*GRAPHICAL SOLUTION FOR TRIODE OPERATING POINT

by Arthur Schach

In designing vacuum tube circuits, we are frequently confronted with a problem:

Find the operating point from the static characteristic curves when E_{bb}, R, and R_k are given as in Fig. 1.

The usual method of solution is one of successive approximations. First, the load line corresponding to R (or to R + R_k, if R_k is not negligible in comparison with R) is drawn on the plate characteristic curves. Then a guess is made at a likely plate current and the voltage drop that this current would produce across R_k is computed. Next, from the load line we read the current which would result from a bias equal to the computed drop.

The whole process is repeated several times until a current is obtained which differs only slightly from the previous approximation.

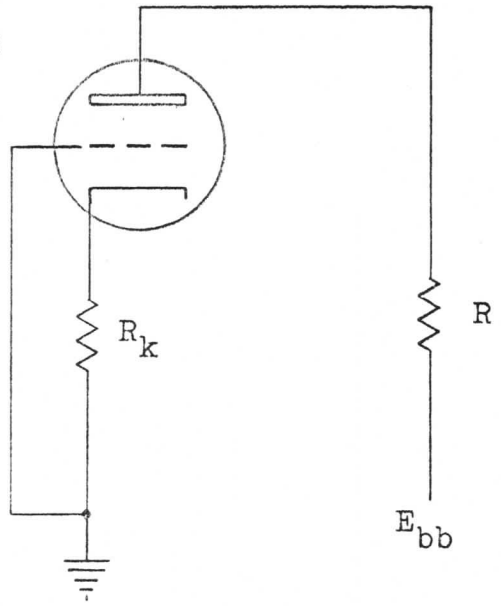

Fig. 1.

Here's an easy method of obtaining the true limit of successive approximations (the exact solution) by using a simple graphic procedure:

1. Note the intersection of the load line with the zero-bias curve (A, Fig. 2) and mark the point A' vertically below it on the voltage axis;
2. Choose a convenient plate current, I_o, (preferably less than that corresponding to A) and calculate the drop it would produce across R_k;
3. Locate the point B, on the load line, which corresponds to a grid-bias equal to the drop just calculated, and mark the point B' vertically above or below B on the horizontal line corresponding to the chosen current;
4. Draw A'B'. The intersection, C, of A'B' with the load line is the required operating point.

See example(worked out on the accompanying sheet)for a 12AT7.

NOTES: If a constant bias is superimposed upon the self-bias, the method of solution is the same if we allow the grid-bias curve corresponding to the constant bias to play the same role as the zero-bias curve plays in the method as outlined above.

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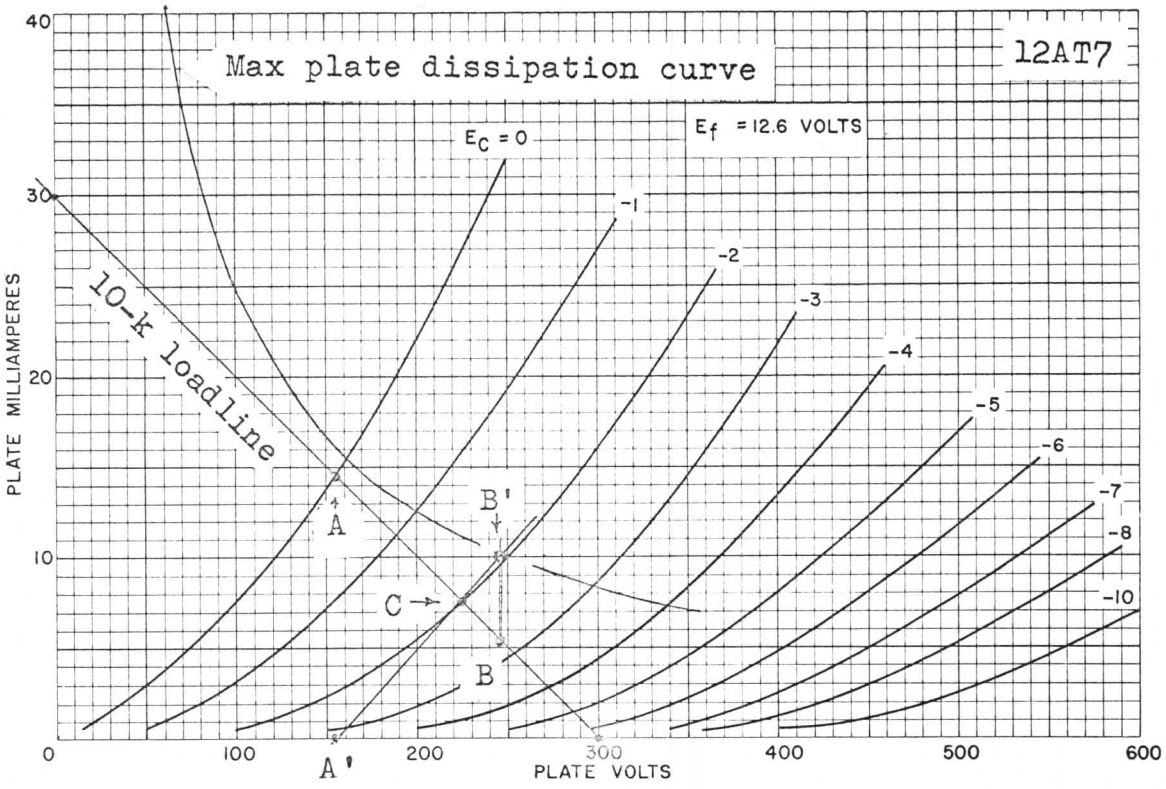
EXAMPLE: Tube: ½ of 12AT7

Ebb = 300 volts

R_k = 270 ohms

R = 10-k



NOTE: By similar methods, a solution for R_k can be obtained when E_{bb}, R, and I_b are given.