

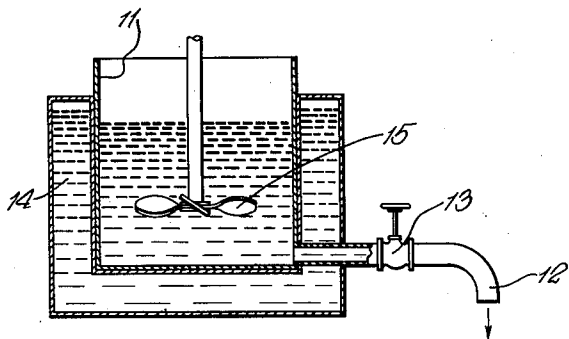
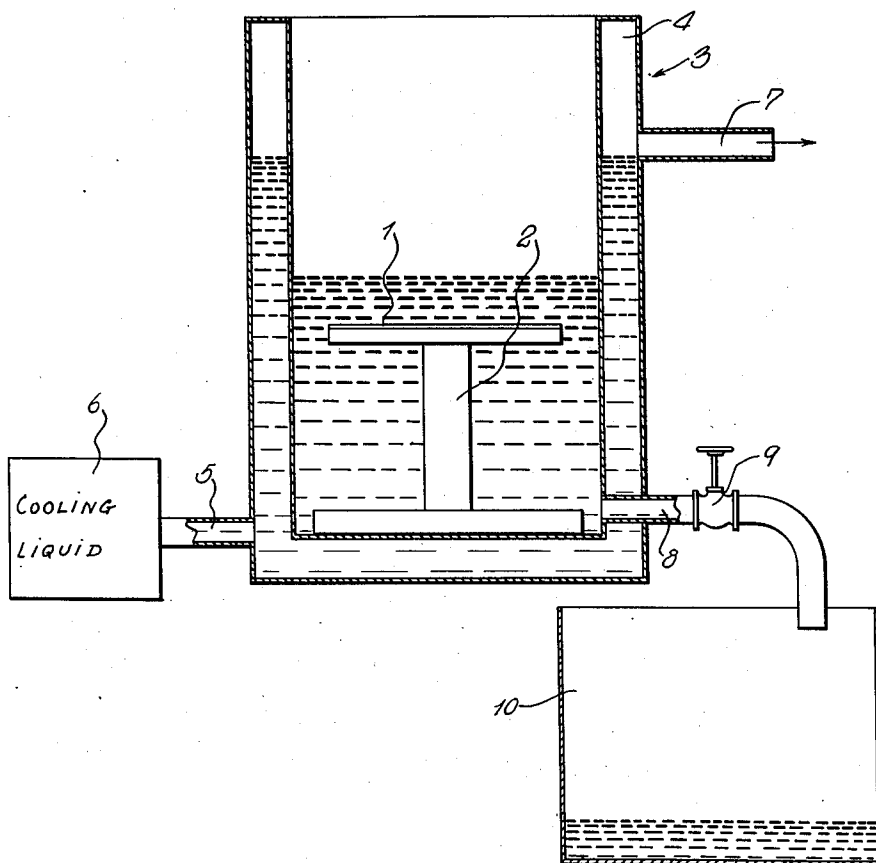
Oct. 28, 1952

G. LEVY

2,615,821

METHOD OF MAKING SCOTOPHOR SCREENS

Filed March 11, 1949



INVENTOR.
GUSTAVE LEVY

BY

John J. Hogan
ATTORNEY

UNITED STATES PATENT OFFICE

2,615,821

METHOD OF MAKING SCOTOPHOR SCREENS

Gustave Levy, East Orange, N. J., assignor to National Union Radio Corporation, Orange, N. J., a corporation of Delaware

Application March 11, 1949, Serial No. 80,905

6 Claims. (Cl. 117—33.5)

1

This invention relates to so-called dark trace cathode-ray tubes, and more particularly to methods and means for forming the viewing screens of such tubes.

It has been known for some time that certain crystals, such as crystals of the alkali halides, are sensitive to impinging cathode-ray beams, and respond by a change in opacity or light transmission properties. Such crystals are referred to in the art as scotophors. As is well known in the art, the expression "alkali halide" refers to a halogen salt of an alkali metal. Such scotophors are referred to in the art either as alkali metal halides or merely as alkali halides. Screens formed from such crystals have been used in so-called dark trace tubes for television reproduction, signal storage and the like. One of the difficulties in producing such tubes is that of applying the screen material to the backing support with the desired uniformity and fineness of the crystals.

Accordingly, one of the principal objects of this invention is to provide novel methods and apparatus for forming such screens and attaching them to their final backings or supports.

Another object is to provide a scotophor screen which is attached to a transparent support and which also has a coating of a plastic film.

Another object is to provide an improved screen of the type having a coating of a transparent metal such as aluminum or the like which metal is sufficiently thin to be transparent to a cathode-ray beam while acting as an effective electrode for controlling the opacity conditions of the scotophor screen.

A feature of the invention relates to an arrangement for forming a scotophor screen by direct precipitation from a concentrated solution of an alkali halide.

Another feature relates to an arrangement for forming a scotophor screen by direct precipitation from a saturated solution of an alkali halide and by incorporating in the solution a liquid plastic material which settles on the finished screen to form a protective layer or film thereover.

Another feature relates to a novel arrangement for precipitating a scotophor screen by rapid cooling of a saturated solution of an alkali halide.

A further feature relates to the novel method of controlling the deposition and fineness of the scotophor crystals which form a scotophor screen.

A still further feature relates to the novel organization, arrangement and relative location of parts which cooperate to provide an improved

2

arrangement for forming screens which are sensitive to cathode-ray beams.

The single figure of the drawing shows, in composite schematic and structural form, one preferred arrangement according to the invention.

In order to produce scotophor screens of the required uniformity and sensitivity, it is desirable that the individual alkali halide crystals which constitute the screen, be less than a predetermined maximum grain size. For example, in one type of screen it was found desirable that the particle size be not much greater than 20 microns. In accordance with one feature of this invention, the crystals, for example crystals of potassium chloride, are separated from a saturated or supersaturated solution by an accurately controlled rapid rate of cooling of the solution. According to this feature, a saturated or supersaturated water solution of the alkali halide is subjected to very rapid cooling. It has been found that upon cooling such a solution below the temperatures at which crystallization starts to take place, crystal centers are first formed in the cooled liquid. The velocity with which these centers form is very small just below the saturation point, but increases very rapidly as the temperature is lowered. In general, the velocity with which the crystals form, and also the crystal size, depend upon the velocity with which the said crystal centers form, and upon the linear velocity of crystallization. It has been found that by cooling a saturated solution of the alkali halide from room temperature, for example 22° C. to a comparatively low temperature, for example -2° C. in a short time, for example one minute, it is possible to control the resultant crystals so that they have an average size of 9 microns with the limits of crystal size between 5 and 20 microns. On the other hand, it was found that by extending the cooling period to more than 5 minutes, the particle size was increased by a factor of 2.

A description will now be given in connection with Fig. 1, of one procedure and organization of apparatus found satisfactory for applying such a scotophor screen to a support such for example as a transparent mica plate. The mica plate 1 is placed in an approximately horizontal or very slightly tilted position upon a suitable pedestal 2 inside a double walled or jacketed liquid container 3. The jacket 4 of this container is connected by a suitable intake conduit 5 to a source 6 of cooling liquid or medium such for example as a brine solution at about 10 to 15° C. The

3

jacket 4 is also provided with an overflow conduit 7 to permit a continuous supply of the cooling medium to be pumped through the jacket. The interior of container 3 has an outlet pipe 8 and a petcock 9 which discharges into a suitable vessel or reservoir 10. Another vessel 11 having a discharge conduit 12 with a valve 13, contains a required quantity of saturated alkali halide, for example potassium chloride. The vessel 10 has a jacket 14 containing a controlled refrigerating medium whereby the contents of vessel 11 can be rapidly cooled from room temperature to -2°C . within approximately one minute. The valve 13 is such as to permit, when opened, the refrigerated contents of vessel 11 to be discharged rapidly into the container 3. As pointed out above, as a result of this rapid cooling of the saturated alkali halide solution, fine crystals of potassium chloride are formed with an average size of approximately 9 microns. Preferably the vessel 11 is also provided with a suitable stirring member 15 for thoroughly mixing the crystals in the solution.

The valve 13 is held open for a sufficient time so that the crystal-bearing solution rapidly discharges into the container 3, to a predetermined level above the mica 1. The rapidity of this discharge should be so high as not to materially change the temperature of the solution before it reaches the required level within the vessel 3. During this charging of the vessel 3, the brine from source 6 maintains the contents of the vessel 3 cooled. The petcock 9 is then opened to permit the refrigerated solution to drip out into the vessel 10 at a predetermined rate, for example one drop per second. The fine crystals which are uniformly distributed throughout the refrigerated liquid in vessel 3 will then settle upon the mica 1 until the supernatant liquid reaches a level below the mica 1. The crystal screen thus deposited on mica 1 is allowed to dry in air, or if desired it may dry by a special flow of moisture free air from a suitable source. The thickness of the scotophor screen thus formed on mica 1, is primarily determined by the volume of the solution used for crystallization which, in turn, determines the level of the solution above the mica 1; and secondly by the amount of crystals originally formed in the solution in vessel 11.

An alternative procedure for effecting the precipitation of the crystals from the saturated alkali halide solution in vessel 10 involves the use of a special precipitant. Thus the desired fine crystallization can be obtained by adding to a saturated or supersaturated water solution of the alkali halide, a water miscible solvent in which the alkali halides are less soluble than they are in water. As examples of these latter solvents may be mentioned, acetone, methyl alcohol, ethyl alcohol. Acetone has been particularly found successful for this purpose. For example, in the case of acetone, it was found that by adding 2 cc. of acetone to 50 cc. of a concentrated potassium chloride solution, the desired fine crystals were obtained. If desired, this method of precipitation can be used as a supplement to the rapid cooling procedure above described.

In some cases it may be required to settle the scotophor screen directly on the inner surface of a bulb, such for example as the inner surface of the end or viewing wall of a cathode-ray tube. In such a situation, the following procedure can then be used, it being assumed for example that the bulb has a screen surface of 3 inches in diameter. In that case 1.5 grams of KCl is added

4

to 50 cc. of a room temperature (22°C .) saturated KCl solution heated to 35°C ., then cooled rapidly to 20°C ., and next heated to 24°C . (which is 2°C . above room temperature). This solution is placed upon a settling table, the room temperature is accurately maintained at $22^{\circ} \pm \frac{1}{4}^{\circ}\text{C}$. for a period of 16 hours. Any fluctuation of room temperature should be avoided since the solubility of KCl in water at room temperature is 3 mg. per cc. per degree. With the procedure of permitting the solution to cool slowly from 24°C . to 22°C ., the settled KCl packs down on the inner bulb face. The supernatant liquid is then removed by the current methods used in practice, such as pouring on a tilting table, or syphoning. It was found desirable, although not necessary, to chill the screen thus formed to 15°C ., and dry same with a flow of moisture free air.

In many cases, it may be required to provide the scotophor screen with a protective coating or film of a plastic material. The above described methods of depositing the scotophor material lend themselves readily to the application of such a plastic film. The latter being insoluble and lighter than the halide solutions mentioned above, floats on the surfaces of these solutions. The plastic may, for example be 60-80 sec nitrocellulose, with a plasticizer of triethylene glycole di-2-ethyl butyrate, and amyl acetate as the vehicle. Any other plastic mixtures well-known in the art can be used. In any case, the plastic film being localized on the surface of the settling solution, it is possible after the required settling of the scotophor has taken place, for example on the mica 1, to remove the supernatant liquid and thus leave a superposed thin layer or film of plastic on the exposed surface of the scotophor. After suitable drying, this plastic layer not only protects the scotophor against contamination and migration of the crystals, but it also permits the subsequent application of a cathode-ray-transparent metal coating such as aluminum to the scotophor screen without damage to the scotophor. Since methods of applying such transparent metallic films are well-known in the art, detailed description thereof is not required herein.

In certain kinds of tubes, it is desirable to insulate, for direct current, the scotophor screen proper from the transparent metal layer. In that event, the plastic film which is formed on the scotophor as above described is chosen so that it has a high electrical resistance. It will be understood of course, that the thinness of this plastic film can be controlled by the amount of liquid plastic which is initially added to the alkali halide solution.

While certain specific materials have been mentioned herein, it will be understood that it is merely by way of example. Thus, while potassium chloride has been chosen as typical, any other alkali halide salt can be used. Furthermore, while the process is preeminently useful in the formation of scotophor screens, in certain of its aspects the invention is also applicable to the formation of screens of fluorophors, phosphors and the like.

What is claimed is:

1. The method of forming a scotophor screen of alkali metal halide on the inner wall of a cathode-ray tube and the like, which comprises discharging into the tube a saturated solution of an alkali metal halide crystal scotophor, adding to the saturated alkali metal halide solution at approximately 20°C . a quantity of the said

5

alkali metal halide scotophor, heating the solution to about 35° C., then cooling the solution rapidly to approximately 20° C., reheating the solution to approximately 24° C., slowly re-cooling the solution to approximately 22° C. to deposit the scotophor on said wall, and decanting the supernatant liquid.

2. The method according to claim 1, in which the deposited scotophor is lowered to approximately 15° C. and dried.

3. The method according to claim 1, in which said precipitation is effected by cooling said saturated solution from approximately 22° C. to approximately freezing temperature within approximately one minute.

4. The method according to claim 1, in which said precipitation is effected by cooling from approximately 22° C. to approximately -2° C.

5. The method according to claim 1, in which the cooling of said solution is at the rate of approximately 22° C. to approximately minus 2° C. per minute to precipitate alkali halide crystals having an average fineness of about 5 microns

6

with a maximum coarseness of approximately 20 microns and a minimum fineness of approximately 5 microns.

6. The method according to claim 1, in which a quantity of liquid plastic is floated on the surface of said solution to form a plastic film on the deposited scotophor after said solution has been removed.

GUSTAVE LEVY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,263,858	Cole	Apr. 23, 1918
2,177,701	Fonda	Oct. 31, 1939
2,374,310	Schaefer	Apr. 24, 1945
2,402,900	Koller	June 25, 1946
2,435,435	Fonda	Feb. 3, 1948
2,441,217	Windsor	May 11, 1948
2,463,551	Myerson et al.	Mar. 8, 1949