Panel type display apparatus.

A panel type display apparatus comprising a back plate (11) and a transparent front plate (12). Parallel strip-like cathodes (15a, 15b, ...) are formed on the back plate (11) and extend in a first direction. An insulating rib structure (13) has a lattice-like structure that extends along lines between adjacent cathodes in the first direction and also along lines extending in a second direction at right angles to the first direction and defines a number of display element sections (14a, 14b, ...). Anodes (16a, 16b, ...) are formed at least on portions of the rib structure extending in the second direction. These anodes (16a, 16b, ..., 20a, 20b, ...) are formed on one side of portions of the rib structure (13) extending in the second direction for the display element sections (14a, 14b, ...) defined on the one side and are isolated from the display element sections defined on the other side of the rib structure portions mentioned by partitioning rib portions (19a, 19b, ...) raised therefrom and in contact with the front plate (12).
Panel type display apparatus

This invention relates to panel type display apparatus, which make use of gas discharge for the display of such information as characters and drawings by selectively controlling the discharge of a number of display element sections arranged in a lattice-like array.

The panel type display apparatus, which is well known as a character display of gas discharge type, has a construction in which a number of display element sections are provided at intersections of pluralities of cathodes and anodes extending perpendicular to one another. When one or more of the cathodes and anodes are selected, corresponding intersections are specified. A high voltage is applied between the cathodes and anodes at the specified intersections, whereby gas discharge is caused at these intersections to cause generation of dots of light therefrom. Predetermined characters or drawings are displayed as corresponding combinations of such light dots.

Fig. 1A shows a display element section of a prior art gas discharge type character display. Back and front plates 11 and 12 which are made of respective glass plates face each other and define a sealed space between them, and this space is filled with the discharge gas. These sealed spaces constitute display
element sections 14, and they are defined by a number of insulating ribs 13 in a perpendicular lattice-like arrangement. In each display element section 14, a cathode 15 made of, for instance, nickel is provided on the corresponding surface of the back plate 11. An anode 16 is provided, facing the cathode 15. The anode 16 is, for example, a silver-electrode, which is laid on the lower surface of the front plate 12.

The front plate here serves as the face plate and is made of a transparent plate for the discharge display within the individual element sections 14 has to be seen from the outside through it. An anode 16 is provided at one corner of the display element section 14 so as not to disturb the display of the display element section 14. In the discharge element section 14, an insulating barrier 17 is provided to define a seed discharge section 18 in a corner portion of the cathode 15 in the closest proximity of the anode 16. In this gas discharge type character display, a low voltage is always applied between the cathode 15 and anode 16 of each display element section, and a seed discharge is maintained in the seed discharge section 18, in which the two electrodes are in the closest proximity to each other. When a high voltage is applied as a display drive voltage between the cathode 15 and anode 16, the discharge in the seed discharge section 18 is spread to the entire area of the cathode 15, whereby a dot of light is produced in the relevant display element section 14.

In the display device of the construction described above, the back plate 11 is provided with the cathodes 15 and barriers 17 while the front plate 12 is provided with the anodes 16. Also, ribs 13 which define the individual display element sections 14 are separately provided on the back and front plates 11 and 12. These ribs 13 are constructed such that the back and front
plates 11 and 12 face each other as shown in Fig. 1A when these plates are assembled together.

In other words, various elements forming the individual element sections 14 are formed as divisions on the back and front plates 11 and 12 respectively. The display device can thus be obtained as a perfect product only when the individual component parts are formed on the back and front plates 11 and 12 and assembled together with sufficient precision.

Therefore, very high precision techniques are required for the machining of the back and front plates 11 and 12, and various problems are liable to be encountered in the manufacture. Also, it is difficult to improve the yield.

In a further aspect, the distance between the cathode 15 and anode 16 substantially corresponds to the distance between the back plate 11 and front plate 12, and the seed discharge section 18 is provided to the end of providing an improved starting characteristic at the time of the dot light generation. However, with this means it is difficult to obtain light emission over the entire surface of the cathode 15 in the display element section 14 at the time of the display state thereof with a high voltage applied between the cathode 15 and anode 16; for example, light emission may be obtained only over a range shown shaded in Fig. 1B. In other words, it is difficult to obtain sufficient brightness of display and obtain sufficient improvement of the display effect.

The object of the invention, accordingly, is to provide a panel type display apparatus, which has a sufficiently simplified construction to permit simplification particularly of manufacture and also permits sufficient light emission area to be obtained for obtaining sufficient improvement of the brightness or like display effect.
This object has been attained by the panel type display apparatus which comprises a transparent front plate, a back plate facing the front plate at a small distance, a plurality of parallel strip-like cathodes formed on the inner surface of the back plate facing the front plate and extending in a first direction, an insulating rib structure formed on the inner surface of the back plate and having a lattice-like structure that extends along lines between adjacent cathodes in the aforementioned first direction and also lines extending in a second direction at right angles to the first direction and defines a number of display element sections, a plurality of anodes formed at least on portions of the rib structure extending in the aforementioned second direction, these anodes being formed on one side of portions of the rib structure extending in the second direction for the display element sections defined on the aforementioned one side, these anodes being also isolated from the display element sections defined on the other side of the rib structure portions mentioned by partitioning rib portions raised therefrom and in contact with the front plate.

With this construction of the panel type display apparatus according to the invention, sufficient simplification of the construction can be obtained, and particularly the manufacturing process can be effectively improved. Further, with this display apparatus, the response of operation and the brightness of display can be improved. Thus, the panel type display apparatus according to the invention can be effectively used as a character display or the like.

By way of example and to make the description clearer, reference is made to the accompanying drawings, in which:

Fig. 1A is a fragmentary sectional view showing a
prior art display device;

Fig. 1B is a view showing an exemplary range of discharge display obtainable with the display apparatus of Fig. 1A;

Fig. 2 is a fragmentary exploded perspective view showing a first embodiment of the display apparatus according to the invention;

Fig. 3A is a sectional view taken along line A-A in Fig. 2;

Fig. 3B is a sectional view taken along line B-B in Fig. 2;

Fig. 4 is a view showing a display element section 14a in the display apparatus shown in Fig. 2;

Fig. 5 is a fragmentary exploded perspective view showing a second embodiment of the display apparatus according to the invention;

Fig. 6 is a sectional view corresponding to a section taken along line C-C in Fig. 5; and

Figs. 7A and 7B are views showing a display element section in the display apparatus shown in Fig. 5.

Fig. 2 shows a fragmentary exploded perspective view of a first embodiment of the panel type display apparatus according to the invention, and Figs. 3A and 3B show sectional views corresponding to the sections taken along line A-A and B-B in Fig. 2.

A back plate 11 and a front plate 12 face each other at a small distance between them. The arrangement of these plates is sealed along its edges by suitable spacers (not shown), and the sealed space is filled with a discharge gas, for example inert gas. The front plate 12 is made of a suitable transparent glass plate.

A plurality of parallel strip-like cathodes 15a, 15b, ... made of, for instance, nickel are provided by means of printing techniques on the inner surface of the back plate 11 to extend in a first direction. An insulating rib structure 13 is formed on inner surface
of the back plate 11 and has a lattice-like structure extending along lines between adjacent cathodes 15a, 15b, ... in the aforementioned first direction and also along lines in a second direction perpendicular to the first direction. This insulating rib structure 13 is formed by such means as repeated screen printing with respect to, for instance, the back plate 11. The cathodes 15a, 15b, ... are divided in the longitudinal direction thereof and confined in respective rectangular sections which are defined by the lattice-like rib structure 13 as display element sections 14a, 14b, ... Portions of the rib structure 13 extending in the second direction perpendicular to the longitudinal direction of the cathodes 15a, 15b, ... include raised partitioning ribs 19a, 19b, ... which are sufficiently high in level to reach the inner surface of the front plate 12 and reliably isolate the common cathodes in the display element sections on their opposite sides. Anodes 16a, 16b, ... of silver or the like are formed on portions of the rib structure 13 on one side of the partitioning rib portions 19a, 19b, ... such that they cross the cathodes 15a, 15b, ... These anodes 16a, 16b, ... have their action for the display element sections 14a, 14b, ... on the side of the partitioning rib portions 19a, 19b, ... on which they are provided. Further, auxiliary anodes 20a, 20b, ... are formed in a comb-like form on top of portions of the rib structure 13 extending in the aforementioned first direction to define the display element sections 14a, 14b, ... Each of the display element sections 14a, 14b, ... is thus surrounded by anodes formed on rib structure portions defining its three sides.

The essential component parts of the panel type display apparatus, namely the insulating rib structure 13 defining the individual display element sections 14a, 14b, ..., cathodes 15a, 15b, ..., anodes 16a, 16b, ...
and 20a, 20b, ... and partition ribs 19a, 19b, ..., which serve to prevent the actions of the anodes in the display element sections on their opposite sides using common cathodes with respect to the display element section on the other side, are all formed on the back plate 11 by suitable means such as screen printing. The display device according to the invention is obtained by assembling the back plate 11 which carries the aforementioned various component parts and the front plate 12 such that these plates correctly face each other.

A mask 21 is formed by printing techniques on the front plate 12 such that it corresponds in position to the rib structure defining the respective display element sections 14a, 14b, ...

With the above construction of the display apparatus, only the aforementioned electrodes and insulating rib structure constituting the display element sections 14a, 14b, ... may be formed on the back plate 11 by means of screen printing techniques, and the front plate 12 is free from any structure requiring particular precision. Thus, in the manufacture, it is necessary to take only the precision with respect to the back plate 11 into considerations.

In the prior art construction as shown in Fig. 1, in which the cathodes 15 are formed on the back plate 11 and the anodes 16 are formed on the front plate 12, if an electrode or a rib division on either back plate 11 or front plate 12 is faulty, the display apparatus which is obtained by assembling these plates is deemed to be rejected, and therefore the yield is extremely inferior.

With the above embodiment of the invention, the front plate 12 need be provided with only the mask 21, and all the parts of the construction that provide their individual actions at the time of the display operation are aggregately formed on the back plate 11. Thus, the
embodiment is greatly effective for the simplification of the manufacture and maintenance and increase of the yield.

In addition to the aforementioned advantages obtainable in connection with the manufacture, with the above embodiment, in which the distance between the anode and cathode can be made sufficiently small, it is possible to extremely improve the response in display at the time of the application of the display drive voltage between the cathode and anode.

Further, with the construction where the three sides of, for instance, the display element section 14a are surrounded by the anodes 16a, 20a and 20b, the cathode 15c of the display element section 14a is faced by the anode over a greater portion of its periphery, that is, the discharge is generated from the three sides of the cathode 15c to spread to the entire display element section 14a. Thus, satisfactory state of discharge over the entire display element section 14a can be obtained, and the brightness of the dot display in the display element section 14a can be extremely improved. In other words, with the above embodiment of the display apparatus satisfactory response in display can be obtained, and also the brightness is also improved, so that it is possible to obtain an extremely improved character display effect.

Fig. 5 shows a fragmentary exploded perspective view of a second embodiment of the panel type display apparatus according to the invention. Fig. 6 shows a sectional view of the second embodiment taken along line C-C in Fig. 5. In Figs. 5 and 6, like or the same numerals are used to denote like or the same elements as those illustrated in Fig. 2.

The embodiment of Figs. 5 and 6 differs from the first embodiment of Fig. 2 in that it is provided ribs 22a, 22b, ..., thereby to have a sufficient response
speed.

In the individual display element sections 14a, 14b, ..., respective seed discharge sections 23a, 23b, ... are formed. Each seed discharge section is defined in a small area of the surface of the cathode, which is in the vicinity of the corresponding one of the anodes 16a, 16b, ..., by a corresponding one of ribs 22a, 22b, ..., and in this section discharge is caused when a low voltage is applied between a corresponding one of the anodes 16a, 16b, ... and a corresponding one of cathodes 15a, 15b, ...

As in the first embodiment of Fig. 2, the essential components of the panel type display apparatus, i.e., the display element sections 14a, 14b, ... are formed on the back plate 11 by suitable means such as screen printing.

A mask 21 may be formed by printing on the front plate 12 such that it corresponds in position to the defining section that defines the individual display element sections 14a, 14b, ... By this mask 21 the rib structure 13 and seed sections 23a, 23b, ... are concealed, so that the discharge display in the cathode surfaces in the individual display element sections can be recognized by sight with sufficient distinction from one another.

Fig. 7A shows one of the display element sections, namely section 14a. With a low voltage held applied between the cathode 15c and anode 16a, a seed discharge is maintained in the seed discharge section 23a which is defined in a small area in the sufficient vicinity of the anode 16a. When a sufficiently high drive voltage is applied between the cathode 15c and anode 16a, a discharge display is obtained over the entire cathode surface in the display element section 14a as shown in Fig. 7B. In this case, since the seed discharge is maintained in the seed discharge section, the discharge
display state as shown in Fig. 7B can be obtained with sufficient response speed.

The above embodiments have been given for the purpose of illustration only and are by no means limitative, and various changes and modifications may be made without departing from the scope and spirit of the invention.
Claims:

1. A panel type display apparatus, in which display is obtained by causing discharge with selective application of a voltage at a plurality of locations where a plurality of cathodes and a plurality of anodes formed between a back plate and a transparent front plate constituting a sealed panel structure sealed with a discharge gas, characterized by

   said front plate (12) and back plate (11), which face each other at a small distance;

   said plurality of cathodes, which are formed as parallel strip-like anodes (15a, 15b, ...) on the inner surface of said back plate (11) facing said front plate (12) and extending in a first direction;

   an insulating rib structure (13) formed on the inner surface of said back plate (11) and having a lattice-like structure extending along lines between adjacent cathodes in said first direction and along lines extending in a second direction at right angles to said first direction, said insulating rib structure defining a number of display element sections (14a, 14b, ...); and

   said plurality of anodes (16a, 16b, ..., 20a, 20b, ...), which are formed at least on portions of said insulating rib structure (13) extending in said second direction, said anodes (16a, 16b, ..., 20a, 20b, ...) being formed on one side of portions of said insulating rib structure (13) extending in said second direction for the display element sections (14a, 14b, ...) defined on said one side, said anodes (16a, 16b, ..., 20a, 20b, ...) being isolated from the display element sections (14a, 14b, ...) defined on the other side of said insulating rib structure portions by partitioning rib portions (19a, 19b, ...) raised therefrom and in contact with said front plate (12).
2. A panel type display apparatus according to claim 1, characterized in that each of said strip-like cathodes (15a, 15b, ...) has seed discharge sections (23a, 23b, ...) at the portion close to the anode (16a, 16b, ...), said seed discharge sections (23a, 23b, ...) being partially surrounded by partitioning ribs (22a, 22b, ...) which are formed integral with said insulating ribs (13).

3. The panel type display apparatus according to claim 1, characterized in that said anodes (16a, 16b, ...) formed on the insulating rib structure portions extending in said second direction each include extensions (20a, 20b, ...) extending in a comb-like form along portions of the insulating rib structure (13) extending in said first direction on the opposite sides of the associated display element sections (14a, 14b, ...) so that three sides of each display element section is thus surrounded by the corresponding anode.

4. The panel type display apparatus according to claim 1, characterized in that said front plate (12) is formed with a lattice-like mask (21) corresponding in position to said lattice-like insulating rib structure (13).
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<th>Citation of document with indication, where appropriate, of relevant passages</th>
<th>Relevant to claim</th>
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<td>JOURNAL OF PHYSICS E: Scientific Instruments, 1975, Vol.8</td>
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<td>G.F. WESTON &quot;Plasma panel displays&quot; pages 981-991</td>
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<td>* Page 984, fig. 4; page 983, right column, lines 46-48 *</td>
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**CLASSIFICATION OF THE APPLICATION (Int. Cl.)**

- H 01 J 17/49
- H 01 J 17/00
- G 09 F 9/00

**TECHNICAL FIELDS SEARCHED (Int. Cl.)**

- H 01 J 17/00
- G 09 F 9/00

**CATEGORY OF CITED DOCUMENTS**

- X: particularly relevant
- A: technological background
- O: non-written disclosure
- P: intermediate document
- T: theory or principle underlying the invention
- E: conflicting application
- D: document cited in the application
- L: citation for other reasons
- 8: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

**Place of search**

VIENNA

**Date of completion of the search**

09-02-1982

**Examiner**

BENISCHKA