Aug. 24, 1965 D. W. DAVIS 3,202,856

STORAGE SCREEN ASSEMBLY FOR CHARGE STORAGE TUBES

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Fig. 1.

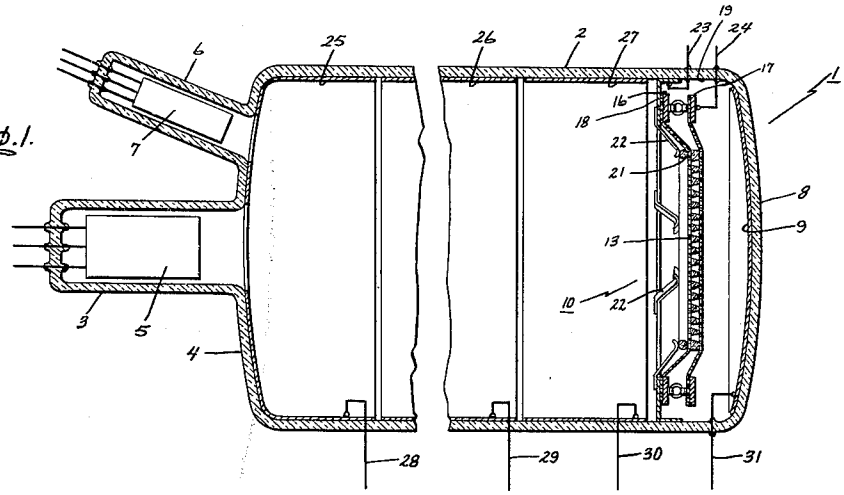


Fig. 2.

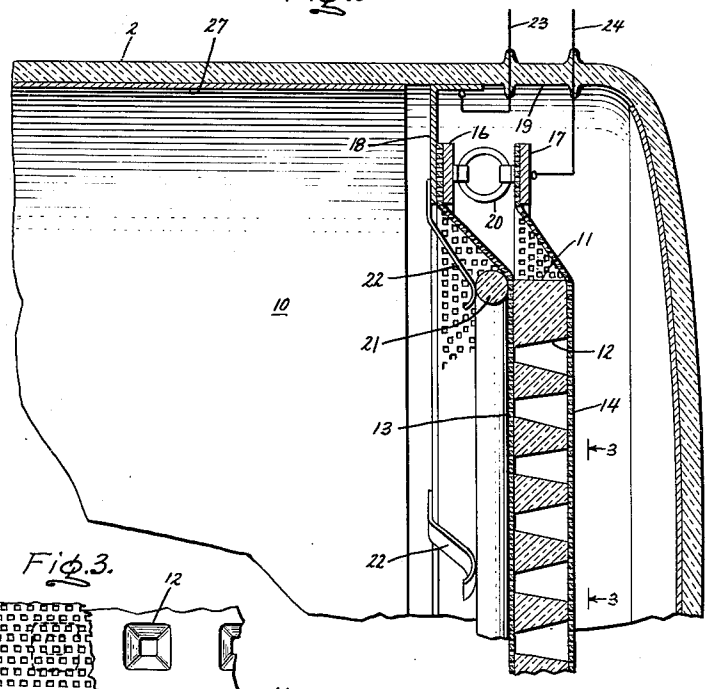
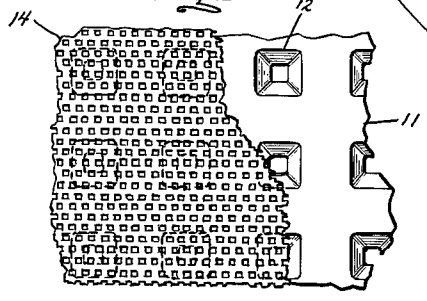


Fig. 3.



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STORAGE SCREEN ASSEMBLY FOR CHARGE STORAGE TUBES

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This invention relates to charge storage tubes, such as signal-to-image storage tubes, and more particularly to storage screen assemblies for such tubes.

Signal-to-image storage tubes are utilized in such applications as indicators in radar systems in which it is desired to store one or more transient input signals and subsequently visibly to display such signals. In these tubes, there is conventionally provided a storage screen assembly including a fine mesh screen of dielectric material having secondary emission properties with a metal backing layer on one side thereof, and a fine mesh metal collector screen closely spaced from the dielectric side of the storage screen. The storage screen assembly is disposed between the phosphor display or viewing screen and an electron gun assembly which provides a high velocity "pencil" electron beam which is caused to scan the storage screen assembly by means of conventional deflection and focusing elements. The high velocity electron beam impinging upon the dielectric coating on the storage screen assembly displaces secondary electrons which are collected by the collector screen, thus leaving a positive charge on the storage screen caused by a deficiency in electrons thereon. By modulating the high velocity electron beam in accordance with the incoming signal, the discrete areas of the storage screen defined by the openings therein will have different charges thereon thereby forming a pattern or charge image on the storage screen corresponding to the input signal; this charge image will be retained on the storage screen for a substantial period of time and may be "read out" at any time during its existence. The charge image is "read out" by providing a second electron gun assembly which directs a flood beam of low velocity electrons onto the storage screen. These low velocity electrons pass through the openings in the storage screen in accordance with the elemental charges thereon and thus excite the phosphor viewing screen to provide a visible display of the charge image stored on the storage screen.

In the past, the storage screen assembly in charge storage tubes has commonly been made by coating a fine-mesh metal screen on one side with a dielectric material, for example by evaporation. In such assemblies, the fine-mesh metal collector screen was spaced as close to the dielectric surface as possible without risk of physical contact between the two during tube operation. In such assemblies, the dielectric coating was necessarily thin and arcing between the metal backing screen and the collector screen through the dielectric layer could occur, or the capacity of the insulator at the point of contact to the collector could become charged spuriously. It has therefore been considered desirable to employ thicker dielectric layers to permit the collector to contact the insulator everywhere uniformly without the possibility of arcing between the metal backing screen and the collector screen. In some applications where the objective is high sensitivity, it is also desirable to reduce the capacity of the surface with respect to the insulator screen and to retain the low capacity gap between the collector screen and dielectric surface; such lower capacity reduces charging time of the dielectric layer and therefore increases the sensitivity of the tube. It was found, however, that thicker dielectric layers could not readily be evaporated onto the metal backing screen since the openings in the metal mesh tended to close as the evaporated layer thereon became thicker.

A recent development in the field of glass technology has permitted the employment of integral fine-mesh glass screens substantially thicker than those which previously could effectively be evaporated onto a metal backing screen. In accordance with this new technique, a sheet of photosensitive glass, referred to as Fotoform glass, can be etched in a ratio on the order of five to one. With this Fotoform glass, therefore, a geometrically arranged pattern of light and dark areas may be photographically imprinted on one surface of the glass with the exposed areas being etched through the glass sheet thereby to form a fine-mesh perforate screen; after baking at high temperature, the resulting perforate dielectric screen is referred to as Fotoceram. Since the Fotoceram dielectric layer is thicker than the dielectric layers previously produced by evaporation techniques, it has been found possible to employ physical contact between the dielectric surface and the collector screen without encountering short circuits between the metal backing screen and the collector screen during operation of the tube.

Subsequent to the development of the Fotoceram screens, it has been common practice to deposit a conductive metal coating on one side of the Fotoceram screen, for example by evaporation, thereby to form the metal backing screen. In such arrangements, the surface of the Fotoceram screen remote from the metal backing screen was left bare to form the charge storage surface and the metal collector screen was mounted in the tube closely spaced from the storage surface.

The method of applying the metal conductive coating to the Fotoceram screen was however very tedious and time-consuming. The Fotoceram screen was laid upon a flat plate and the openings therein were filled with a powder to prevent coating of the walls of the openings of the Fotoceram screen with the evaporated metal. A relatively thin layer of conductive metal was then evaporated in a vacuum onto the exposed surface of the Fotoceram screen and lastly the powder had to be removed from the openings without damaging the metal layer.

It is, therefore, desirable to provide a storage screen assembly for a charge storage tube in which a Fotoceram dielectric screen may be employed without the necessity of evaporating the metal backing layer thereon. While arrangements employing a separate integral fine-mesh dielectric screen in conjunction with a separate integral metal backing screen have been proposed, it has been extremely difficult respectively to arrange the dielectric screen and the metal backing screen so that their openings are in registry, and further, supporting of the Fotoceram screen, which is relatively thin and fragile, has been difficult.

My invention in its broader aspects, therefore, provides a storage screen for charge storage tubes having a thin, perforate screen formed of dielectric material, such as Fotoceram, with a pair of thin fine-mesh metal screens respectively abutting the opposite faces of the dielectric screen, one of the fine-mesh metal screens serving as the metal backing screen and the other serving as the collector screen of the tube. In order to solve the problem of obtaining registry between the openings in the fine-mesh dielectric screen and the fine-mesh metal screens, the metal screens preferably have a substantially finer mesh than the dielectric screens so that registry is no longer a problem. With this arrangement, the dielectric screen is supported between the two fine-mesh metal screens and in the preferred embodiment, resilient means are provided for respectively urging the fine-mesh metal screens into close and taut engagement with the opposite surfaces of the dielectric screen.

It is, therefore, an object of my invention to provide an improved storage screen assembly for charge storage tubes.

Another object of this invention is to provide an improved storage screen assembly for charge storage tubes which can employ a Fotoceram dielectric screen, or the like, but which avoids the prior tedious step of metal coating the dielectric screen.

Yet another object of this invention is to provide an improved storage screen assembly for charge storage tubes in which uniform and very close spacing between the dielectric layer and the collector screen is provided.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a cross-sectional view of a charge storage tube of the signal-to-image display type incorporating my improved storage screen assembly;

FIG. 2 is a fragmentary cross-sectional view further illustrating the construction of my improved storage screen assembly; and

FIG. 3 is a fragmentary front view, partly broken away, of a portion of my improved storage screen assembly as viewed along line 3 of FIG. 2.

Referring now to the drawings, there is shown a signal-to-image storage tube, generally identified as 1, which includes an envelope 2, which may conventionally be formed of glass, and which has a neck portion 3 formed at its end 4 coaxial with the axial centerline of the tube. An electron gun assembly 5 for providing a low velocity "flood" beam of electrons is positioned within the neck 3, it being understood that any conventional electron gun construction may be utilized and that the specific electron gun does not form a part of this invention. The envelope 2 includes another neck portion 6 at its end 4 offset from the axial centerline of the tube in which another electron gun 7 is positioned, the electron gun 7 providing a pencil beam of high velocity electrons. Here again, it is to be understood that any conventional electron gun assembly may be utilized and that this specific electron gun assembly does not form a part of this invention.

The face 8 of the envelope 2 of tube 1 remote from the end 4 and electron guns 5 and 7 has a conventional phosphor coating 9 formed on the inner surface thereof for providing a visual display of the charge image. My improved storage screen assembly, generally identified as 10, is disposed within the envelope 2 intermediate the phosphor coating 9 and the electron guns 5 and 7. The "pencil" beam provided by the writing gun 7 is directed toward the storage screen assembly 10 by means of suitable focusing and deflecting means (not shown), as is well-known in the art, and the flood beam provided by the flood gun 5 is likewise directed toward the storage screen assembly 10.

Referring now particularly to FIGS. 2 and 3 in addition to FIG. 1, my improved storage screen assembly 10 includes a thin, integral, perforate, preferably circular sheet 11 of dielectric material. The sheet 11 is preferably formed of Fotoceram and has a plurality of geometrically arranged openings 12 eteched therein, thereby to form a fine-mesh screen. When Fotoceram is employed as the dielectric material, the dielectric screen 11 may, for example, be 3 mils thick with the openings 12 forming, for example, a 300-mesh screen. A pair of fine-mesh metal screens 13 and 14, for example 0.5 mil thick and with a mesh of 1,000 are arranged abutting the opposite surfaces of the dielectric screen 11; the fine-mesh metal screens 13 and 14 are preferably flat metal screens formed by electroplating with a photo-resist process, as is well-known in the art.

The fine-mesh metal screens 13 and 14 are respectively mounted on annular rings 16 and 17, with screen 13 and its mounting ring 16 being secured to annular metal mounting ring 18, which in turn is secured to inner wall 19 of envelope 2. Screen 14 with its mounting ring 17 is secured to and spaced from rings 16 and 18 by a plurality of ceramic stand-off insulators 20. It will now be seen that the mounting rings 16 and 18 with the fine-mesh metal screen 13 mounted therebetween, and the mounting ring 17 with the fine-mesh metal screen 14 mounted thereon, are respectively arranged in planes parallel and spaced from the opposite faces of the dielectric screen 11. In order to arrange the fine-mesh metal screens 13 and 14 so that they are in intimate contact with the opposite faces of the dielectric screen 11, a toroidal ring 21 is arranged abutting the front face of the fine-mesh metal screen 13 and a plurality of leaf springs 22 are provided respectively secured to the mounting ring 18 and respectively engaging the ring 21 thereby urging the fine-mesh metal screens 13 and 14 into close, intimate, and taut engagement with the opposite faces of the dielectric screen 11, as shown.

It will now be observed that the dielectric screen 11 is supported between the two fine-mesh metal screens 13 and 14 and that both the metal backing screen and the collector screen are provided without the necessity of evaporating a metal layer upon the dielectric layer. With this arrangement, the front fine-mesh metal screen 13 may be employed as the collector screen with a lead 23 being connected thereto which may be connected to an appropriate source of potential, such as 25-volts positive. The backing screen 14 may likewise be connected to a suitable source of potential by a lead 24, such as 5-volts positive. The storage tube 1 is also shown as having conductive coatings 25, 26 and 27 applied to the inner surface of the envelope 2, which is connected to suitable sources of potential, as is well known in the art, by leads 28, 29 and 30 and thus serve as a collimating lens system for the flood electron beam. The phosphor screen 9 is also connected to a suitable source of potential, such as 7,000-volts positive, by a lead 31.

With my improved storage screen assembly, the closest possible spacing between the collector screen and the metal backing screen is provided, this close spacing preventing redistribution of secondary electrons, minimizing the spreading of the writing beam between the collector screen and the storage screen, avoiding non-uniformity caused by changes in the screen spacing found in present tubes, and finally establishing a strong electric field gradient with relatively low collector screen voltage which provides improvement in writing speed, storage time, resolution, and uniformity. Furthermore, as pointed out above, my improved storage screen assembly permits the use of the superior Fotoceram screens without the previous tedious and difficult step of metallizing one surface being required.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention.

What is claimed is:

1. In a charge storage tube, a storage screen assembly comprising: a thin integral perforate screen formed of dielectric material; a pair of thin integral metal screens; and means respectively removably clamping said metal screens against the opposite faces of said dielectric screen.

2. In a charge storage tube, a storage screen assembly comprising: a thin perforate screen formed of dielectric material; a pair of thin metal screens; and means respectively removably clamping said metal screens against the opposite faces of said dielectric screen, said metal screens respectively having a finer mesh than said dielectric screen.

3. In a charge storage tube, a storage screen assembly comprising: a thin perforate screen formed of dielectric material; a pair of thin metal screens; and means respec-

tively removably clamping said metal screens against the opposite faces of said dielectric screen, said dielectric screen being supported by said metal screens.

4. In a charge storage tube, a storage screen assembly comprising: a thin integral perforate screen formed of dielectric material; a pair of thin integral metal screens; and means respectively independently supporting said metal screens and removably clamping the same against the opposite faces of said dielectric screen, said dielectric screen being supported by said metal screens, said metal screens respectively having a finer mesh than said dielectric screen.

5. A storage screen assembly for a charge storage tube comprising: a thin integral perforate screen formed of dielectric material and having flat opposite faces; and a pair of thin, flat integral metal screens respectively in abutting contact with said opposite faces of said dielectric screen but not adhered thereto.

6. In a charge storage tube, a storage screen assembly comprising: a thin integral perforate screen formed of dielectric material; a pair of annular members coaxial with said dielectric screen; and a pair of thin integral metal screens respectively tightly stretched on said annular members and respectively abutting the opposite faces of said dielectric screen and supporting the same.

7. In a charge storage tube, a storage screen assembly comprising: a thin integral perforate screen formed of dielectric material; a pair of thin integral metal screens respectively abutting the opposite faces of said dielectric screen; and resilient means for respectively tightly stretching said metal screens and for urging the same into taut engagement with said dielectric screen so that said dielectric screen is supported solely between said metal screens.

8. In a charge storage tube, a storage screen assembly comprising: a thin integral perforate screen formed of dielectric material; a pair of annular members coaxial with said dielectric screen; a pair of thin integral metal screens respectively mounted on said annular members and respectively abutting opposite faces of said dielectric screen, said metal screens respectively having a finer mesh than said dielectric screen; and resilient means for respectively tightly stretching said metal screens and for urging the same into close engagement with said dielectric screen so that said dielectric screen is supported solely between said metal screens.

9. In a charge storage tube, a storage screen assembly comprising: a thin, circular, integral, perforate screen formed of dielectric material; a pair of annular rings respectively coaxially arranged with said dielectric screen; a pair of thin integral metal screens respectively mounted on said rings; and resilient means for urging said metal screens into close and taut engagement with the opposite

faces of said dielectric screen so that said dielectric screen is supported solely between said metal screens.

10. In a charge storage tube, a storage screen assembly comprising: a thin, circular, integral, perforate screen formed of dielectric material; a pair of annular rings respectively coaxially arranged with said dielectric screen; a pair of thin integral metal screens respectively mounted on said rings; another annular ring smaller than said pair of rings and respectively coaxial therewith, said other ring abutting the face of one of said metal screens; and resilient means respectively engaging said other ring for urging said metal screens into close and taut engagement with the opposite faces of said dielectric screen so that said dielectric screen is supported solely between said metal screens.

11. In a charge storage tube, a storage screen assembly comprising: a thin, circular, integral, perforate screen formed of dielectric material; a pair of annular rings respectively coaxially arranged with said dielectric screen; a pair of thin integral metal screens respectively mounted on said rings and a plurality of spring fingers mounted on one of said rings for urging said metal screens into close and taut engagement with the opposite faces of said dielectric screen so that said dielectric screen is supported solely between said metal screens.

12. In a charge storage tube, a storage screen assembly comprising: a thin, circular, integral, perforate screen formed of dielectric material; a pair of annular rings respectively coaxially arranged with said dielectric screen; a pair of thin integral metal screens respectively mounted on said rings; said metal screens respectively having a substantially finer mesh than said dielectric screen; another annular ring smaller than said pair of rings and coaxial therewith, said other ring abutting the face of one of said metal screens; and a plurality of spring fingers mounted on one of said pair of rings and engaging said other ring for urging said metal screens into close and taut engagement with the opposite faces of said dielectric screen so that said dielectric screen is supported solely between said metal screens.

References Cited by the Examiner

UNITED STATES PATENTS

2,777,084	1/57	Lafferty	313—348 X
2,788,466	4/57	Hansen	315—13 X
2,821,637	1/58	Roberts et al.	313—68 X
2,879,442	3/59	Kompfner et al.	315—12
2,922,906	1/60	Day et al.	313—68
2,926,419	3/60	Harris	313—68
2,927,239	3/60	Hunter	313—68

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