T-4

TRIP REPORT

Plant Visited - General Electric X-Ray Department, Milwaukee, Wisconsin

Date - February 17, 1955

Trip Made By - Benjamin P. Ransom

Objective - To observe and discuss X-Ray excitation of Cathode-Ray Tube Screen Phosphors, monochrome and color.

Persons Contacted - Dr. John E. Jacobs - Manager X-Ray Advanced Development Laboratory
Mr. Charles Hart - X-Ray Advanced Development Laboratory
Mr. Art Pace - X-Ray Product Planning Engineer

Summary

Visual inspection of monochrome screens, using X-Ray excitation, although possible, is felt to be impractical. Automatic inspection of monochrome screens, using X-Ray excitation, could be practical, if economically feasible.

Using X-Ray to excite color screens, visual inspection would not be possible; automatic inspection, such as proposed by the General Engineering Laboratory, would be possible for the blue and green phosphors. Whether or not it would be possible for the red phosphor remains to be determined.

Report

The following had been shipped to Dr. Jacobs:-

1. A 21" 90° aluminized monochrome bulb ready for gun seal.
2. A 21" 90° non-aluminized monochrome bulb ready for gun seal.
3. A completed Post Acceleration tube phosphor plate screened by the offset printing process.
4. An Apple bulb screened by the photo-resist process.

Prior to my arrival, tests had been made with these screens. I was shown those tests that had produced the best results. The screens were radiated with X-Ray equipment operating at 85KV, 5ma, and equipment operating at 140KV, 10ma. Dr. Jacobs feels that operation at 60KV or above will produce results comparable with the above. None of the phosphors were excited sufficiently to be visible to the naked eye in a lighted room. Attempts were made to measure the light produced in a dark room by the X-Ray excitation of the various phosphors. The best excitation was insufficient to produce an indication on the meter. This meter would not accurately measure levels of less than one half a foot candle. It would be reasonable to conclude from these tests, however, that the greatest excitation produced less than one quarter of a foot candle.

With the X-Ray beamed through the neck of the monochrome bulbs, screen excitation was produced that was clearly visible to the naked eye in a darkened room. When the X-Ray beam was directed through the cone it was possible to excite the entire screen but the glass cone absorbed the X-Ray beam so that the brightness was reduced by one half. It was impossible to penetrate the faceplate sufficiently to excite the screen.

The blue phosphor of the Post Acceleration screen was excited at a level somewhat lower than the monochrome. The green phosphor was just faintly visible and there was no visible indication of excitation of the red phosphor. Similar results were obtained with the apple phosphors.

I feel that it would be possible to inspect monochrome screens visually using X-Ray excitation. It would require a darkened viewing area, and extensive safety precautions due to the high radiation. (This problem is simplified slightly by the absorption qualities of the faceplate). Due to the low level of excitation compared with our present methods, however, such a system does not appear practical.

In the tests run, it was necessary to view the monochrome screens from some distance, due to the necessity of using existing facilities. This made it difficult to judge the degree to which minor screen defects would be noticeable. Since the screens were excited quite uniformally, however, I feel that this would not be a problem.

The X-Ray excitation of monochrome screens is sufficient to make X-Ray a practical excitation source for use with an automatic screen inspection method using a photoelectric pickup.

The X-Ray excitation of color phosphors is felt to be too low to make visual inspection of color screens, practical. The excitation of the blue and green phosphors is probably sufficient to make X-Ray a practical excitation source, for these phosphors, for use with an automatic screen inspection method, such as that proposed by the General Engineering Laboratory. Whether or not X-Ray excitation of the red phosphors, sufficient to be detected by a photomultiplier tube, could be obtained remains to be determined. In the tests performed, during this trip, it was not possible to tell if the red phosphors were being excited at all.

The X-Ray people use phosphors readily excited by X-Rays, usually Zinc Cadmium Sulfides, or Cadmium Tungstates. If the effects of the addition of various quantities of these phosphors, to Cathode Ray Tube phosphors, on X-Ray excitation, and Cathode Ray Tube performance, were studied, information might be obtained that could lead to improved results with X-Ray excitation.

An X-Ray machine capable of continuous operation at 100KV, 7ma* suitable for the above mentioned applications could be purchased for approximately $2500. A machine incorporating this X-Ray equipment plus shielding and automatic feed,* that could probably be readily adapted to inspection of P.A. plates as proposed by the General Engineering Laboratory is available for approximately $8500.

They have in operation in Milwaukee one of the new Electron-Beam Generators* used for food irradiation and electron chemistry. A monochrome screen and a Post Acceleration screen were successfully excited by this machine. It is felt, however, that the size of this machine, and the extreme safety precautions required, make it impractical for our applications.

I witnessed what I felt was a very successful demonstration of the X-Ray Image Tube (Samples of improved guns for this tube are being supplied by our Advanced Tube Development Section).

* I have literature on this equipment which is available to anyone interested.

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CATHODE-RAY TUBE SUB DEPT.

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