleeve towards each other or by stretching the sides of the braid it can accommodate itself to shells of larger diameter. The braid may be

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positioned to overhang the edge of the electrode and in this condition the overhanging edge is heated by sharp pointed fires to fuse the glass adjacent the rim so that in this fusion process it drops or becomes constricted to cover the rim or edge of the electrode. The remainder of the braiding is left unaltered along the length of the electrode which it covers. The sleeve hugs the electrode without being readily displaced therefrom. The fusion of the rim of the braid, forming something in the nature of a selvage edge, is accomplished rapidly since the bundles of filaments, thread or yarn of glass wool are much more readily responsive to the flame than glass tubing. A flexible support remains for the fused constricted selvage edge of the braid in which shock resistance is added by reason of the fibrous body which may be retained or which may exist adjacent the rim. To some extent a core of fibrous material may be present in the fused rim.

The soft flaccid condition of the braid which has remained unheated provides admirable spacer qualities on the exterior of the shell electrode in relation to the glass envelope within which it is to be located.

Further advantages of my procedure will be evident hereinafter.

Making reference to the drawing, I show an electrode shell 10 generally tubular, having a closed end 11 but which may be of the type now generally in use. To the exterior of the closed end lead wires 12 may be attached by the spot weld 13 though crimping or other means may be employed. It is to be observed that the deep-draw closed end type of electrode shell is illustrative only and that I may use any of the electrode shells known in the trade or illustrated in my aforementioned patents, whether lined by forming a pair of concentric shells or with an electron emitting coating.

A sleeve or tube of glass wool braiding 14 is then provided.

The braiding chosen for a shell which is three-eighths of an inch in diameter is a five-sixteenth of an inch braiding made from glass wool yarn or a bundle of filaments which has been woven into a braid. I have found desirable braid sleeving such as "natural type H sleeving" furnished by the Varflex Corporation which firm employs a glass wool yarn or fiber-glass yarn furnished by the Owens-Corning Fiberglass Corporation. The fiber-glass braid which I prefer is one in which the lubricant for the fiber-glass is readily removed without leaving any impurities at relatively low temperatures. Mere heating with a good circulation of air at from 500 to 600 degrees Fahrenheit should remove the organic matter to leave a pure product. The braid of fiber-glass or glass wool yarns which I may employ is of the type which fuses at about 1100 degrees Fahrenheit and sinters at about 100 degrees lower.

With a glass fiber braid of this type, thus provided, a section cut from a continuous length is sleeved over the electrode shell 10 so that an edge thereof 15 overhangs the rim 16 of the electrode shell 10, and is long enough so that it overhangs at 17 well beyond the closed end 11 of the electrode and extends for a distance along the lead-in wires 12. With the electrode 10 serving as a mandrel the edge 15 is brought into the flame and while it is kept rotating, the edge 15 is heated to the point where the braid filaments fuse at the unselved edge and forms a con-

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stricted mouth 18 completely enveloping the rim 16 of the shell. The extensiveness of the fused more or less selvaged edge 18 is determined by the size of the shell in accordance with known practise as well as with the nature of the shell and whether it carries an inner electron emitting coating or a separate sleeve on which it is deposited. The fused rim protecting portion thus obtained is only partly fused or sintered and gradiently merges into yarns unaffected by the heat applied in forming the fused rim. Enough fusion of the rim 18 is effected to supply the desired shielding for the rim 16 or for non-sputtering operation, the glass yarns at the rim 17 having been fused into a continuous protective coating in which the outline of yarn appears to be present in a matrix of fused glass. The assembly of shell electrode 10 with its frictionally enveloped braid sleeving may now be handled readily for sealing into a section of glass tubing forming the envelope therefor.

In the illustration the assembly shown in Figure 5 is inserted within a glass envelope 19 to extend the lead-in wires 12 through one end 20 where the seal or pedestal 21 is formed about the lead-in wires. The edge 17 of the braid sleeving 14 adjacent the end 20 of the glass envelope may have been left untreated or unfused. The process of heating the glass tubing 19 to form the seal or pedestal 21 may be carried out to be intense enough to sinter or fuse the edge 17 to provide a sintered constricted edge 22. It is understood, however, that the finishing of the edge 22 may be effected before assembly of a shell with its glass envelope, is made.

The braid sleeving 14 between the edges 18 and 22 retains its fluffy or flaccid condition, and is readily capable of being handled between the initial assembly as shown in Figure 5 to the sealing-in stage in Figure 1. The original strength of the glass wool yarn and its flaccid condition provides a shock-proof spacer between the glass envelope 19 and the shell 10, eliminating the need of mica sheeting and like solid spacer material in accordance with prior practice.

The raw edge 23 of the assembly of shell and glass envelope may then be embodied into a luminous tube 24, the opposite ends of which are sealed by the electrode and tube assemblies specifically shown in Figure 1. The gaseous electrical discharge device may be finished in the form of an illuminant or other illuminating displays such as signs and may then be processed to remove impurities and otherwise condition the assembly for operation. During this stage of processing the employment of a braid of raw glass wool or fiber-glass yarn introduces no adverse effect. Organic lubricants may be removed during this processing step. Any tendency of the electrode shell 10 and its glass braid sleeving 14 to sag about the lead-in wires 12, has no adverse effect as the fluffy flaccid sleeving acts as an effective spacer during the processing of the tube.

Upon completion of the tube, the fused rim 18 acts as a shielding minimizing sputtering during operation of the gaseous discharge device. It will thus be observed that simple glass forming technique, whether hand operated or automatic, may be employed in forming the glass braid shielding for the mouth of the electrode. Lengths of the glass wool yarn braid may be readily cut and sleeved in position. A friction fit is secured as the braiding accommodates itself readily to

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different sizes of shells. Manufacturing processes, therefore, are simplified.

It will be understood that while I prescribe glass wool yarn braiding which responds to fusion at about 1100 degrees Fahrenheit, lower or higher fusing glass may be employed for in any event the filamentary condition of the yarn lends itself to rapidly reaching the fusing stage and the passing on to the next step without special care in annealing the glass in view of the reinforcement supplied by the unfused yarns adjacent the rim.

In general I have provided a new method for applying a combined sputter-resistant coating for the electrode and a spacer between the electrode and glass envelope.

By supporting the sputter-retarding rim of fused glass-fiber from the outside of the shell electrode, this opening may be kept of maximum size and undue restriction of the mouth of the electrode is avoided, thereby providing for lower electrical resistance in operation in discharge devices of this kind especially where there is a tendency in the art of go into higher current densities for luminous tube operation.

The braid may be purified fully, a factor not possible with ceramic shielding or mica spacing elements. The flexible, frictional fit of the braid upon the shell electrode also contributes to a fine adjustment of the shielding formed by the mouth of the braid with respect to the rim of the electrode.

It will be understood that while I have described as one method the positioning of the braid sleeving on the shell electrode to act as a mandrel during fusion or sintering of the edge, it is understood that I may either sinter the braid before assembly on the shell electrode, or completely fuse that edge before the assembly operation is carried out. It will also be understood that the braid sleeve of glass-fiber strands may be made non-ravelling at its edges before assembly is effected with the electrode, including not only the sintering or fusing step, but by the use of temporary adhesives. Such temporary adhesives are those which readily char and are burnt off and leave no residue at processing temperatures or by a generous circulation of air while heating at temperatures no higher than about 600 degrees Fahrenheit.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is:

1. An electrode for a gaseous electrical discharge device comprising a substantially tubular shell having sleeved thereover a fabricated braid of glass-fiber strands, said braid accommodating itself to the tubular shell, and constricted at the mouth of the shell.

2. An electrode for a gaseous electrical discharge device comprising a tubular shell having lead-in conductors at one end and an open mouth at the other, the shell having sleeved thereover a braid of glass-fiber strands, said sleeve extending over the rim edge of the electrode and having a portion of said end at least partly fused into a constricted mouth portion shielding the rim edge of the electrode.

3. An electrode for a gaseous electrical discharge device comprising a tubular shell having lead-in conductors at one end and an open mouth at the other, the shell having sleeved thereover a braid of glass-fiber strands extending over the rim edge of the mouth of the electrode, the end so extending being constricted shielding the edge of the electrode, said constricted portion

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comprising fiber-glass in a matrix of fused glass merging into unaltered fiber-glass strands in the braiding.

4. A combined spacer and sputter-retarding shielding for a shell electrode of a gaseous electrical discharge device comprising a sleeve of self sustaining glass-fiber strands, one end of said sleeve being at least partly fused into a constricted mouth portion.

5. A terminal tubing for a gaseous electrical discharge device comprising a glass envelope one end of which is sealed over lead-in conductors and substantially axially holding a shell electrode, the combination therewith of a braid of glass-fiber strands sleeved over said electrode including an end thereof constricted about the rim of said electrode providing a shield for said electrode.

6. A terminal tubing for a gaseous electrical discharge device comprising a glass envelope one end of which is sealed over lead-in conductors and substantially axially holding a shell electrode, the combination therewith of a braid of glass-fiber strands sleeved over said electrode including an end thereof constricted about the rim of said electrode providing a shield for said electrode, the body of said sleeve remaining flaccid and flexibly supporting said constricted rim portion.

7. A terminal tubing for a gaseous electrical discharge device comprising a glass envelope one end of which is sealed over lead-in conductors and substantially axially holding a shell electrode, the combination therewith of a braid of glass-fiber strands sleeved over said electrode including an end thereof constricted about the rim of said electrode providing a shield for said electrode, the opposite end of said sleeve portion being at least sintered to restrain displacement of said sleeve from said electrode.

8. The terminal end of a gaseous electrical discharge device comprising a glass envelope one end of which is sealed over the lead-in conductors of an electrode shell axially positioned within said envelope, said shell having sleeved thereover a braid of partially flaccid glass-fiber strands extending at least beyond the open end of the electrode and frictionally accommodated and partially sintered to be held by said electrode, said sleeve acting as a spacer between said electrode and glass envelope.

9. The terminal end portion of a gaseous electrical discharge device in accordance with claim 8 wherein said braid, extending beyond the mouth of the electrode, is fused to a constricted open mouth portion shielding the rim of said electrode.

10. The method of making a sputter-resistant shielding for the electrode of a gaseous electrical discharge device comprising the steps of sleeving a braid of glass-fiber strands over a mandrel forming element and locally heating the braid at an edge at least partially to sinter said edge of said sleeve to provide a non-ravelling edge leaving the main body of the braid flaccid.

11. The method of making a sputter-resistant shielding for the electrode of a gaseous electrical discharge device comprising the steps of sleeving a braid of glass-fiber strands over a mandrel forming element and locally heating the braid at an edge at least partially to sinter said edge of said sleeve to provide a non-ravelling edge leaving the main body of the braid flaccid and constricting said edge by the heating step aforementioned to the point where said constricted

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edge provides a fused matrix of glass merging in the strands of glass-fiber.

12. The method of making a combined sputter-retarding shield and spacer for the shell electrodes of a gaseous electrical discharge device comprising the steps of mounting a pre-formed braid of glass-fiber strands on a mandrel, heating one edge of said braid to rapidly fuse said edge into non-ravelling condition and continuing the heat to fuse said edge into a constricted condition, the body of said sleeve being retained in a flaccid condition.

13. The terminal end of a gaseous electric discharge device comprising a glass envelope, one end of which is sealed over the lead-in conductors of an electrode shell axially positioned within said envelope, said shell having sleeved thereover

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a braid of partially flaccid glass fibre strands, frictionally accommodated and partially sintered to be held by said electrode, said sleeve acting as a spacer between said electrode and envelope.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name    | Date          |
|-----------|---------|---------------|
| 2,062,959 | Barclay | Dec. 1, 1936  |
| 2,064,485 | Miller  | Dec. 15, 1936 |
| 2,202,820 | Baird   | June 4, 1940  |
| 2,310,983 | Miller  | Feb. 16, 1943 |

#### Certificate of Correction

Patent No. 2,443,632.

June 22, 1948.

SAMUEL C. MILLER

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 49, after the word and period "Fahrenheit.", insert the following paragraph:

*Phases of the invention described and disclosed herein are set forth and claimed in an application of Charles W. Homan for Method of Making Electrode Spacer Material and Resultant Article and Electrode, filed on November 14, 1947, as a division of application Serial No. 670,584, filed December 30, 1942.*

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of January, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,  
Assistant Commissioner of Patents.

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13. The terminal end of a gaseous electric discharge device comprising a glass envelope, one end of which is sealed over the lead-in conductors of an electrode shell axially positioned within said envelope, said shell having sleeved thereover

a braid of partially flaccid glass fibre strands, frictionally accommodated and partially sintered to be held by said electrode, said sleeve acting as a spacer between said electrode and envelope.

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