7. The Design of a New High Speed Scaling Circuit

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With the development of nuclear research it becomes neccesary to construct a high speed and a more reliable scaler suitable for high rate of counting. For this purpose we have analysed the operation of the well-known Eccles-Jordan trigger circuit, which is generally used.

According to our studies, vacuum tubes with high *gm* and small interelectrode capacitance, and low plate resistance are suitable for the high speed scaling circuit. However, one can not obtain large output voltage in this case. We should especially take care to avoid the over driving in such a circuit, since the plate over driving causes oscillation in the circuit, and the grid over driving changes the grid bias and decreases the counting power of the circuit. Concerning the reliability of the scaling circuit, we analysed rigorously its negative resistance characteristic and found the following results. The reliability of the trigger circuit essentially depends upon its symmetrical condition, which affects also the resolving power. By the use of pentodes resolving power and reliability can be improved to a great extent. Further, we can simplify the circuit considerably by the application of dynatron tubes, because they have negative resistance characteristic in the curve of plate voltage *versus* plate current.

For this reason mentioned above, we have designed a high speed scaling circuit, called S-D-1 scaling circuit, using dynatron tubes. Further studies, however are now in progress.

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8. The Pumping Speed Ratio of H_2 to D_2 of Oil Diffusion Pump

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It has come into question that the pumping speeds of the oil diffusion pump for light gases do not agree with Goede's theory. The reason of this discrepancy was ascribed by several workers to the diffusing back of light gases from fore vacuum side to high vacuum side through the jet of the diffusion pump. To observe this back diffusion phenomenon more precisely, we measured and compared the speeds especially for hydrogen and deuterium which seemed to give the least relative errors in the experimental results.

The variable gas leakage method described in the preceding report was adopted. The pumping speeds were calculated under the range of 400 to 1600 watts heater inputs and various vacuum pressures. The results were that the maximum speed for hydrogen was 180 litre/sec at 1200 watts and that for deuterium 120 litre/sec at 800 watts both under the pressure of about 3×10^{-4} mmHg. Referring to other papers, we deduced that the normal rating was at abott 600 watts, and here the pumping speed ratio for hydrogen to deuterium had far smaller value than the theoretical value of $\sqrt{2}$, but this experimental ratio approached to $\sqrt{2}$ in the case of higher heater input.

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9. A New Device of a Leak Detector

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The glow discharge of the Philips type vacuum gauge shows the characteristic spectrum of the gas contained. Therefore, the spectroscopic difference takes place according as whether a small quantity of air leaks into the vacuum system or not. Applying a selenium photo-element attached closely to this gauge, we could detect this spectroscopic difference by its photo electromotive force more sensitively and quantitatively than the observation by our naked eyes.

When some organic fluids or gases are attached to the leaking position, they diffuse into the vacuum system and a galvanometer connected to a photo-element shows a conspicuous deflexion after a short time.

Under 1.7 c.c./hr leakage of air, for example, alcohol deflected the galvanometer 20 or 40 divisions after a time lag of 15 seconds and hydrogen 10 divisions after 2 or 5 seconds, whereas the discharge current of the Philips gauge was constant in each case. But acetone gave remarkable effect at once both to the gauge and galvanometer; the deflexion reached 60 or more divisions.

In our present condition, the minimum leakage quantity being detectable will be about 0.2 c.c./hr in air. However, the stabilization of the circuit and the increase of the photo-element will lower this limit, and the usage for a practical leak detector will be expected.
