Reduction of Snivets Interference In Television Receivers

This Note discusses the problem of "snivets" interference in television receivers, points out probable sources of such interference, and describes several methods by which the interference may be reduced through careful circuit design, chassis layout, and lead dress.

General Considerations

In radio broadcast receivers, "snivets"-type interference originating in the audio-output tube has been virtually eliminated by two methods: (1) the equipment manufacturer has located the audio-output tube as far as possible from the loop antenna, and (2) the tube manufacturer has rounded the "knee" of the output-tube plate-current characteristic, i.e., the point at which the sharp rise from zero plate current begins to level off. Usually, either of these two steps is sufficient to eliminate the interference.

In television receivers, "snivets" are believed to be due to a form of Barkhausen oscillation in the horizontal-deflection tube resulting from the operating conditions used in most present-day deflection systems. Because the energy level of this interference is higher than that encountered in radio broadcast receivers, and because a change in tube design to eliminate snivets would reduce tube and circuit efficiency, the most practical method for reducing snivets interference in television receivers is by circuit modification.

Causes of Snivets Interference

One possible cause of snivets interference is illustrated in Fig.1, which shows the plate-current, plate-voltage characteristic of a typical horizontal-deflection tube at zero bias. When the plate current of such a tube rises from zero to saturation, it follows a smooth curve. When it decreases from saturation toward zero, however, there is a discontinuity in the curve. This sudden change in plate current produces many harmonics of the horizontal-deflection frequency. Harmonics which lie within the television broadcast bands may then be amplified by the rf amplifier and produce interference on the television receiver, as shown in Fig.2.

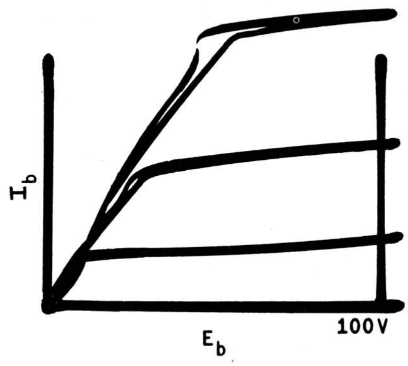

Fig.1 - Plate characteristics of a 6BQ6-GT tube selected to illustrate "snivets." Note loop and discontinuity in the top curve.

For most efficient utilization of B+ power, horizontal-deflection circuits are designed so that the plate current swings as far into the "knee" region as possible. In addition, deflection tubes are designed so that the plate-current "knee" occurs at the lowest possible plate voltage, producing a characteristic curve which has a very sharp "knee" and a strong likelihood of a discontinuity at the "knee". The most efficient deflection circuits, therefore, tend to produce the most snivets interference.

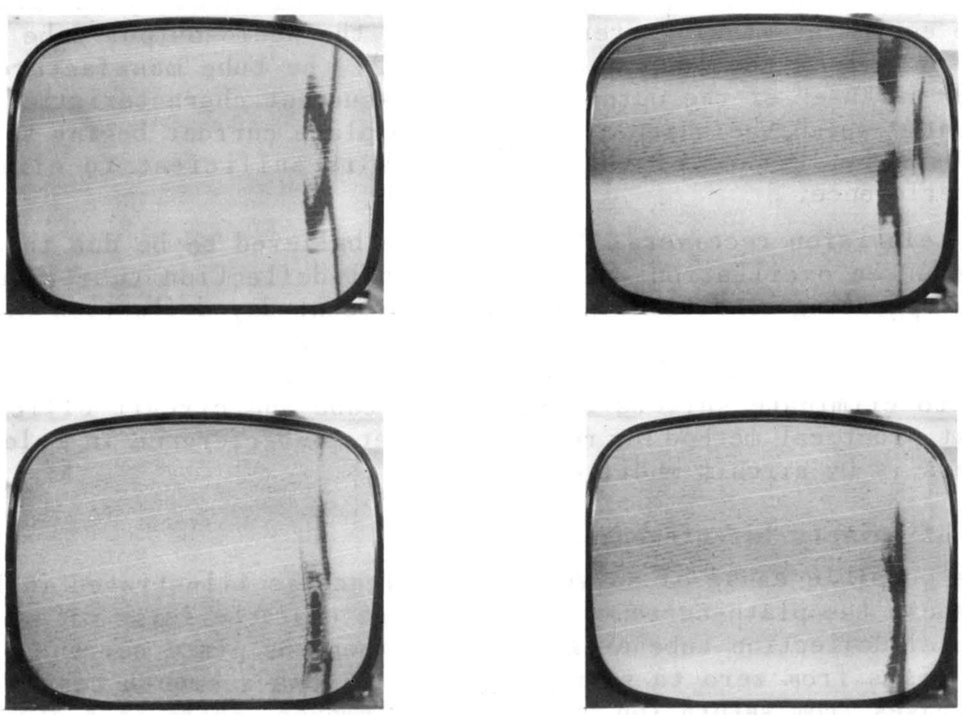

Fig.2 - Four examples of "snivets" on a picture-tube screen.

In many cases, snivets interference may also be produced by horizontal-deflection tubes which exhibit no apparent discontinuities at the "knee" of the plate-current characteristic. The reason for this type of interference is indicated by the load line for the horizontal-deflection tube. Fig.3 shows the load line of a 25CD6-G in a typical deflection circuit in a television receiver which exhibited strong snivets interference. The contour of this load line shows that the plate voltage of the horizontal-output tube swings considerably below the grid-No.2 (screen-grid) voltage. A curve showing the instantaneous plate voltage of the 25CD6-G as a function of trace time is given in Fig.4. This curve shows how the plate voltage actually becomes negative at some points during trace time. The type of operation represented by Figs.3 and 4 satisfies the conditions for Barkhausen oscillation -- a positive grid between two negative (less positive) elements.

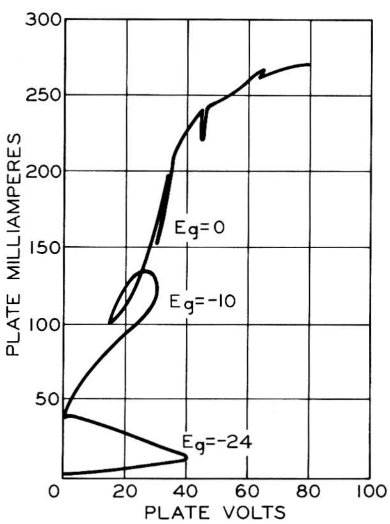

Fig.3 - Load line of a 25CD6-G in a television receiver which exhibited strong "snivets" interference.

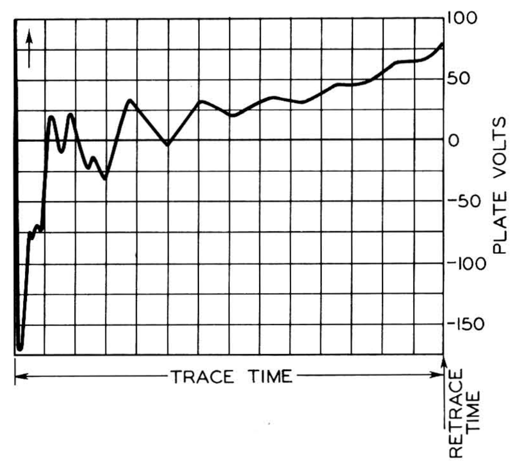

Fig.4 - Curve showing instantaneous values of plate voltage as a function of trace time.

Methods of Minimizing Snivets Interference

Various tube designs developed to minimize the energy of snivets interference have met with little success because the frequency spectrum and strength of the interference depend so much on the particular deflection system and tube operating conditions that a design which minimizes snivets in one circuit may accentuate it in another. Because snivets interference is primarily a "deflection system" problem, and not simply a tube problem, the equipment manufacturer can best reduce the interference by careful circuit design and layout. Several methods which may be helpful in minimizing snivets are described below.

1. **Load Line Removed from "Knee".** One of the most obvious ways of reducing snivets interference (and probably the least acceptable to equipment manufacturers) is to design the deflection circuit so that the load line is well removed from the "knee" region of the deflection-tube characteristic. Laboratory tests of such a design show that snivets

interference is virtually eliminated. This solution, however, has the disadvantage that plate dissipation and B+ power for a given scan and high-voltage output are increased, or that less high voltage and scan are obtained. Nevertheless, this approach is the most effective way to reduce snivets interference, and is recommended wherever it is commercially practical.

2. **Circuit Layout.** Another method of reducing snivets interference is the use of careful circuit layout and lead dress and the addition of isolating chokes or resistors. In practically all cases, snivets interference is picked up by the television tuner. Therefore, the tuner should be located as far as possible from the horizontal-deflection circuits and, if practical, on a bracket several inches away from the main chassis.

In addition, the antenna lead-in to the tuner should be dressed so that it is as far from the deflection circuits as possible. If the length of the lead-in is such that it resonates at the interfering frequency, the lead-in may tend to increase the susceptibility to interference. Tests should be made on a finished design to eliminate this possibility. "In-cabinet" antennas, in particular, should be kept at least several inches away from the deflection circuits.

All heater, plate, and grid-No.2 (screen-grid) supply leads to the deflection circuits should be isolated by means of rf chokes or small resistors located as close as possible to the deflection circuits. Whether all or only a portion of the precautions described in this section are required will vary with the design of a particular television receiver.

3. **Unbypassed Grid-No.2 Resistor.** If there is some margin of scan in the receiver, snivets interference may be reduced in many cases by the use of an unbypassed grid-No.2 (screen-grid) resistor. Although this resistor reduces the output of the horizontal-deflection tube, it is often effective if its use can be tolerated. The unbypassed resistor acts to reduce the instantaneous grid-No.2 voltage (and thus the tendency toward oscillation) at the time when plate voltage is very low. It may also tend to act as a suppressor and to reduce the amplitude of any interference which is generated.

4. **Series Grid-No.2 Inductance.** Another method of reducing snivets interference in some receivers is to place a small value of inductance (about 5 to 10 millihenries) in series with the grid No.2. This inductance reduces the instantaneous grid-No.2 voltage when plate voltage is low in much the same fashion as the unbypassed resistor mentioned above. However, this method has the advantage that output is not reduced.

5. **Fixed Bias.** In many cases, snivets may also be reduced by the use of fixed bias for the horizontal-output tube of such value that the tube is never quite driven to zero bias. In this case, however, the value of fixed bias must be chosen to accommodate the normal range of tube characteristics so that a reasonable compromise between snivets and output is achieved.