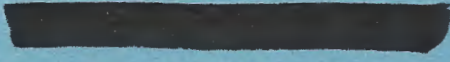


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NRL Report No. 4527



PROGRESS REPORT
For The Period
January - March 1955

4527

Work Performed
on
NRL Problem No. 74H03-01
Supported Jointly by
Los Alamos Scientific Laboratory
and
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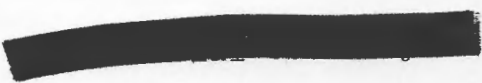
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Radiation Division

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WEAPONS INSTRUMENTATION

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M. R. McCraven, and J. H. Miller

NRL Problem No: 74H03-01

Photomultiplier Development

Four high-current tubes have been received from the Farnsworth Electronics Company. The parts of these tubes, hydrogen fired in previous tubes, were vacuum fired at over 800°C. Tests performed on the four tubes showed no improvement in regard to regeneration over previous tubes. When the output currents of the tubes were high, light flashes were observed, as before, in the collector ends of the tubes and when analyzed with a spectroscope were found to have a spectrum line which coincides with the 4861.3-A line of a hydrogen discharge tube. With the new light-trapping baffles in the tubes it was more difficult to observe the light with the spectroscope, and other lines were not intense enough to be identified.

Our current belief is that the light is still due to the excitation of hydrogen, and that the hydrogen is in the magnesium of the silver-magnesium dynodes (Mg is a good getter of atomic hydrogen) and is released by electron bombardment when the tube is conducting. In processing the tube, Farnsworth reports that if the temperature of the dynode is raised above 475°C the multiplying surfaces will be damaged. This temperature is apparently insufficient to drive all the hydrogen from the magnesium.

An experiment is now under way to make a comparison between Ag-Mg and Cu-Be dynodes in regard to the generation of light. The experiment consists of placing an 11-stage Cu-Be dynode structure, in which the final dynode can be made either Cu-Be or Ag-Mg, in a demountable vacuum enclosure and determining if one or both generate light when the tube current is high. If it is found that Cu-Be does not generate light under electron bombardment and that Ag-Mg does, a switch to Cu-Be dynodes will be made in the sealed glass expanded version tube. This will mean a loss of surface gain at the operating voltages previously recommended.

Cathode-Ray Tubes

The two Type TW-11 cathode-ray tubes received from the Rauland Corporation during the reporting period show

considerable improvement over previous tubes. The new type seals used to replace the Type BNC connectors resulted in a reduction of impedance mismatch from 40 to 10 percent within the seal itself.

The problem of defocusing the beam as it is deflected to the edge of the field has been solved. It was found that a charge was collecting on the surface of the insulator supports for the helices. The insulators were removed and a method devised to support the helix, by means of short wires imbedded in glass external to the ground shield. But the metal pins attached to the helix cause a small discontinuity, as determined by use of the separate deflection structure and a probe. Means of correcting this difficulty has not been determined to date, nor has the seriousness been fully evaluated.

The operational characteristics of the tubes are excellent. Writing speeds up to 3.5×10^{11} trace widths per second were obtained on the first tube received.

Wide-Band Amplifiers

Work is proceeding on a wide-band (approximately 300 Mc) amplifier for use with the TW-11 cathode-ray tube. This will probably consist of an input stage of 6AK5's, a driver stage, and a push-pull output stage of 4 x 150's. The push-pull output stage has been built and tested. It employs ten Eimac 4 x 150 tetrodes, and has a gain of about 4.5 and a 3-db bandwidth of approximately 260 Mc. The output voltage has less than 2-percent nonlinearity throughout the entire vertical field of the TW-11 cathode-ray tube.

The grid-line impedance of this stage is approximately 45 ohms. This makes possible the use of 50-ohm input signal cable with very little distortion resulting from impedance mismatch. The impedance of the plate lines is 125 ohms, thus permitting the plate lines to be connected directly to the deflection structure of the TW-11 cathode-ray tube by means of RG-63/U cables. The tubes are arranged in two stages of five tubes per stage. The grid line of the first stage is coupled to the grid line of the second stage by means of a pulse inverter. Thus the signals on grid lines of the two stages are of opposite polarities, resulting in push-pull operation of the two stages. The output of the second stage, however, is delayed in time with respect to the output of the first stage by an amount equal to the delay of the first grid line plus the delay of the pulse inverter. The outputs of the two stages are brought into proper time relationships by adding the correct length of RG-63/U to the plate line of the first stage.

Development of this stage of the amplifier has involved chiefly the investigation of grid-line and plate-line constructions which would give the most uniform frequency response over the desired bandwidth. The best results for the more critical grid line have been obtained with a continuous 1/8-in. strip of very thin (0.007 in.) copper soldered directly to the grid terminal of the tubes. With this line a 3-db bandwidth of 260 Mc was obtained, as shown in Figure 1. Figure 2 is a linearity curve of this amplifier without correction for attenuator errors which causes some spread in the plotted points.

A distributed-line input stage has been built and tested which uses nine 6AK5 pentodes in a single-ended input, single-ended output arrangement. The gain of the amplifier is approximately 4, with a 3-db bandwidth of 300 Mc. The amplifier has a grid line whose impedance can be adjusted to 125 ohms and a plate line whose impedance is 220 ohms.

Work has started on the driver stage, with all investigations to date involving the 6BQ7-A double triode. It is hoped that a gain of 4 can be obtained. The output impedance of the amplifier will necessarily be approximately 50 ohms, so that it matches the grid line impedance of the 4 x 150 amplifier.

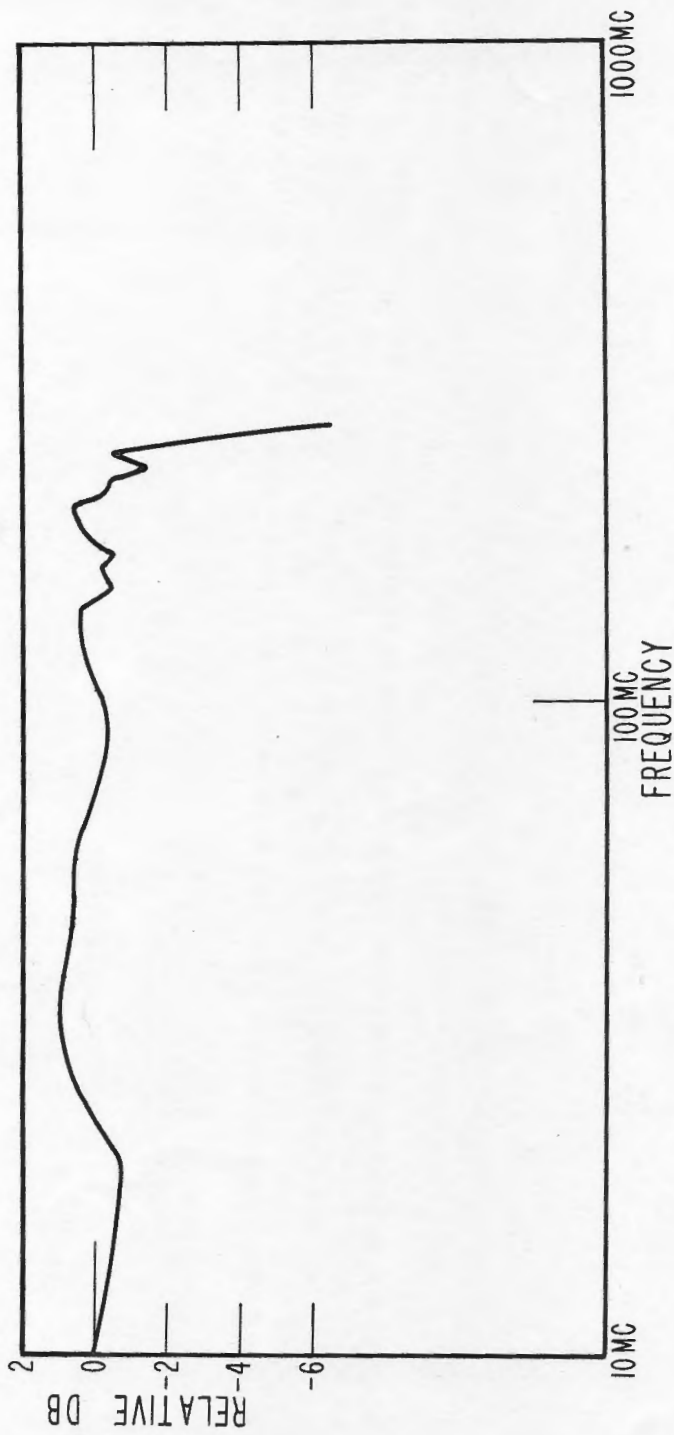


Fig. 1 High-frequency-response of 4 x 150 amplifier

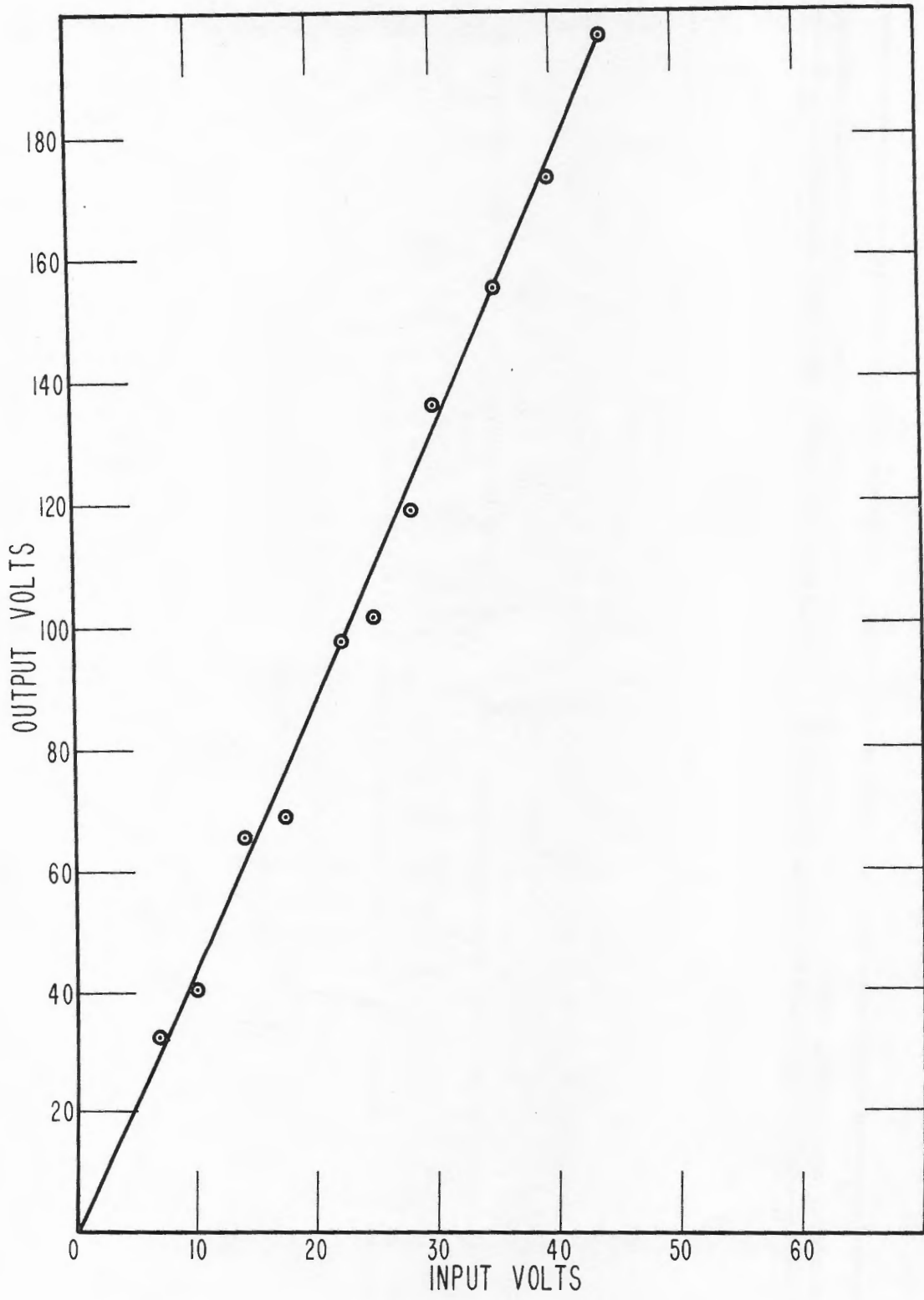


Fig. 2 Linearity of 4 x 150 amplifier