Feb. 17, 1959 H. J. HAMPEL 2,874,320

INDICATING DEVICE

Filed Dec. 13, 1955 2 Sheets-Sheet 1

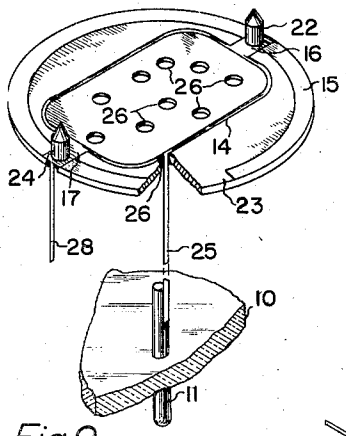


Fig. 9

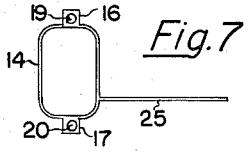


Fig. 7

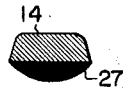


Fig. 8

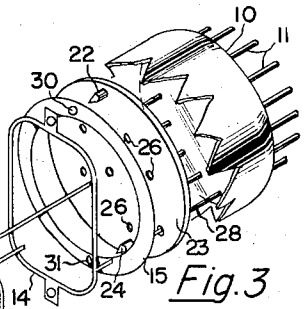
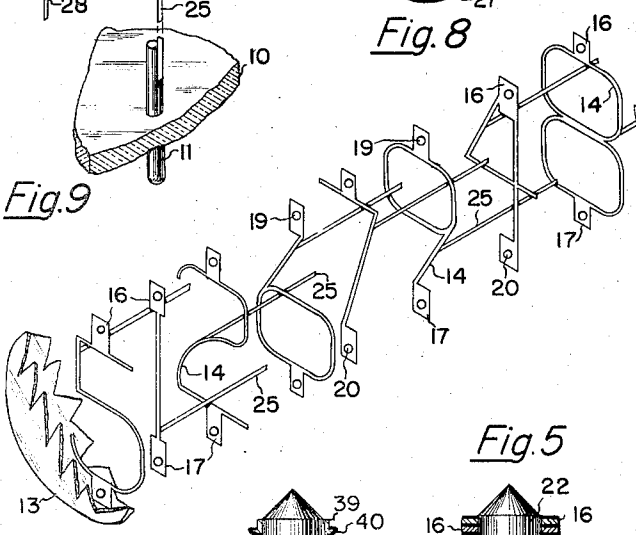


Fig. 3



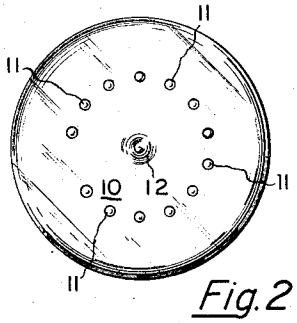
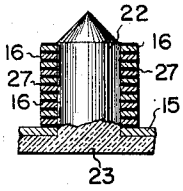


Fig. 2

Fig. 5



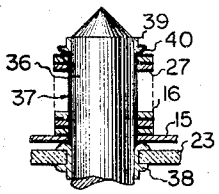


Fig. 6

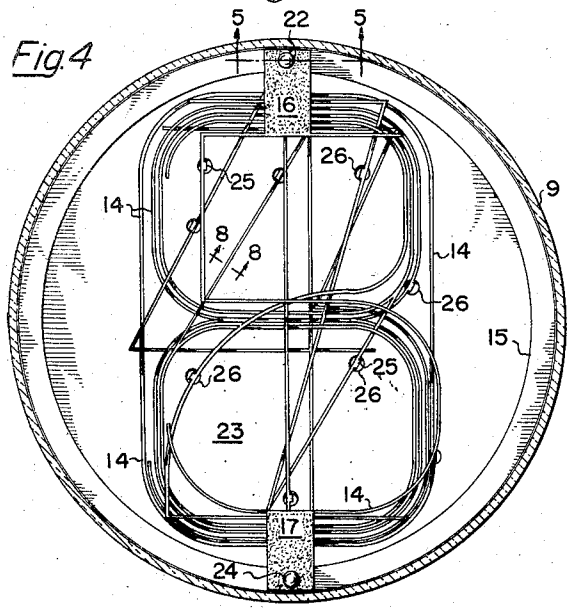


Fig. 4

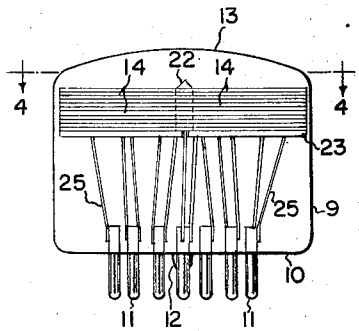


Fig. 1

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Feb. 17, 1959 H. J. HAMPEL 2,874,320

INDICATING DEVICE

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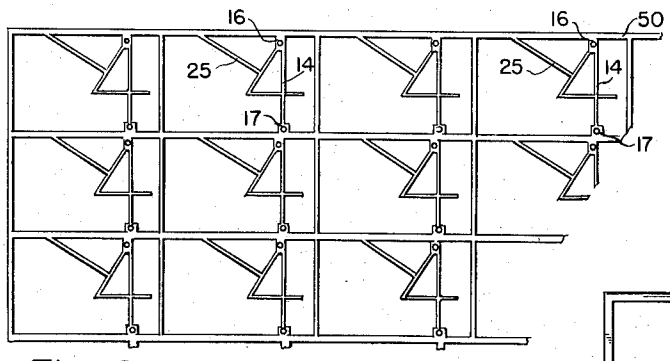

Fig. 10

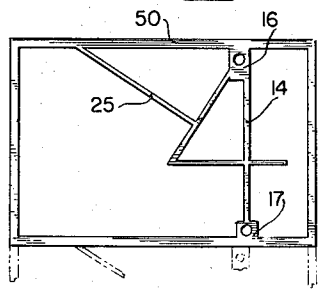

Fig. 11

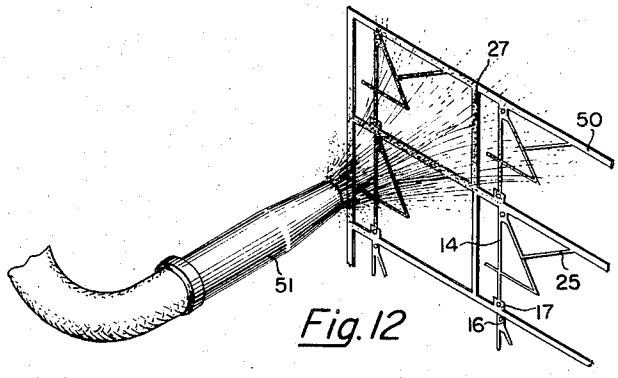

Fig. 12

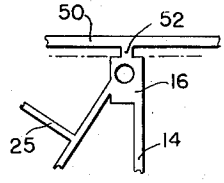

Fig. 13

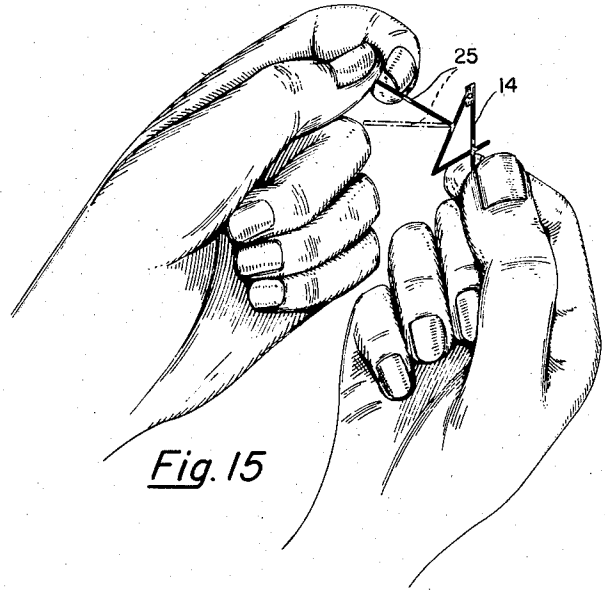

Fig. 15

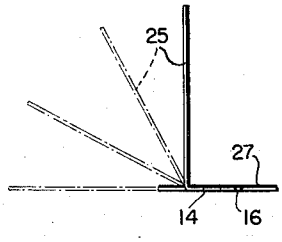

Fig. 14

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INDICATING DEVICE

Herbert J. Hampel, Philadelphia, Pa., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan

Application December 13, 1955, Serial No. 552,748

16 Claims. (Cl. 313—109.5)

This invention relates to indicating devices and methods of making the same and more particularly to glow type gas tubes for showing any one of a plurality of numbers or other characters as selected.

Neon gas glow tube devices displaying an array of numerical characters are known to the art, as exemplified by United States patents to H. P. Buswau and F. B. Maynard, Nos. 2,142,106 and 2,756,366, respectively. However, these tubes have been subject to manufacturing difficulties and have shown in many applications a wide variation in firing and quenching voltage requirements for the various characters. As a result, tubes capable of displaying many characters are somewhat costly for initial installation and require complex and extensive circuitry for reliable operation. A further handicap is experienced in the electrode mounting and positioning arrangements used which result in a considerable depth for the complete display, limiting the angle in which a character can be viewed, causing an apparent variation in character as seen from separated points, and hiding or masking effects upon the rearmost characters from forward characters and from reflections of room lighting from broad areas of supporting insulators. Mounting techniques which provide for compact display assemblies have included insulating structures which impede the current paths necessary to uniform glow over all portions of each character.

An object of this invention is to provide an indicating tube suitable for wide-angle viewing and with negligible parallax effects for all characters.

Another object of this invention is to provide a novel structural arrangement possessing improved precision and durability yet adapted for rapid and economical manufacture.

Another object of this invention is to provide an indicating tube having superior electrical characteristics.

A further object of this invention is to provide an assembly of characters wherein hiding of one character by another is reduced to a minimum so each number is clearly visible when illuminated, and all characters are in a closely stacked but insulated relationship, with the assembly in close proximity to the viewing end of the tube.

A still further object of this invention is to provide a method for producing the assembly of respective characters for a character display tube, whereby the respective characters together with their supporting tabs and connecting leads are formed as individual conductors by stamping, etching, or electrolytic action, are coated with insulating material on those surfaces from which electronic conduction is not desired, bent into shape for final assembly, mounted upon a supporting structure of insulating material, and encased in a partially evacuated tube which permits viewing, maintains the low-pressure gas atmosphere needed for glow discharge, and holds leads for connections from outside the tube to the electrodes within the tube.

Reference is made to the accompanying drawings in which:

Fig. 1 represents a side elevation of a completed tube;

Fig. 2 is a view of the prong or base end of the tube;

Fig. 3 is an enlarged exploded perspective view of a number display tube embodying one form of the present invention;

Fig. 4 represents an enlarged section on line 4—4 of Fig. 1;

Fig. 5 represents a section on line 5—5 of Fig. 4, showing one form of stud mounting;

Fig. 6 represents a sectional detail of a modified form of stud mounting;

Fig. 7 is a view of one of the cathodes and is illustrative of all of the cathodes as ready for bending and assembly;

Fig. 8 represents an enlarged sectional view on line 8—8 of Fig. 4.

Fig. 9 is a fragmentary and exploded view of a cathode as assembled;

Fig. 10 is a front view of a framed assembly of one particular cathode character as produced by a stamping or etching process in accordance with this invention.

Fig. 11 is an enlarged front view of one of the cathode characters from the frame of Fig. 10;

Fig. 12 is a pictorial representation of the process of spraying insulating material on the back of a framed assembly of cathode characters;

Fig. 13 shows an alternate embodiment of the integral structure connecting a mounting tab to the frame on which the cathode characters are supported when produced; and

Figs. 14 and 15 pictorially illustrate the step of bending the integrally connected lead of a cathode character to a right angled position.

As shown in Figure 1, an embodiment of the invention is assembled in a transparent envelope **9**, which has been evacuated and then filled to a low pressure with a gas such as neon, making the tube suitable for glow operation. Envelope **9** is sealed to a base **10**, which may be a conventional base disc or button of glass through which a plurality of leads **11** project to connect the various electrodes of the glow tube into control and indicating circuits. Once the tube has been evacuated and the gas for glow operation has been introduced, the tube is sealed off at vacuum seal **12**, preferably located in base **10** so as to leave a transparent and unobstructed viewing face **13** at the other end of the envelope **9**.

The assembly of cathodes **14**, anode **15**, and a supporting structure of electrically insulating material comprising a disc **23** and studs **22** and **24** are positioned within envelope **9** very close to the transparent end face **13**. Leads **25** provide electrical connections from the cathodes **14** to individual base pins **11**. A similar lead **28** electrically connects anode **15** to another base pin **11**. Figure 2 shows base **10** with vacuum seal **12** centrally positioned and with leads **11** positioned on a circle as is the practice for "button base" vacuum tubes. A slight bend in each lead **25** and **28** from the axis of its passage through disc **23** to reach one of the leads in the smaller diameter of the leads **11** may serve to hold disc **23** from movement away from face **13**, although special provision for holding the disc from such movement may be provided.

Figure 3 shows the tube parts in an exploded view to more clearly show the arrangement of one cathode character **14** behind the other, in a single file, with the anode **15** behind the assembly of cathodes. The filamentary nature of the cathodes which, together with the relative proportions and positions of their component parts, described below, results in substantially equal visibility for the different luminous numerals of the illustrated arrangement, is apparent, also, in this figure.

Each cathode has a connecting lead **25** which is an integral part of that cathode and which, when folded back at substantially right angles to the plane of that cathode, pro-

jects rearwardly through the assembly of cathodes and the disc 23 for connection to its particular lead-in pin. Each cathode is insulated from the other in any suitable fashion, and when the assembly is stacked compactly in the manner as shown in Fig. 1 the overall thickness of the assembly is quite small, being in the order of 0.08 to 0.10 inch in certain embodiments of the invention made to date.

As a means for obtaining this compact, relatively thin pattern assembly, each cathode 14 is stamped, etched or otherwise developed from a thin sheet of metal, preferably copper, which may have a thickness of the order of approximately 0.002 to 0.004 of an inch and at the same time each character is formed it is provided with two spaced apart upper and lower tabs 16 and 17, preferably in aligned relation for mounting on a stable support, each of the tabs 16 having an aperture 19 and each of the tabs 17 having an aperture 20. The tabs 16 and 17 are similarly located on each character electrode for alignment so that when assembled in the final stacked relation with the characters in the desired relative positions there will be a row of tabs 16 with registering apertures 19 and a row of tabs 17 with like registering apertures 20. The row of tab apertures 19 receive a supporting stud 22 of insulating material projecting from the face of the supporting disc 23 and the row of tab apertures 20 receive a supporting stud 24 of insulating material projecting from the same face of the disc 23, such disc being of insulating material such as ceramic or mica.

The connecting leads 25 are formed as extensions of the various cathodes 14 and at points thereon which may be different for each cathode, so that, in the illustrated arrangement, they may be projected through separate holes 26 in disc 23, when assembled, and do not contact one another. Behind disc 23, the leads 25 connect to base prongs 11. As shown in Fig. 3, anode 15 is in the shape of a ring. It is provided with diametrically spaced apart apertures 30 and 31 and has lead 28 attached to its rear face for projection through disc 23 to an individual lead 11 in a manner similar to that described for leads 25. Once the assembly is stacked in its final form, leads 25 and 28 are bent to go to their respective base prongs 11. These slight bends behind disc 23 confine disc 23, anode 15 and cathodes 14 in this compact arrangement. Leads 25 and 28 being very flexible in nature can readily be bent in a minimum of space to carry out the foregoing method of assembly.

Figure 4 shows this assembly in its final form, viewed from the face end of the tube. The linear lengths and continuing arcuate portions of each cathode character are preferably formed of slightly different dimensions so that these portions of the numbers or characters are laterally offset one from the other. In this manner, each number or character is made clearly visible from the viewing end of the tube, when illuminated, and is not perceptibly obscured by cathodes in front of it. In the illustrated embodiment of the invention, the character representing "zero" has the largest dimensions of all the characters, extending to near the inside diameter of anode ring 15. The characters representative of "three," "eight" and "nine" are smaller than the "zero" so as to be separately visible when it is illuminated and alternatively not to obscure the other characters when any one of them is illuminated. This arrangement pattern is continued in the remaining characters. When portions thereof do cross, the intersection is made at an angle as near right-angle as is practical as is exemplified in the crossing of "nine" over "three" and "eight." When portions thereof must be essentially parallel, they are kept in different lateral positions. Because of the thinness of the stack of character electrodes, a slight lateral displacement between portions of each electrode permits unobscured viewing over a wide angle. Since the displacements can be small, the difference in dimensions for the various characters can be small, i. e., the largest and smallest characters are not noticeably different in size from a viewer's position.

The diagonally sloping portions of "four" and "six" and the horizontal portions of "2," "3" and "5" are illustrative of such laterally offset portions. Except for the tabs 16 and 17 which overlap anode 15, all portions of cathodes 14 are of smaller dimensions and lie within the diameter of anode 15. This distribution within an anode ring insures uniform glow intensity from various portions of all cathodes. Tabs 16 and 17 have been shown of considerable width, for clarity, but can be made of narrower width, particularly along the portion not surrounding holes 19 and 20 but extending therefrom to the character which is supported by that tab. Furthermore, the front surfaces of tabs 16 and 17 for the foremost character also are coated with insulating material 27, as indicated by the stippling in Fig. 4, to prevent glow from this easily visible area. The remaining tabs behind the foremost pin may also be coated with the insulating material if desired.

Figure illustrates in detail the mounting arrangement provided by the studs 22 and 24. Stud 22 is used as the example, and as previously described the stud forms an integral portion of disc 23, and upon which anode 15 and the mounting tabs or stubs 16 of cathodes 14 are mounted. Each cathode 14 and tabs 16 and 17 is coated on its rear face with an insulating and preferably light absorbing material 27 which isolates each electrode from adjacent electrodes and also prevents electronic current from flowing from cathode areas from which glow is not desired. Leads 25 are similarly coated to prevent glow therefrom. With this control over the cathode areas which can support electronic current, current is limited to those areas from which glow is required and a high ratio of light output to current is obtained. Further, the resulting low current minimizes harmful sublimation and contamination effects and minimizes outgassing of tube elements due to heating; providing long tube life without sacrificing light output.

Figure 6 shows an alternate embodiment of the supporting structure for the assembly of cathodes 14 and anode 15. In place of the studs 22–24, the alternate embodiment employs metal rods. One of the rods is in Figure 6 and identified as "36." Glass or other insulating material 37 is coated on that portion of rod 36 which will fit into hole 19 of each tab 16 and hole 30 of anode 15. Disc 23 is provided with an aperture therethrough at the point where rod 36 is to be positioned. An eyelet or grommet 38 is mounted in this aperture, and disc 23 and eyelet 38 are slid onto rod 36 until eyelet 38 abuts against the insulation coating 37. The shank of eyelet 38 then is spot-welded or otherwise affixed to rod 36. It is understood that a similar rod, coating, and eyelet are used in place of stud 24.

Anode 15 and the tabs 16 and 17 of the cathode characters with their back surface insulation 27 are then slid onto the front or pointed end of each rod 36 over the portion covered with insulating material 37. A collar 39 with an insulated flange 40 is then slid down each rod 36 until it abuts against the insulating coating 37 and uppermost cathode tab, where it is affixed to the rod by spot welding or other method. The same assembly steps are performed simultaneously for the other mounting rod and for the other side of disc 23, anode 15 and the cathode characters. Each rod 36 projects into the region of the base prongs 11 and is rigidly fixed to a base prong such as by spot welding.

Since considerable mechanical strength is provided in the assembly of cathodes 14 on studs 22 and 24, the disc 23 and the associated eyelets may be omitted and replaced by another insulated collar similar to collar 39 to support the assembly of cathodes 14 and anode 15 upon the stud.

As shown in Figure 7, the numeral "zero" is typical of the characters produced by stamping, etching, electrolytic action, or other process for production of small cross-sectioned, precisely contoured characters. The supporting

tabs 16 and 17 with mounting holes 19 and 20 respectively, and the connecting lead 25 are formed at the same time as the character and out of the same material and thus are integrally connected to the material out of which the character is formed.

After a character is produced as shown in Fig. 7, the back is sprayed with insulating material 27, and lead 25 is bent rearwardly to right angles to the plane of the character. The characters or numerals are then placed upon the assembly of disc 23 and anode 15, as shown in Figure 9 for the "zero" numeral's cathode 14. As each cathode is placed on studs 22 and 24 its lead 25 fits through a hole 26 in disc 23, for connection to a particular prong 11 in the tube base 10.

Although stamping, electrolytic action, or etching can be utilized to produce the cross section as shown by area 14 of Figure 8, the photo-etching process of the Buckbee-Mears Company is preferred because of its precise control. The sides of this truncated section slope to produce a wider surface on one side than on the other side. This difference is attained by controlled etching from both sides, causing the etching to remove material from one side more extensively than from the other side.

In order to insulate each cathode 14 from adjacent cathodes and the anode 15 in a stacked assembly, the back of each character may be sprayed or otherwise coated with an insulating and preferably opaque and non-light transmitting and non-reflective material 27. This coating 27 is as shown in Figure 8, of convex cross section with a major thickness of about 0.06 inch. Thus, the cross section of all cathode members comprises a forward-looking electrode 14, with sides slanting to a wider rear surface on which insulating material 27 is coated. By making the rear side, which is coated, wider than the front side, a larger insulation barrier is interposed between successive stacked cathodes when they are assembled.

Figure 10 shows a quantity of one type cathode as integral parts of a frame 50. Each cathode 14 therein is produced complete with its integral connection lead 25 and support tabs 16 and 17. When the quantity of a particular cathode which is desired is less than the capacity of frame 50, then several different cathodes can be produced in a given frame.

As stated in describing Fig. 8, the photo-chemical etching process of Buckbee-Mears Company of St. Paul 1, Minnesota is preferred. This process is described in United States Patents 2,536,383; 2,710,591; 2,710,814; and 2,720,146 to N. B. Mears or N. B. Mears et al. In this process, a thin sheet of metal is covered on both sides with photo-sensitive glue, exposed on both sides to a light pattern exhibiting a picture of the desired configuration of the final etching, washed to remove the glue from unexposed areas, baring the metal in these areas, and etched by application of appropriate salt solutions to remove the metal from these exposed areas. The result is a precise metallic reproduction of the light pattern applied to the metal sheet, wherein detail is as fine and precise as the pattern a camera can photograph and which can be reproduced in the light pattern which is applied to the metal sheet.

When single cathodes are to be produced, as shown in Figure 11, then the frame 50 encloses only that single cathode 14 together with its connecting lead 25 and support tabs 16 and 17. The quantity of cathodes per frame, the different cathodes which any particular frame encloses, and the dimensions of various tabs and leads are determined by the particular production requirements. Once the frame 50 and its cathodes 14 are produced, the back side is sprayed with insulating material 27 as shown in Figure 12. In the spraying operation, the wider back side of each cathode provides a shadowing effect and substantially prevents insulating material from falling on the narrower front surface. Spray nozzle 51 projects insulating material, such as molten glass or a suspension of Alundum in a suitable liquid vehicle, onto the back side as shown. The surface tension and adhesive forces exerted on the material after it is applied to the metal will hold the material 27 in the shape shown in Figure 8 until molten material cools and sets or a volatile vehicle has evaporated, leaving a dense, strongly adhering coating. The cathode 14 with its connecting lead 25 and supporting tabs 16 and 17 is then cut free of frame 50.

Because of the precision and fine detail which can be provided by the stamping, etching, or electrolytic actions used, numerous changes in the product are possible within the scope of this invention. As shown in Figure 13, the support tab 16 can have a narrower section 52 between it and frame 50. This provides for easier and more precise separation of the tab 16 from frame 50, since the edge of tab 16 is clearly observable on the structure.

Figure 14 shows a cathode 14 with its connecting lead 25 in the process of being bent to its right angle position preparatory to being mounted in an assembly of cathodes. While hand bending is shown in Figure 15, it is fully within the scope of this invention to use tweezers, jigs, or other tools which are useful in metal forming by bending. Once connecting lead 25 is bent into position, its full length on both sides is coated with glass, Alundum, or other insulating material, except for where it will be bonded to a base prong 11 of the tube. This coating prevents unwanted glow and minimizes current, in the same manner as does the back coating 27 on the cathode 14.

From the foregoing is will be seen that each cathode 14 is a separate character with a backing 27 of insulating and preferably opaque, non-reflecting material. When assembled into a sequence of numerals, each cathode is supported by tabs from insulated studs projecting from an insulating base. As so assembled, these cathodes form a compact stack of numerals wherein the outline of each number is out of register with all other numerals. Also, the opaque, non-reflecting backing eliminates disturbing reflections and limits glow to those front surfaces from which light is desired. This current limitation provides a high ratio of light output-to-current.

The novel construction further provides for uniform, predictable and stable ionization and sustaining voltage levels. When a designer can depend upon ionization occurring at some definite voltage, he can provide much of that voltage as a pre-bias to which only a small voltage increment or pulse must be applied in order to fire the tube. Since transistor and magnetic core circuitry inherently provide pulse outputs, direct interconnections can be made between such circuits and this tube when pre-bias is used. This can save a large percentage of the total circuitry of a display or indicating unit.

The unique method of fabrication by etching results in dimensional precision of the parts which is not possible with standard die techniques. Further, the provision of integral mount tabs and connecting leads reduces assembly steps to a minimum, and the use of precision parts in an assembly achieves minimum screening or interaction since relative positions are closely controlled and small dimensions can be used.

What is claimed is:

1. An indicating tube of the glow lamp type comprising a gas-filled envelope having a portion thereof constituting a transparent viewing face, a plurality of planar cathodes within said envelope having the active portions thereof respectively formed in accordance with outline representations of different characters, a coating of insulating material on one side of each of said cathodes, a planar anode within said envelope for ionizing the gas in response to a suitable potential difference between said anode and a selected one of said cathodes, structural means within said envelope mounting said cathodes and said anode in stacked relationship with said coatings of

insulating material on the sides of said cathodes remote from said viewing face, said structural means including integrally formed mounting tabs for each cathode extending without the area of the character-formed portion thereof and also including mounting studs projecting through holes in said mounting tabs and in said anode and further including support means holding said mounting studs and said cathodes and said anode in assembly therewith close to said viewing face of the envelope, said cathodes when luminously active providing a viewable pattern of characters having dimensions and an arrangement of the parts such that the character-formed portions of the cathodes nearer to said transparent face have a minimum obstructing effect on character-formed portions of the luminous cathodes more remote therefrom, and electrical conducting means connecting said cathodes and said anode with the exterior of said envelope.

2. An indicating tube of the gaseous glow type having an assembly of character indicating electrodes comprising, in combination, a plurality of cathodes respectively produced in the shape of different characters, a connecting lead for each cathode formed of the same material as the cathode and integrally joined thereto, at least two supporting tabs for each cathode formed of the same material as the cathode and integrally joined thereto, and supporting studs for holding said cathodes in a closely stacked but insulated relationship, said studs engaging the supporting tabs of the cathodes and said engagement being the sole support for the cathodes.

3. An indicating tube of the glow lamp type comprising a gas filled transparent envelope, a plurality of cathode electrodes and an anode in said envelope, each of said cathodes having a face of conducting material delineated in the shape of a different character to be indicated and a back surface of insulating material conforming to the shape of the character, and means mounting said cathodes and said anode in stacked relation in the envelope.

4. The tube defined in claim 3 wherein some of said cathode electrodes have a different width than others and some are offset laterally from others so that when the cathodes are viewed through the viewing window, none of the cathode electrodes is obscured by any of the others.

5. The tube defined in claim 3 wherein each cathode electrode has at least two mounting tabs and a connecting lead integral therewith.

6. The tube defined in claim 3 wherein each of said cathode electrodes has a plurality of mounting tabs and an electrode lead integral therewith, the lead extending substantially perpendicularly to the plane of the cathode electrode itself.

7. The tube defined in claim 3 wherein the edges of the cathode electrodes are tapered so that the rear surface which is coated with insulating material has a larger width than the uncoated front surface, the coating of insulating material on the rear surface of the cathodes having a generally convex surface.

8. An indicating tube of the glow lamp type comprising a gas-filled transparent envelope, a plurality of cathodes formed respectively in the shape of different characters, at least two spaced means outside of the field of said characters and supporting all of said cathodes in mutually insulated stacked relation axially of the tube without intervening material therebetween in the fields of said characters for forming a pattern of said characters selectively visible through ionization of the gas about the cathodes, said cathode characters being dimensioned and offset from each other so that they have a minimum obscuring effect on each other and projections thereof on a plane normal to the axis of the tube are substantially non-coincident except as to intersections thereof, an anode operatively associated with said cathodes to ionize the gas thereabout in response to an ionizing difference of potential applied between said anode and any of said cathodes, and lead means for making individual connections to said anode and cathodes externally of said envelope.

9. The process of making an electrode assembly for a gaseous glow type indicator tube having electrode mounting structure which comprises coating a metal sheet with photo-sensitive material which has the property of decreased solubility after exposure to high-energy electromagnetic radiation, irradiating said coated sheet with radiation in a pattern which conforms to the desired structure of electrodes, mounting tabs, connecting leads, and supporting frame, dissolving the non-irradiated coating material, etching to remove the bared metal where coating material has been removed, removing the coating material of decreased solubility, spraying the resulting metallic structure with insulating material where electrical insulation and glow inhibition are desired, cutting the electrodes complete with connecting leads and mounting tabs from the supporting frame, bending the connecting lead of each electrode to fit into the electrode assembly, stacking the electrodes in a close but insulated assembly, and affixing said electrode assembly to the mounting structure and connecting pins of the indicator tube.

10. In the manufacture of electrodes for gaseous glow type indicator tubes, the steps which comprise removing metal from a metallic sheet by photo-chemical etching in a pattern which excludes from etching the pattern forming the desired structure of electrode, mounting tabs, connecting lead, and supporting frame, and spraying this desired structure with insulating material where electrical insulation and glow inhibition are desired.

11. In the manufacture of electrodes for indicator tubes, the steps which comprise removing metal from both surfaces of a metallic sheet by controlled photo-chemical etching which excludes from surface etching the pattern forming the structure of electrode, mounting tabs, and connecting leads within a supporting frame, maintaining the etching action on a first face more extensively than on the opposed face thereby producing a smaller-area surface on said first face than on said opposed face of the pattern excluded from surface etching and resulting in a truncated cross section for members of said pattern, and spraying insulating material upon the pattern of remaining metal on its surface of greater-area to utilize the shadowing effect of this greater-area surface upon the smaller-area surface so as to keep insulating material off of said smaller-area surface, and additionally spraying insulating material upon those portions of the smaller-area surface from which glow is to be inhibited.

12. In the manufacture of electrodes, the steps which comprise removing metal from a metallic sheet by photo-chemical etching in a pattern which excludes from etching the pattern forming the desired composite structure of electrode and an integrally joined connecting lead, applying insulating material to portions of this electrode structure where electrical insulation is desired, and bending the connecting lead at approximately its juncture to the electrode so that the lead extends at a substantial angle to the plane of the electrode.

13. In the manufacture of electrodes, the steps which include etching a metallic sheet to form a filamentary cathode configurated into the shape of a character and having an integrally joined connecting lead and at least one integrally joined laterally projecting supporting tab, bending the connection lead at approximately its juncture to the cathode character so that the lead extends at a substantial angle to the plane of the character, and utilizing the integrally connected tab to support the cathode character in proper position in a tube device.

14. A glow discharge device for the selective display of a variety of luminous indicia in a substantially common field comprising an envelope having a transparent portion for viewing said indicia and containing gas at a low pressure suitable for glow operation, a plurality of planar cathodes arranged in said envelope in closely spaced electrically insulatively stacked relationship without intervening light obstructing or reflecting material, each cathode comprising a metallic filament portion in the

form of one of the indicia and being designed to have a low obscuring effect on the filament portions of other cathodes in the stack more remote from said transparent portion of the envelope, each cathode having a pair of thin metallic mounting tabs integral with its filament portion and extending laterally in substantially opposite directions away from the area generally defined thereby, a pair of spaced apart posts mounted in fixed relationship in said envelope but located outside of the area defined by the indicia formed portions of the cathodes, said posts engaging said tabs and serving to mount said cathodes in said stacked relationship in the envelope, a plurality of electrically conducting leads each having a portion thereof entering said envelope and another portion thereof within said envelope in electrical connection with an individual one of said cathodes, said last portion of the leads being flexible and one or more of these portions assuming a bend in the envelope, said leads providing means for applying a sufficiently different electrical potential to any one of said cathodes relative to a reference potential existing within the envelope to cause a luminous glow at the filament portion of the selected cathode.

15. A glow discharge device as defined in claim 14 wherein each combination of a cathode and pair of mounting tabs together with said lead extension thereof is constituted by a single thin metallic member in which said cathode and mounting tabs lie in the same plane and said lead extension extends at an angle thereto.

16. An indicating tube of the glow lamp type comprising a gas-filled envelope having a portion thereof constituting a transparent viewing face, a plurality of planar glow cathodes within said envelope having the active portions thereof respectively formed in accordance with outline representations of different characters, a body of insulating material between each cathode to insulate them from each other, a separate anode electrode within said envelope for ionizing the gas in response to a suitable potential difference between said anode and a selected one of said cathodes, structural means within said envelope mounting said cathodes and said anode in stacked relationship with said bodies of insulating material on the sides of said cathodes remote from said viewing face, said structural means including integrally formed mounting tabs for each cathode extending outside of the area of the character-representing portion thereof and also including mounting studs projecting through holes in said mounting tabs in all of said cathodes and in said anode and further including support means holding said mounting studs and said cathodes and said anode in assembly therewith close to said viewing face of the envelope, said cathodes when luminously active providing a viewable pattern of characters having dimensions and an arrangement of the parts such that the character-formed portions of the cathodes nearer to said transparent face have a minimum obstructing effect on character-formed portions of the luminous cathodes more remote therefrom, and electrical conducting means including a flexible wire portion connecting said cathodes and said anode with the exterior of said envelope.

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