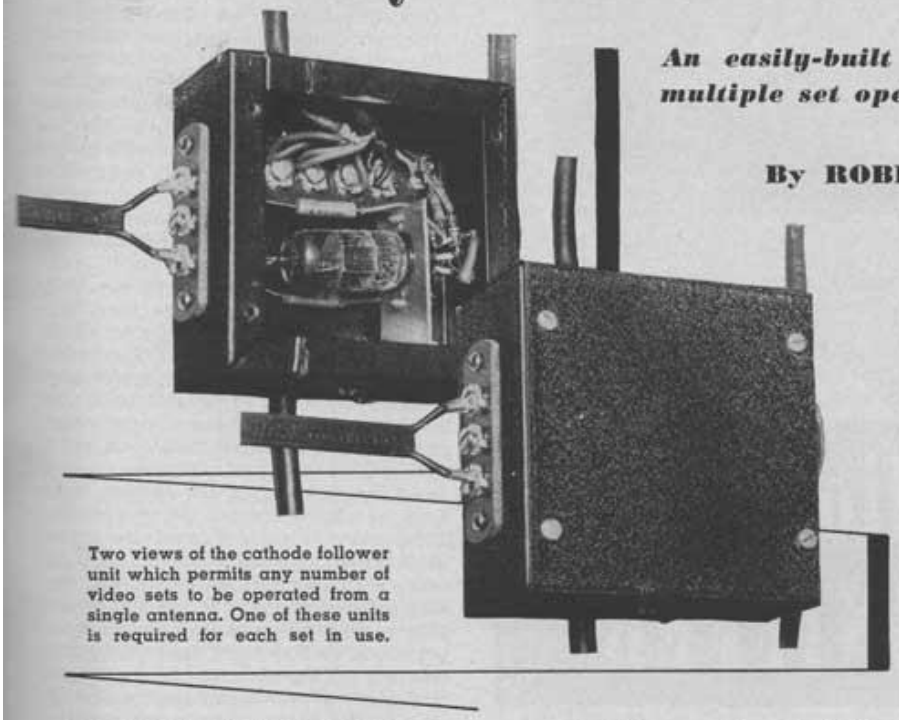
MULTIPLEX TV ANTENNA Systems for Stores



Two views of the cathode follower unit which permits any number of video sets to be operated from a single antenna. One of these units is required for each set in use.

An easily-built cathode follower unit for multiple set operation from single antenna.

By ROBERT L. DONALDSON

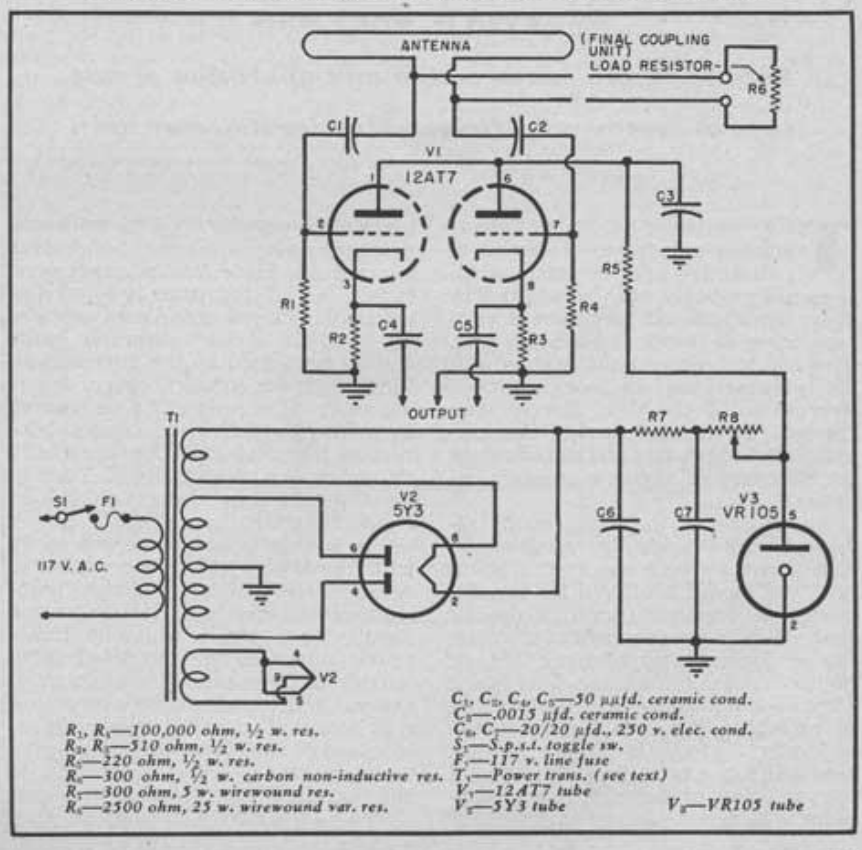
ONE of the problems faced by operators of television receiver showrooms is that of multiple operation of several TV sets from one antenna system. The usual evasion of the problem by installing a switch system that allows but one set at a time to be connected is not satisfactory. The impossibility of showing direct comparisons between sets, and the bother of constantly operating the switch are annoying factors. If two or more sets are connected in parallel across the lead-in the signal power is shared by the sets, and so the signal available to each set gets poorer as more sets are added. The very low load impedance of the combination causes extreme standing wave effects, and reflections result in degeneration of the image on all sets. Resistance pads between the sets and the lead-in help to maintain proper impedance match, but result in even greater attenuation of the signal at the set. In addition, there is usually severe interference between sets, limiting simultaneous operation. What is needed, then, is a simple system that would overcome this general problem.

Such a system is herein described. It operates by employing a number of cathode follower units between the lead-in distribution line and the set inputs. The cathode follower circuit has the desirable characteristics of extremely high input impedance, thus not loading the line, and low output impedance that may be made equal to the input impedance of the set used, thus assuring maximum power transfer. It is also a "one way" device that effectively prevents oscillator energy from a set going back into the line and causing interference with other sets.

The particular arrangement that has proven very effective is where a 300 ohm twin lead is run down from the antenna and is routed around the showroom. At intervals along this line the cathode follower units are placed, attached to the wall, and merely shunted across the line. Any reasonable number of coupling units may be used,

(*Continued on page* 110)

Circuit diagram of the cathode follower unit for multiple receiver operation.



R_1, R_4—100,000 ohm, ½ w. res.
R_2, R_3—510 ohm, ½ w. res.
R_5—220 ohm, ½ w. res.
R_6—300 ohm, ½ w. carbon non-inductive res.
R_7—300 ohm, 5 w. wirewound res.
R_8—2500 ohm, 25 w. wirewound var. res.

C_1, C_2, C_4, C_5—50 μμfd. ceramic cond.
C_3—.0015 μfd. ceramic cond.
C_6, C_7—20/20 μfd., 250 v. elec. cond.
S_1—S.p.s.t. toggle sw.
F_1—117 v. line fuse
T_1—Power trans. (see text)
V_1—12AT7 tube
V_2—5Y3 tube
V_3—VR105 tube

Multiplex Systems

(*Continued from page 45*)

since they do not load the line or otherwise consume the signal energy on the line. At the end of the line a 300 ohm carbon non-inductive resistor is installed so as to properly terminate the line in its own impedance, preventing standing wave effects and reflections. It will be recalled that if this is done, it will be unimportant where the coupling units are bridged across the line, since all points on the line will have the same impedance and current-voltage relationship.

The individual coupling units consist of a 12AT7 connected as a balanced dual cathode follower. Output for 300 ohm sets is taken from cathode to cathode, whereas that for low impedance sets is taken from one cathode to ground. Power for the coupling units is run in from a four wire cable that connects all the units to a common power supply. This supply is of standard design and need only supply 6.3 volts at .3 amp. and about 10 milliamperes at 100 or so volts d.c. for each unit. The total requirement can easily be calculated by multiplication. For instance in a setup of 10 units, the power supply is designed to provide 6.3 volts a.c. at 3.0 amps. and 105 volts d.c. at 100 ma. This is easily provided by the circuit suggested. It is important that an a.c.-d.c. supply is *NOT USED*. Use a transformer in order to isolate from the power line.

The VR-105 regulator tube is not absolutely necessary, but by its inclusion the power supply for the units is made quite constant irrespective of the number of units used or variation in the line voltage. When the system is first set up, it is only necessary to adjust the series resistor to such a point that the VR tube lights up to a normal brilliance. Then any small variations will be automatically compensated for by the regulator action of the tube. If desired, this point may be accurately placed so that a meter inserted in series with the VR tube to ground lead reads 25 ma. under normal conditions. This current is in about the center of the tube's range, and a difference of 15 ma. more or less will be compensated for by the tube.

The coupling units are constructed in 4"x4"x2" steel boxes, and each has on the 4"x2" top side a strip of three screw terminals. These are the cathode-ground-cathode connections and from them a piece of 300 ohm or 75 ohm twin-lead is run to each set. Thus it takes only a moment to change connections for either type of set. In making up the coupling units it is suggested that the layout shown in the photograph be followed rather closely to avoid headaches. The tube is mounted inside the steel box, in order to prevent accidental damage or tampering. The two-terminal input strip is run across the narrow dimension of the 4"x2" bottom so that the lead-in line is merely run through continuously from one unit across to the next. The wires of the twin-lead, being bared of insulation and held under the screw terminals, make a straight-through connection.

The 4"x4" back plate is drilled so as to pass two wood screws which then hold the whole unit to the wall. The power cable is run in one side and out the other through rubber grommets, and connections are made inside by means of a four-terminal strip mounted on standoff spacers bolted to the back plate. The nine-pin tube socket is similarly mounted on the bottom and placed so that short equal connections will be obtained between the grid terminals and the input strip, to prevent unbalancing the line. The length of the output leads is not critical. Nothing is mounted on the 4"x4" front plate, so that it is merely a cover, and may easily be removed for tube changes, etc. The various condensers and resistors are mounted by their own leads from point to point.

With this setup it is possible for any or all sets to be operated simultaneously, without mutual interference. Sets can be easily moved about, connected and disconnected. The signal delivered to each set is only about 2½ db. down from that delivered by the antenna, and therefore no trouble is encountered because of a weak signal. A good antenna installation with small line loss will more than make up for this slight loss. In weak signal areas stacking of two antennas would be advisable, since stacking affords a gain of about 4 db. over a single antenna, and thus the loss in the coupling unit is more than made up. No ghosts or reflections are noted due to the coupling system, and the picture on every set is equal to its eventual performance on its own antenna.

The above discussion and circuit is based on the use of a folded dipole having its center connected to the mast and grounded. With other types of antennas where the dipole arms are not grounded at its midpoint, there will be a strong 60-cycle a.c. component on the twin-lead lead-in. If this is not eliminated it will tend to drive the 12AT7 into cut-off and operation will be very poor. In addition, with any type of antenna, if the location is very close to an AM transmitter, that will also tend to do the same thing.

Both of these effects can be completely eliminated by placing a trap across the lead-in at any convenient point. The trap consists of one of the popular double slug-tuned FM traps with the small condensers removed and the center point between the coils brought to a good ground. The outside end of each coil is connected to either side of the twin-lead. The slugs may be tuned in or out for best operation. The coils themselves usually consist of about 5 turns on a ⅜" form and may be easily constructed if not already on hand. The object is to obtain a shunt inductance of about 1 μhy. so as to short out all frequencies lower than the bottom of the TV band. This will protect the 12AT7 from any interference, and result in the properly operating circuit.

Another recommendation is to use two 150 ohm resistors center-tap grounded instead of the single 300 ohm resistor, R_k, specified.

Formulas for cathode follower design are:

$$Gain = M = \frac{\mu \times R_c}{R_c(\mu + 1) + r_p}$$

$$\frac{55 \times 500}{500(56) + 10000} = \frac{27500}{38000} = .73 =$$

2½ db. loss

$$Output\ Impedance = Z_o = \frac{1}{G_m + 1/R_c + 1/r_p} = \frac{1}{.004 + .002 + .0001}$$

$$= 1/.0061 = 164 \text{ ohms}$$

each side, or total Z_o (cathode to cathode) = 328 ohms which is within 10% nominal tolerance of input circuit of receiver.

The various terms in the above equation are defined as follows:

μ = Mu of the tube
R_c = Cathode resistance
r_p = Plate resistance
Z_o = Output impedance
G_m = Mutual conductance of the tube