AGING

Prior to being aged, the cathode in a cathode-ray tube consists essentially of a nickel base covered with a layer of the mixed oxides of barium, calcium, and strontium. In this condition the cathode is a poor emitter. It can be converted into an efficient emitter, however, by the process of aging which reduces a portion of the barium oxide to metallic barium. The mixture of barium and alkaline earth oxides is a much better emitter than either component alone.

The reduction of barium oxide takes place primarily due to the presence of closely controlled impurities in the base nickel which act as reducing agents. The reduction actually starts during activation. In fact, carbon and carbon monoxide, which are decomposition products of the organic binder used in the cathode coating mixture, aid in the reduction during activation. However, the optimum excess of barium cannot be produced under the vacuum conditions existing during pumping, and must be attained during the aging operation.

The time required to achieve optimum barium content decreases with increasing temperature. On the other hand, if very high temperatures are applied, the emission decreases due to excessive evaporation of barium from the surface of the coating. The aging temperature should therefore be chosen in a medium range in which the time necessary for reaching maximum emission is not too long and in which excessive evaporation does not occur.

A second function of aging is to remove residual gas from surrounding electrodes, gas which might otherwise poison the cathode and reduce its emission. This is accomplished by applying positive potentials to the adjacent electrodes and bombarding them with a stream of electrons. The gas thus evolved is picked up by the getter. There are several reasons why residual gas is present in spite of heating during exhaust: (1) the vacuum during exhaust is not as good as that following getter flash, (2) some gas is evolved during tip-off and getter flash, (3) if a metal has been degassed even by intense eddy current heating, additional gas is always set free by subsequent electron bombardment, and (4) traces of metallic oxides in the gun structures may be decomposed by bombarding electrons.

Due to the high cathode temperatures required for aging, some barium and barium oxide evaporate from the cathode and deposit on grid-No.1. To prevent emission from this "second cathode", the heater voltage is lowered during the electronic bombardment of the adjacent electrodes. This permits the temperature of grid-No. 1 to decrease to the point where it is readily poisoned by gas evolved from the other electrodes.

The flow of current required for degassing will also cause electrolytic reduction of barium oxide in the coating mixture. An optimum aging schedule must take this factor into account.

AGING

SCHEDULE A

EQUIPMENT

1. Sources of following potentials:
   a. 9.0 ± 5% volts AC
   b. 11.5 ± 5% volts AC
   c. 3.0 ± 10% volts DC
   d. 600 ± 10% volts DC

PROCEDURE

1. With tube in any convenient position, 11.5 volts AC is applied to the heater for 2½ minutes.

2. The heater voltage is reduced to 9.0 volts; ± 3.0 volts is applied to grid-No. 1 and ± 600 volts to grid-No. 2 for 30 minutes.

3. All applied voltages are removed and the tube is permitted to cool at least 2 hours before being tested.

LIMITATIONS

1. Apply above schedule also to tubes rejected at test for low emission, but do not age any tube more than 3 times.

2. Take precautionary measures to avoid accidental reaging.