ELECTRON TUBES

RCA Application Note

AN-152

Design and Adjustment of Kinescope Centering Magnets and Ion-Trap Magnets

This note discusses some important considerations pertaining to the design and adjustment of centering magnets and ion-trap magnets used in television receivers. Particular attention is given to the use of such magnets with kinescopes utilizing electrostatic focus.

Centering Magnets

In a kinescope utilizing magnetic focus, the electron beam is generally centered, as well as focused, by the magnetic focusing device. In a kinescope utilizing electrostatic focus, the electron beam is centered by means of a small external magnet used exclusively for that purpose. This magnet, however, deflects the electron beam and may, therefore, cause defocusing. To minimize defocusing, it is important that the field of the centering magnet be uniform; to provide varying degrees of centering, it is necessary to have the field strength of the magnet adjustable to zero. Adjustment can be obtained by using two uniform fields of equal strength which can be rotated to aid or oppose each other. A magnet having a maximum field strength of 8 gausses placed directly behind the base end of the deflecting yoke will produce sufficient centering for a kinescope having a horizontal deflection angle up to 70 degrees and operating at a voltage as high as 18 kilovolts.

In the design of a centering magnet, particular attention should be given not only to uniformity of the magnetic field but also to straightness of the field lines. Nonuniform fields and curved lines produce serious defocusing, especially with electrostatic-focus kinescopes designed to operate at low focusing voltages. Field uniformity can be measured with a gauss meter (such as the General Electric Gauss Meter Cat. No. 409X51) and a jig of the type shown in Fig. 1. Five holes are drilled in the top of a bakelite rod, as shown, to permit insertion of the gauss-meter probe. The probe is first inserted in the center hole, and the magnet to be tested is slipped over the rod in the position shown in Fig. 1 and moved up and down until the point of maximum field strength is located to line up with the tip of the probe. With this arrangement, the field

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strength can be measured at the center of the magnet, and at distances of 1/4 and 1/2 inch from the center on either side.

Curvature of the field lines can be determined conveniently through the use of the usual iron-filings procedure. Straightness of field lines is critical only in the region through which the electron beam travels and in the plane perpendicular to the tube axis and parallel to the reference line. Field lines in this region should be straight through the entire range of the magnet from zero to full strength. A further check of line straightness can be made by placing the magnet on a kinescope in operation and observing either a resolution test pattern or a blank raster. With a well-focused test pattern or raster, the magnet should be rotated through 360° and varied from zero to full strength and the pattern or raster checked for any change in focus. When the centering magnet is well-designed, the change in focus, if observable at all, is slight.

The centering magnet should be placed as close to the base end of the deflecting yoke as possible so that the field of the magnet will not extend into the field of the electron-lens portion of the gun and, therefore, cause focus distortion. Since the region between the base end of the deflecting yoke and the electron lens is limited, the pole pieces of the centering device must be comparatively narrow in order to restrict the magnetic field to this region.

Ion-Trap Magnets

The effect on spot shape of the magnetic field of the ion-trap magnet is less than that of the centering magnet because the beam diameter is much smaller in the ion-trap region. Nevertheless, the effect of an improperly designed ion-trap magnet can be detected and is quite noticeable with a kinescope having low-voltage electrostatic focus.

Best performance is obtained, therefore, when the field of the ion-trap magnet is uniform and the field lines are straight throughout the region traversed by the beam. If a magnet having a nonuniform field is used, the side of the tilted gun chosen for location of the magnet influences the effective value of the field. Field uniformity can be measured with the jig and gauss meter previously described; field curvature can be studied with iron filings.

Experience with kinescopes of present design indicates that an ion-trap magnet for use with a tube having electrostatic focus generally has a field strength about 5 or 10 gausses less than that of a magnet used with a comparable tube having magnetic focus. The field strength requirement for the electrostatic-focus tube is lower because there is no external focusing device to shunt the field of the ion-trap magnet when it is moved along the neck of the kinescope toward the faceplate. The field strength requirement for a particular tube type is usually given in the published data for the tube. For a kinescope utilizing electrostatic focus, it is important that the field strength be close to the given value. A field strength appreciably higher than that specified distorts the focused spot, changes the focusing voltage of the tube, and also requires a shift in the position of the magnet on the neck of the tube. A field strength appreciably lower than that specified decreases maximum brightness, makes centering of the beam difficult, and may cause neck shadow. Polarity should be indicated on the magnet in some manner to facilitate correct positioning when the kinescope is installed.

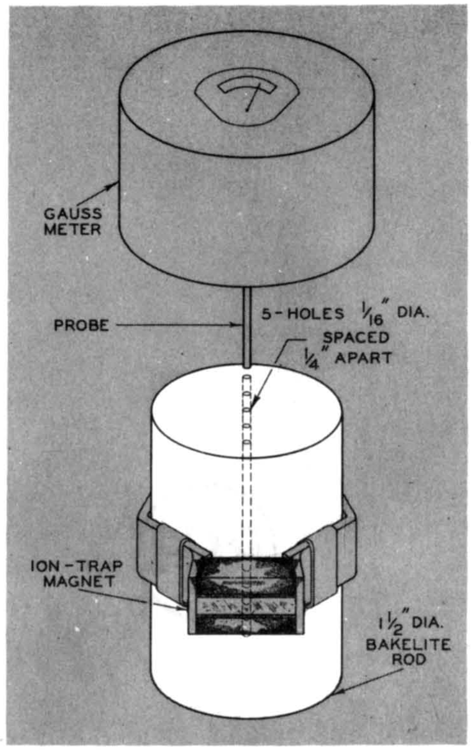

Fig. 1 - Test Jig for Measuring Field Strength of Centering and Ion-Trap Magnets with Gauss Meter.