MEMORANDUM ON DARK TRACE TUBES

On February 1, 1951 I visited the Bureau of Ships in Washington, D.C. and attended a conference on dark-trace cathode ray tubes. This meeting was called to discuss the history of dark-trace tubes and to obtain from those present suggestions for criticism as to what course future design and development should take. In reality the conference was called primarily to obtain assistance for National Union in their project on building a fast erase dark-trace cathode ray tube.

The past history of the dark trace tube was adequately covered by Dr. Nottingham from the Radiation Laboratory, Dr. Gordon of the G.E. Research Laboratory, Al. Bentley of DuMont and the writer. The general consensus of opinion was that there was very little basic research work to be done if potassium chloride was to be used as the screen material. Dr. Gordon reviewed his tests on other halide type materials and reported that he still felt that potassium chloride was the best material to use.

Dr. Jarvis of National Union described the tube which they had developed for the Navy. He maintained that this tube was a simple thing to build. In this no one agreed, as will be apparent from the following description of the tube. To date, National Union have built one 10" tube and a number of 7" tubes. They are building 7" tubes at the rate of about 4 tubes per week. This tube is made from the 7BP7 bulb assembly and has the following important features. The dark trace screen consists of an evaporated layer of potassium chloride on a mica carrier. This screen material is evaporated onto the mica target in a separate bell jar and then covered with a layer of evaporated aluminum. The screen is fastened inside the bulb with Sauresine cement. A nickel alloy oxide coated filament is located about an inch behind the potassium chloride screen. The filament is strung in a zig-zag pattern across the bulb, and from the photograph which they passed around there appeared to be about 17 strands of this wire. This filament is used as an erase gun to remove the dark trace pattern. To erase the pattern, they pass current through the filament until it reaches an emitting temperature. Then they apply a potential of 500 volts between the filament and the aluminized potassium chloride screen. About 100 watts energy can be delivered to the aluminum-backed screen in this manner. Erase time is approximately 8 seconds.

The electron gun was said to be a standard 7BP7A gun. In fabricating this tube it is necessary to seal four high-voltage terminals through the wall of the tube to supply connections for erase filaments and high-voltage anodes.

This tube has the following inherent limitations:

1. Insufficient contrast
2. Necessity for external lighting source
3. The internal lighting source interferes with night vision
4. The erase time is 8 seconds
5. Unavailability of tube
6. Fragility of screen
7. Fragility of trace erase filament which to date will not withstand vibration in an aircraft. This filament has a resonant frequency of approximately 60 cycles and seems to be much too weak for any practical use.

8. Reduction of resolution due to lack of optical quality in the molded faceplate of the 7BP7 bulb.
9. Parallax between the faceplate and the screen.
10. Inconvenience of providing connecting leads to the four high voltage terminals while the tube is being rotated.
11. Discoloration of the screen during the erase time because of the 500 volt potential applied.
12. Distortion due to flatness of the screen
13. The erase time of 8 seconds is good for only a small section of the screen, as they are apparently using some electron bombardment from the electron gun to hasten the erase. One National Union man said that in actuality about 25 seconds were required for a complete screen erase. They are getting considerable contradictory results with their screens on these tubes as compared with the old 4AP10. This, Dr. Gordon pointed out, was probably due to the difference in the amount of water vapor present when the screen was sealed in the final tube. He said that as long as it was necessary to make these screens in an external bell jar vacuum system that no different results could be expected.

Dr. Jarvis further pointed out that the filament to screen potential was extremely critical during operation. He said that when the potential between the two elements was too low a shadow of the filament was cast on the screen or if the potential was too high, or the current through the filament too great, that a bright image of the filament was produced on the target. Furthermore, during trace erase care must be taken not to overheat the target; they have found that the target reaches a temperature of approximately 375° C. during erase, but cools sufficiently for re-use in about 4 seconds.

It was pointed out to the Government people that what they wanted was not in reality contrast but contrast gradient and that they might secure better results if they did not operate these tubes such as to give a very dark pattern.

The Bureau of Ships people reported that they must have these tubes, or if such tubes were unavailable that they would be willing to use tubes without the quick-erase feature. In that event, they would plug in a new tube whenever one with a clean pattern was needed to work with. They would then erase the trace from used tubes when they returned to home base.

They were particularly anxious that those attending should send their comments and suggestions on this project to them. In other words, would we help National Union.

Their airborne equipment in which this tube is used will not be ready until about 18 months from now. A suggestion for a tube that might work on this project would be to use a thin glass target which had been coated with stannic chloride and made conductive. Thus the application of DC or AC current could be used to remove the dark trace pattern by straight resistive heating. If it is deemed advisable that we reply to the Bureau of Ships, I believe that we should emphasize that we are interested in

working on this problem only from a standpoint of developing a suitable tube for manufacture with an eventual contract to produce the prerequisite number of samples. This tube might be best made in a metal envelope which would permit assembly after the faceplate and target have been prepared.

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