Oct. 24, 1961 B. J. HART 3,005,922

LUMINOUS DISCHARGE INDICIA TUBE

Filed Nov. 13, 1959 2 Sheets-Sheet 1

Fig. 1.

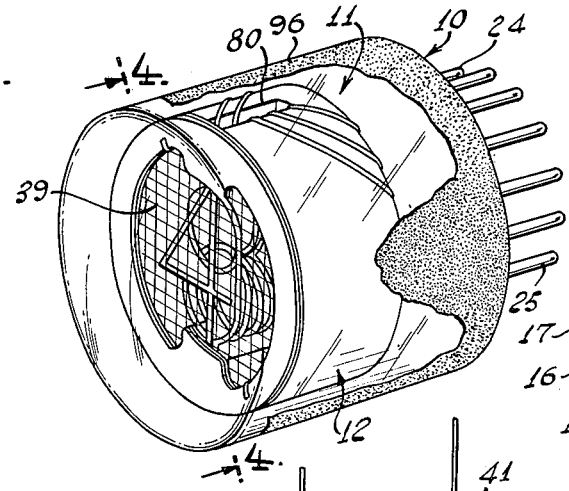


Fig. 3.

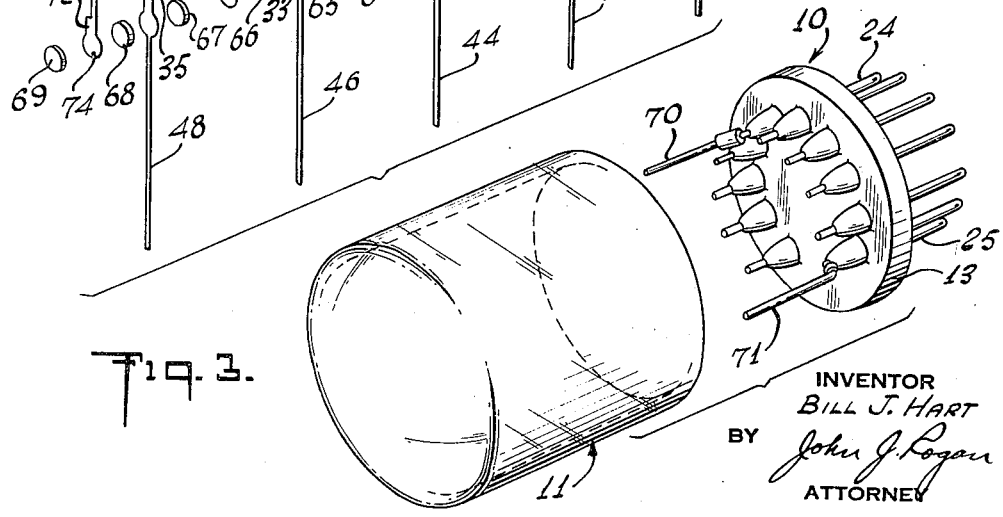


Fig. 2.

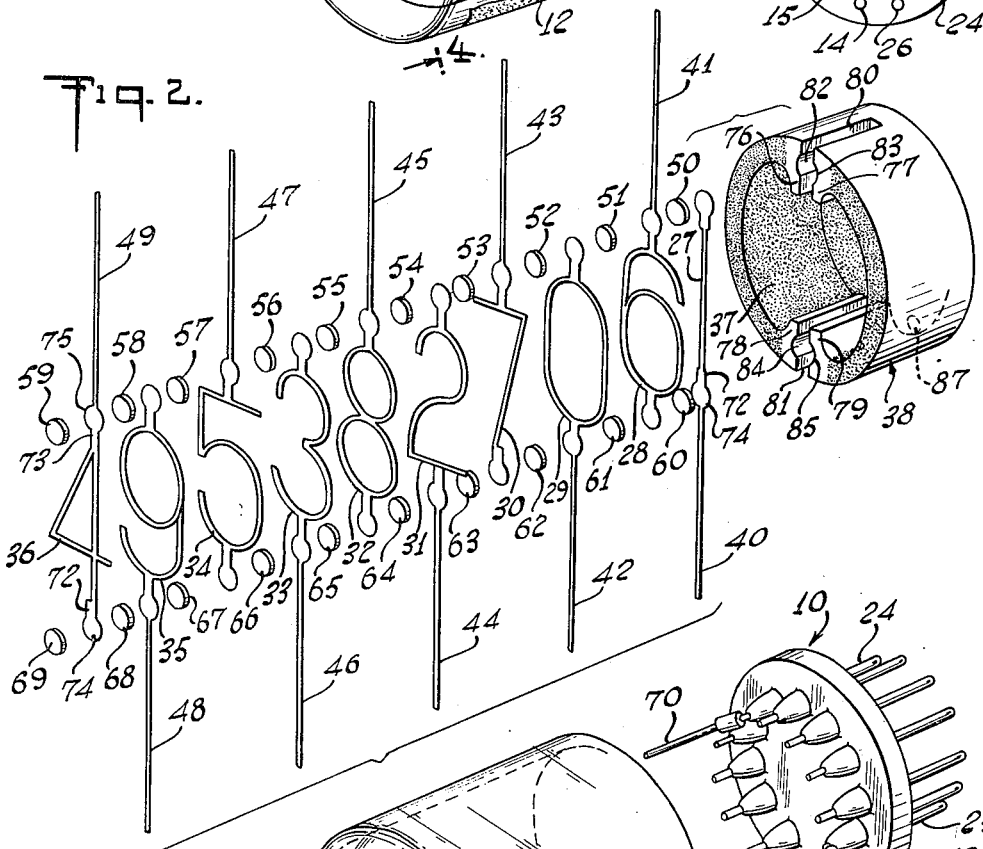
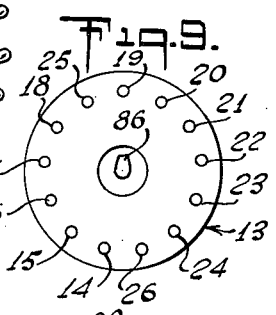


Fig. 4.



INVENTOR
BILL J. HART
BY
John J. Logan
ATTORNEY

Oct. 24, 1961 B. J. HART 3,005,922

LUMINOUS DISCHARGE INDICIA TUBE

Filed Nov. 13, 1959 2 Sheets-Sheet 2

Fig. 4.

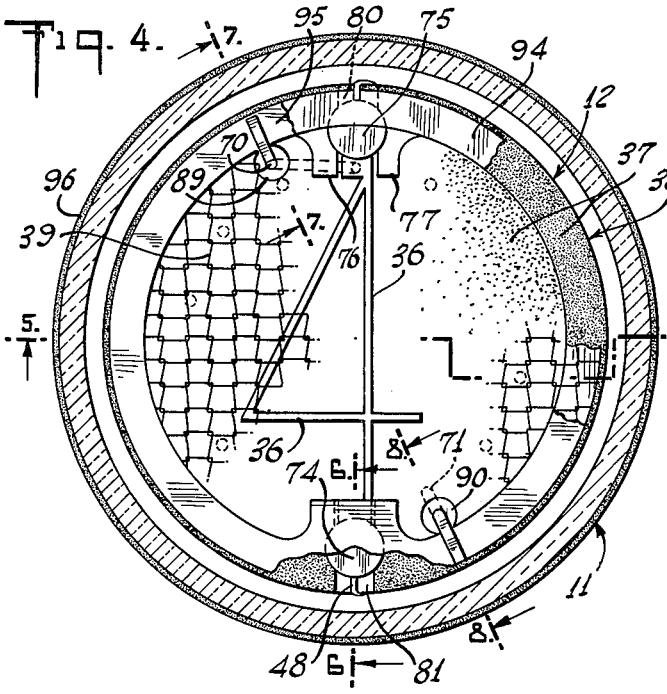


Fig. 6.

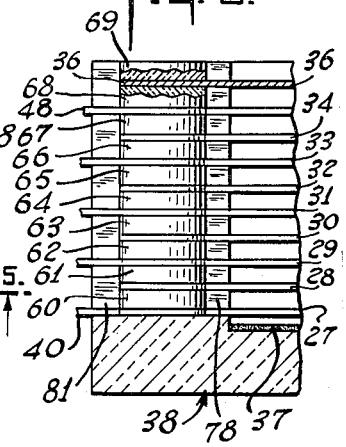


Fig. 7.

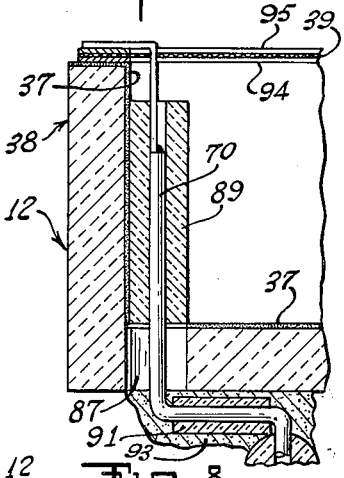


Fig. 5.

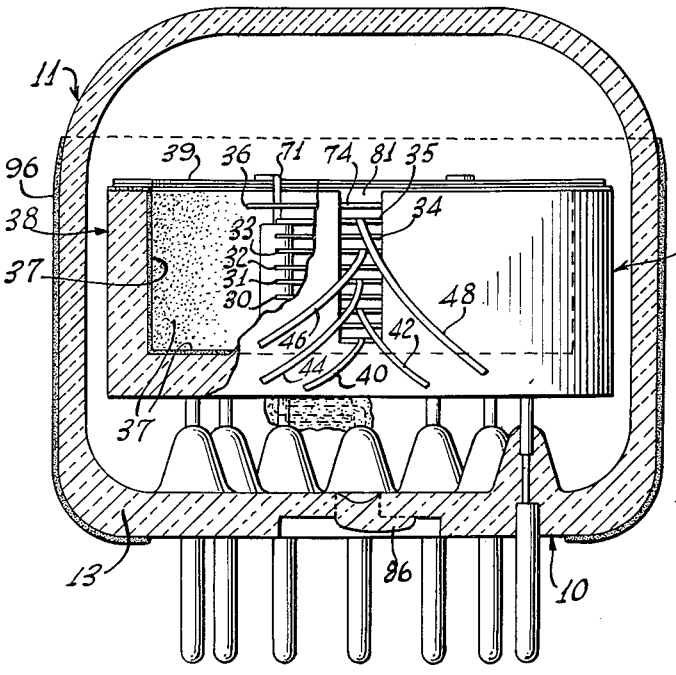
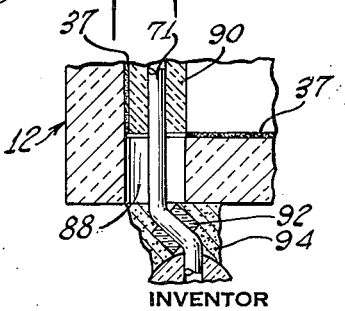


Fig. 8.



INVENTOR
BILL J. HART
BY John J. Regan
ATTORNEY

United States Patent Office 3,005,922 Patented Oct. 24, 1961

3,005,922

LUMINOUS DISCHARGE INDICIA TUBE

Bill J. Hart, Bloomington, Ill., assignor to National Union Electric Corporation, Bloomington, Ill., a corporation of Delaware

Filed Nov. 13, 1959, Ser. No. 852,760
6 Claims. (Cl. 313—109.5)

This invention relates to luminous discharge tubes and more particularly its relates to such tubes wherein a plurality of separate luminous displays or indicia can be selectively produced.

A principal object is to provide a novel and simplified luminous display tube wherein, at any given viewing area or boundary, any desired luminous indicia, whether numerical or alphabetical, or other symbol, can be selectively displayed.

Another principal object is to provide a plural indicia luminous discharge tube employing a series of skeleton-like or fine wire luminous targets in stacked array for selective illumination; employing a novel arrangement of parts whereby the tube can be economically manufactured and assembled with permanent and accurate spacing of the various targets.

A feature of the invention relates to a luminous indicia tube of the stacked skeleton target kind, wherein the various targets and the cooperating energizing electrode or anode, form a complete mount assembly unit, which can be readily attached to the base or header of any well known tube structure such as conventionally used in radio tubes and the like.

Another feature relates to a unitary anode and plural target retainer for aligning a series of luminous indicator targets of the stacked skeleton kind.

Another feature relates to a novel construction for luminous indicia tubes of the stacked skeleton target kind, whereby the various targets can be assembled in accurately spaced stacked array, while enabling the supply conductors or leads to the several targets to be assembled without requiring special insulating coatings on the leads.

A further feature relates to the novel organization, arrangement and relative location and interconnection of parts which cooperate to provide an improved luminous discharge tube of the selective indicia kind.

Other features and advantages not particularly enumerated will be apparent after a consideration of the following detailed description, the appended claims, and the attached drawings.

The present invention is in the nature of an improvement on the kind of luminous indicia tube disclosed in U.S. Letters Patent No. 2,756,366.

In the drawing which shows, by way of example, a tube embodying features of the invention,

FIG. 1 is a perspective view of the completed tube;

FIG. 2 is an exploded view of the composite cup anode and target mount, explaining the method of assembly;

FIG. 3 is a perspective exploded view of the bulb stem and header;

FIG. 4 is a plan sectional view of the tube of FIG. 1 taken along the line 4—4 thereof;

FIG. 5 is a broken sectional view of FIG. 4 taken along the line 5—5 thereof;

FIGS. 6, 7 and 8 are respective sectional views of FIG. 4 taken along the respective lines 6—6, 7—7 and 8—8 thereof. FIG. 9 is a bottom view of FIG. 5.

In general, the tube according to the invention comprises three main sub-assembly units comprised respectively of the pronged glass stem or header 10, the enclosing bulb 11 and the electrode or target mount 12, the said mount being shown in perspective exploded view in FIG. 2. The glass header 10 may be of any

well known kind conventionally used in the making of radio tubes and the like and may comprise a flattened glass member 13 through which are sealed in a vacuum-tight manner, a series of rigid metal rods or prongs. Eleven of these prongs, namely prongs 14—24 extend in both directions from the header, while the twelfth prong 25 extends only in one direction, the external part of that prong being cut off. If the header is of the standard thirteen prong type, the thirteenth prong 26 may be cut off adjacent both sides of the header since it performs no useful function in the particular tube illustrated.

The inwardly extending ends of each one of the prongs 14—23 is connected respectively to a corresponding one of the ten luminous target electrodes 27—36. Merely for purposes of illustration, these electrodes are shaped in the form of numerals, but it will be understood that they may be shaped to alphabetical form or to any other symbol form. The inwardly extending ends of rods 24—25 are connected to the anode coating 37 on the inside and on the top rim of a ceramic cup 38, and also to the woven wire mesh screen of the electrode 39 to be described hereinbelow.

The cup anode 38 and the target electrodes 27—36, together with the integral tabe 40—49 on the targets, are assembled together with a series of interelectrode insulating spacers or washers 50—69 to form a unitary sub-assembly or mount. This mount can be supported from the stem 10 by means of attachment to the inwardly extending ends 70—71 of prongs 24—25 which also serve to apply necessary anode potential to the anode coating 37 and to the screen 39.

Each target electrode has integrally formed therewith, at diametrically opposite points, a pair of target locating lugs consisting of a straight portion 72—73 and a circular flat portion 74—75. The circular portions are, of course, also integrally formed with the respective tabs 40—49. The cup anode 38 has its cylindrical wall provided at diametrically opposite points with inwardly extending flanges 76—77 and 78—79, and the cup wall, as well as the flanges, are cut away to provide respective diametrically opposite slots 80—81. The opposed side walls of the slots are provided with circularly arcuate grooves 82—83, 84—85. These oppositely disposed grooves define circular channels each of a diameter closely fitting the diameter of each of the lug sections 74—75 on each of the target electrodes, but providing just sufficient clearance to permit the easy assembly of the targets in stacked array within the cup 38. It should be observed that the lug portions 74—75 on each target are formed so that the distance between the centers of those circular lug portions is the same as the diametric distance between the centers of the channels 80—81. Likewise each of the ceramic spacer members 50—69 is of approximately the same circular size as the lug portions 74—75. As pointed out hereinabove, the entire inner surface of ceramic cup 38, as well as its flat upper rim, is provided with a coating of graphite or other conductive material so that the cup, in effect, acts as the anode, while the target electrodes 27—36 act as cathodes, each of which is capable of sustaining thereon a cathodic glow. This cathodic glow, of course, is confined to the skeleton shape of each target electrode. For that purpose, after the mount has been assembled and fastened to the stem 10 and the bulb 11 has been sealed to the stem, the bulb is evacuated in the conventional manner and then provided with a filling of a gaseous conduction medium such for example as an inert gas or mixture of such gases. Thereupon the exhaust tubulation 86 at the center of the header 10 can be tipped off and pressed back to flattened form within the preformed recess in

the outer face of the header as described in U.S. Letters Patent No. 2,889,670.

The bottom wall of cup 38 is provided at diametrically opposite points with holes 87—88 (see FIGS. 7 and 8), through which pass the ends of rods 70—71. The holes 87—88 are circumferentially displaced from the adjacent slots 80—81 so that the rods 70—71 can pass upwardly but outside the boundaries of all the target electrodes without touching any of them, as shown in FIG. 4. In addition, each of the rods 70—71 has slipped over it, where it passes the various target electrodes, a respective ceramic sleeve 89—90. Also the lower end of each of the rods 70—71 between the mount 12 and the header 10 is provided with another ceramic sleeve 91—92 (see FIGS. 7 and 8) and any remaining exposed lengths of the lower ends of rods 70—71 are additionally covered with any well known electric insulating cement 93—94.

Seated against the graphite coated rim of cup 38 is the fine wire woven mesh electrode 39, the outer margin of which is welded between a pair of metal rings 94—95 whose inside diameter is approximately the same as the inside diameter of cup 38 as shown more clearly in FIGS. 5, 6, and 7.

The mesh of electrode 39 is formed of very fine wire and the mesh is sufficiently coarse that it presents negligible obstruction to the light emitted by any target which is illuminated by cathodic glow. The rods 70—71 at their upper ends are provided with extensions which pass through the mesh on electrode 39, and these extensions are bent over at right angles against the mesh supporting ring 95 to which they are welded. As shown more clearly in FIG. 6, the uppermost ceramic spacer washers 59 and 69 are substantially flush or even slightly higher than the rim of the cup 38 so that when the ends of rods 70—71 are bent back and fastened against the ring 95, the stacked up targets and intervening ceramic spacers are firmly held in stacked array. It should be observed that the bottom of each of the slots 80—81 are higher than the bottom of the cup 38 as shown more clearly in FIG. 6, thus providing an insulating platform for the first target electrode so as to space that electrode from the graphite 37 on the bottom of the cup.

The manner of assembly of the tube is as follows. The inside surface of cup 38, as well as the upper rim thereof, are coated with graphite or any other conductive material in any well known manner. Care, however, is taken so that the conductive coating is not applied to any of the walls of the slots 80—81 or to any of the walls of the flanges 76—77—78—79. The first target electrode 27 is then dropped into the slots 80—81 and rests against the raised bottom of the slot to space it from the coating 37 on the bottom of the cup. It should be observed that in assembling the first target electrode the circular portions 74—75 of the target tab register with and are seated within the corresponding circular slot defined by the grooves 82—83, and likewise the portions 72—73 of the target tab also fit within the space defined by the opposed flanges 76—77 and 78—79. Then a pair of ceramic spacers 50, 60 are dropped into the circularly grooved slots, whereupon the next target electrode 28 is similarly assembled. This alternate assembly of each target electrode and its corresponding pair of ceramic washers serves to maintain all the targets in the proper insulated spaced relation, but without any visual obstruction of any illuminated target. Furthermore, by the interlocking arrangement between the tabs on opposite sides of each target and the circularly grooved slots 80—81, all the targets are maintained in aligned stacked relation substantially centrally within the cup 38.

It should be observed that the connector tabs 40–49 extend in opposite directions from the alternate target electrodes so that in assembling the stacked electrodes and spacers, the connector tabs 41, 43, 45, 47, 49 extend outwardly through the slot 80; while the connector tabs 40, 42, 44, 46, 48 extend outwardly through the slot 81. These outwardly projecting connector tabs can then be bent downwardly, as shown in FIG. 5, in position to be welded to respective lead-in prongs 14–23. Since the exposed parts of the anode lead are completely covered with insulation, and since the side walls of the slots 80—81 are not covered with conductive material, it is not necessary to cover the connector tabs 40–49 with insulation.

The preformed stem 10 with its respective sealed-in prongs is then assembled with the stacked electrode and cup mount, so that the unbent upper ends of rods 70—71 extend past the stacked electrodes. The ceramic sleeves 89—90 are then slipped over the respective rods 70—71. The screen electrode 39 is then placed on top of the upper graphite coated rim of cup 38 with the upper ends of rods 70—71 protruding therethrough. Thereupon the said rod ends may be bent back and welded against the grid ring 95. The bulb 11 is then assembled over the mount and its rim is sealed to the rim 13 of header 10 in the well known manner. The tube is then exhausted through the exhaust tubulation 86 and subjected to the well known exhaust and baking schedule usually employed in the manufacture of radio tubes and the like. After exhaust and baking, the tube is filled with a mixture of neon and argon gas, whereupon the exhaust tube may be tipped-off and pushed into the preformed recess in the external face of header 10, as described in U.S. Letters Patent 2,889,670. Thereupon the tube may be subjected to the standard aging operation after which the external surface of the bulb along the cylindrical external wall thereof may be provided with a coating 96 of black opaque insulating material. This leaves the upper flattened or dome shaped end of the bulb 11 transparent so that the glowing targets can be seen visually.

It will be understood, of course, that the cathodic glow targets are provided with any well known circuit arrangement for applying a positive potential to the coating 37 causing it to act as an anode while the targets can be connected to any suitable switching arrangement (not shown) to connect any one of the targets selectively in circuit whereby only that particular target sustains a visible cathodic glow. It has been found that by deleting all light obstruction material between the stacked targets and by making them of fine wire or skeleton form, even the lowermost target, for example target 27, is visually distinctive when illuminated, notwithstanding the presence of the intervening non-illuminated skeleton targets. Furthermore, the construction as described provides a more uniform distribution of the anode potential with respect to the various cathode targets since they are all in effect enclosed within a box-like anode constituted of the inner walls of the cup 38 and the screen electrode 39. Furthermore, the construction as shown is particularly well suited to machine assembly of all the parts of the tube, resulting in a rugged and precise finished tube which can be used for example as a numerical read-out tube in any digital indication device or the like.

Various changes and modifications may be made in the disclosed embodiment without departing from the spirit and scope of the invention.

What is claimed is:

1. A plural indicia display device, comprising an enclosing envelope having a transparent portion through which the indicia are viewed, a plurality of separate skeleton target electrodes in stacked array and in alignment with said portion of said envelope, and means to support said electrodes in spaced relation and substantially entirely free from intervening light obstruction or absorption elements, the last mentioned means comprising a cup-shaped member of insulation having at least one slot in the wall thereof, and means integral with each target electrode and interlocked with the walls of said slot to maintain said electrodes against radial displacement and in superposed viewing alignment.

2. A plural indicia device according to claim 1 in which said envelope contains a filling of an ionizable

medium and in which each electrode is arranged to support a cathodic glow, each electrode having a tab with a portion which is in interlocking relation with the walls of said slot and another portion which extends outwardly from said slot to provide an electrical connection to the electrode.

3. A plural indicia gaseous glow discharge device, comprising an enclosing envelope containing an ionizable medium and having a transparent portion through which the idicia are viewed, a plurality of separate cathodic glow-sustaining skeleton cathodes, a cup-shaped member of insulation having at least one slot in the wall thereof, a conductive coating on the inside surface of said cup-shaped member to constitute an anode common to all said cathodes, means to interlock each of said cathodes with the walls of said slot, and insulator spacer means to space and insulate the cathodes from each other in aligned stacked array within said cup-shaped member.

4. A plural indicia gaseous glow discharge device, comprising an enclosing envelope containing an ionizable medium and having a transparent portion through which the indicia are viewed, a plurality of stacked glow sustaining skeleton cathodes, a cup shaped member of insulation having a pair of diametrically opposite slots in the wall thereof, a conductive coating on the inside surface of said cup shaped member the walls of said slots being free from said conductive coating, cathode anchoring means extending in opposite directions from each of said cathodes and interlocked with the walls of said slots to maintain said cathodes in stacked alignment within said cup shaped member, and connector tabs attached to said anchoring means, the connector tabs for alternate cathodes extending outwardly through one of said slots and the connector means for the intervening alternate cathodes extending outwardly through the other of said slots.

5. A mount sub-assembly unit for a plural indicia read-out tube of the stacked skeleton electrode kind, comprising a cup shaped member of insulation having a pair of slots in the wall thereof, said member having its inside surface coated with conductive material to constitute it an anode common to all said cathodes, a plurality of skeleton cathodes stacked in insulated spaced array within the cup, and means carried by each cathode and interlocked with said slots to maintain the cathodes in aligned stacked array.

6. A mount sub-assembly unit for a plural indicia read-out tube of the stacked skeleton electrode kind, comprising a cup shaped member of insulation having a pair of slots in the walls thereof, said member having its inside surface coated with conductive material to constitute it an anode common to all said cathodes, a plurality of skeleton cathodes stacked in insulated spaced array within the cup, means carried by each cathode and interlocked with said slots to maintain the cathodes in aligned stacked array, said cup shaped member being fastened to a pair of metal uprights which are attached to a multi-pronged header, said uprights extending through the cup shaped member and located outside the boundaries of all said stacked electrodes, at least one of said uprights being electrically connected to said conductive material on the inside surface of said cup shaped member, the upper end of the cup shaped member being bridged by a fine wire open mesh electrode which is fastened to the upper ends of said uprights, and said mesh electrode is electrically connected to said conductive material on the inside surface of said cup shaped member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,906,906 McCauley et al. ------- Sept. 29, 1959