GE Electronic TUBE

Ham News

MARCH—APRIL 1951 VOL. 6—NO. 2

TVR HIGH-PASS FILTER

Effective, Economical 300-ohm Filter to Prevent Receiver Overload

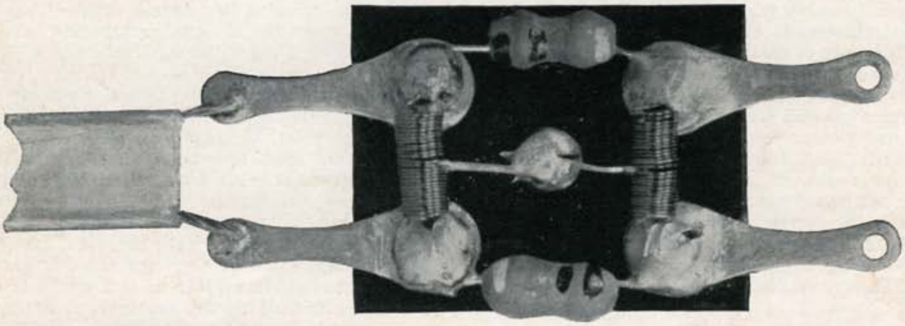

Fig. 1. Top view of the TVR Filter (shown 60% larger than full size). A short length of 300 ohm line is attached to give a better idea of the filter's actual size.

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UTILITY POWER SUPPLY

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Contents

TVR HIGH-PASS FILTER

TVI eliminated from a TV set for less than half a dollar? The answer is very likely yes, but that's getting ahead of the story. The TVR filter does cost less than fifty cents, and may make you say, "Why didn't I think of that before?" but before any real claims are made let's see what it is and why it works.

The TVR filter is merely a balanced constant-K high-pass filter designed for 300 ohm transmission line. It should be used at the input to the television receiver where it is capable of greatly attenuating signals below 44 megacycles, and passing all television channel frequencies.

Why and when should it be used? That involves a little discussion.

THE TVI PROBLEM

The general problem of amateur radio interference to television receivers has been the subject of articles beyond number. The amateur who has not heard of TVI is either a hermit or else is rare DX residing in some far-away place where the mail boat seldom calls.

This intensive educational program on TVI is as it should be, and many fine articles have been written by the ham radio experts. Unfortunately, however, most of the emphasis on TVI elimination has been directed toward the harmonic-radiation problem. The result is that thousands of ham rigs are thoroughly covered with layers of shielding and use transmission line filters (see Ham News Vol. 4 No. 6).

All of this has been good and has been necessary, but many hams are still collecting stamps because the aforementioned precautions have not been sufficient.

Amateurs who have done an excellent job of reducing harmonic radiation still receive "legitimate" complaints that interference still exists. The cause of this trouble is the modern version of that old complaint, BCI. In our preoccupation with harmonic control we have lost sight of the possibility that other sources of difficulty can and do exist.

THE TV RECEIVER

Many modern television receivers will respond to strong signals on frequencies far removed from the frequency band to which they are tuned. Grid rectification (the big complaint in AC-DC broadcast sets) frequently exists. In addition, the TV receiver uses many sharp cut-off high-Gm tubes in order to obtain reasonable gain in the broad-band circuits. These sharp cut-off tubes simply won't take much extraneous signal without overloading. Further, these same tubes may also generate harmonics of a low-frequency amateur signal and thus produce their own interference.

So many possibilities of this sort exist in TV sets that it is not practical to make a complete list of them. Suffice it to say that the average TV set is wide open to signals of many frequencies, including fundamental amateur band frequencies. Reducing the strength of such signals by a filter placed at the antenna terminals of the television receiver will greatly reduce or eliminate the remaining interference.

PUBLIC RELATIONS

It is not the intent of this article to imply that the amateur is ***responsible*** for the installation of high-pass filters in his neighbor's TV receiver. Any TVI problem must be solved to the satisfaction of both parties. The best solution usually involves a judicious mixing of technical know-how and intelligent public relations.

Once you are convinced that your signals are clean and not at fault in any case of TVI, you are in an excellent spot to make a friend of your complainant. One tested approach is the demonstration approach. Ask the set owner for permission to make a simple demonstration, which does not involve going into his receiver.

When permission is granted, make the demonstration with the help of another amateur who will run your rig. The TVR Filter will reduce the interference and in most cases eliminate it. If one filter will not completely do the job, two in series certainly should.

After the demonstration, remove the filter (if the owner lets you), because you have only set out to demonstrate that something can be done. This is especially desirable if a serviceman has told the owner that nothing can be done to improve the receiver.

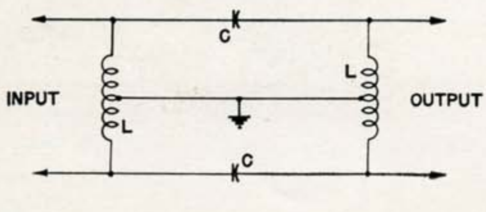
Of course, if the owner insists that such a filter be kept on his receiver—well, the rest must be obvious. Many owners insist on paying for the filter. Obviously, the most perfect filter in the world is useless if it is not attached to the receiver. A little tact will enable you to make a demonstration which ought to end the entire controversy.

ELECTRICAL DETAILS

The circuit diagram of the TVR Filter is shown in Fig. 2. There is absolutely nothing new in the design. It is a simple balanced constant-K high-pass filter with cut-off at 44 megacycles and a characteristic impedance of 300 ohms. In other words, it is used in 300 ohm lines, and attenuates all frequencies below 44 megacycles, yet permits the transmission of the television frequencies.

In cases where a television receiver uses a trans-

Electrical Circuit



CIRCUIT CONSTANTS

C. . . . . . 12 mmf general purpose ceramic condensers (Centralab .000012 mf Hi-Kaps are recommended.)

L. . . . . . 1.08 microhenry (28 turns No. 30 enamel wire. See text for coil winding details.)

Fig. 2. Circuit diagram of TVR Filter.

mission line of other than 300 ohms, the TVR Filter may be easily redesigned for the new impedance. The ARRL Radio Amateur's Handbook contains the design formulae for constant-K high-pass filters. It is recommended that the cut-off frequency be maintained at 44 megacycles.

It is possible to use more complex types of filters, but the majority of receiver overload problems can be cured by a simple filter, and the tough cases by two simple filters in series. Extremely severe cases may be better handled by means of highly complex (but more effective) high-pass or M-derived filters. For an exhaustive discussion of this class of filter the reader is referred to the article by W2RYI entitled "Design and Application of High-Pass Filters," which appeared in the Fall, 1950 ***Ham Tips.***

CUT-OFF FREQUENCY

The selection of the cut-off frequency is an important one. If the frequency selected is too low, filter effectiveness is lost. If the frequency selected is too high, you may make a small error in coil winding and attenuate the lowest TV channel.

It is possible to specify a relatively high cut-off frequency for the TVR Filter because the coil-winding instructions, if followed carefully, allow very little room for error. However, it is not practical to use a cut-off frequency which excludes the six meter band. Therefore, the TVR Filter is not effective in reducing overload caused by six meter energy. Further, the two meter band is between two sets of TV channels so it cannot be taken care of by the TVR Filter.

In cases where interference from 50 or 144 megacycle transmitters is experienced, it is recommended that traps tuned to the band involved be inserted between the antenna and the TVR Filter. Tuned traps are discussed in the ARRL Radio Amateur's Handbook, and represent the most practical approach for these frequencies.

CONSTRUCTION

The "chassis" for the TVR Filter consists of a piece of insulating material 1 by 1¼ inches by $\frac{1}{16}$ inch thick. The material may be bakelite, lucite, etc. A piece thicker than $\frac{1}{16}$ inch may be used but this is unnecessary.

With reference to the photographs, five holes are drilled in the insulating material. Four of these are placed ¼ inch in from each corner and the fifth is in the exact center. Drill and tap each for a 4-40 machine screw. Brass screws are desirable.

Place a soldering lug under each corner screw and mount securely. Now solder the condensers in place between the two pairs of screws which are ¾ of an inch apart. Make certain that the solder flows over the head of the machine screw, thus bonding the screw to the lug. Make a ball of solder at this point.

Coil winding is next. Procure the No. 30 wire and cut off a piece approximately fifteen inches long. Fold it double. Remove the insulation carefully for a length of about one inch at the point of the fold. Tin and solder together the two wires at this point. Now lay this wire out straight with the tinned center at right angles to the length of the wire and measure out 6⅜ inches from this center point to each end. Cut the wire to this length. You should now have a straight piece of wire 12¾ inches long, not counting the length of the center-tap. Next, remove the insulation and tin the ends of the wire for a distance of ⅛ inch on both ends.

Procure a No. 30 drill (or a rod ***exactly*** ⅛ inch in diameter) and use this as the winding form. Start with one end of the wire and carefully wrap this wire around the solid (not the fluted) end of the drill until the entire coil is wound. Slip the coil off the drill, handling it with the stiff center-tap. Repeat for the second coil.

With tweezers turn out the tinned ⅛ inch length at each end, cut the center-tap to length, and solder the center-tap to the middle machine screw after tinning it. With the coil thus secured make a good solder joint with the end connections. Repeat for the second coil and you are almost finished.

Put nuts on the bottom side of the protruding machine screws, tighten carefully, and the TVR Filter is complete.

The coils are not as fragile as they might sound. Number 30 wire wound on a ⅛ inch diameter form has the same strength factor, wire diameter to coil diameter, as a coil wound with ⅛ inch tubing on a 1½ inch diameter form.

While it is a little less convenient to wind these coils on a ⅛ inch diameter form, it has been possible to eliminate the need for shielding by keeping the coils so small that direct pickup is negligible.

INSTALLATION

Attach the TVR Filter directly to the antenna posts of the television receiver. If a television booster is used, two TVR Filters should be employed. Place one at the receiver and one at the input to the booster.

In many cases no ground connection is necessary, or desirable, but if complete attenuation is not achieved try connecting the ground point on the TVR Filter with as short a lead as possible directly to the television receiver chassis.

Fig. 3. Oblique view of the TVR Filter.

UTILITY POWER SUPPLY

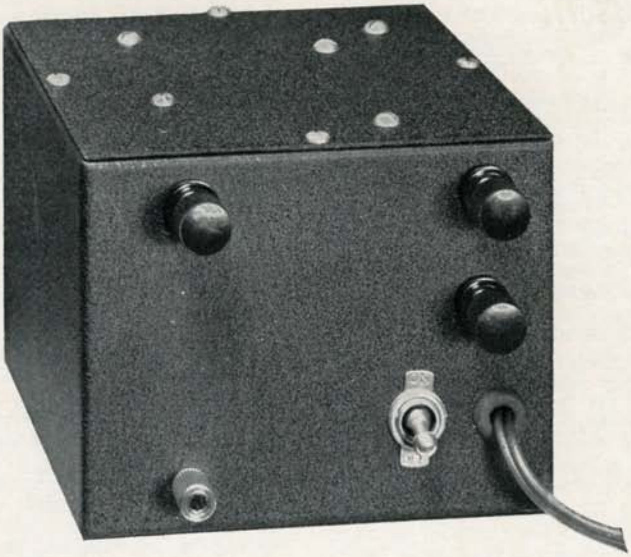


Fig. 4. Front view of the Utility Power Supply. High voltage connections on left, filament connections on the right.

In doing experimental work around the shack there is nothing more convenient than a compact power supply which is capable of an output of 300 volts or so, especially if the same unit supplies 6.3 volts a-c for filament use. There are many ways to design such a power supply, but the supply about to be described has several advantages over the normal type of tube power supply.

Instantaneous output (no heat-up time required) is achieved by using selenium rectifiers. Further, a-c line isolation problems are avoided by use of an isolation transformer which also has a 6.3 volt winding. The result is a compact, cool-running, long-life power supply.

ELECTRICAL DETAILS

The complete circuit is shown in Fig. 6. The transformer specified is a Thordarson T-22R12 which has a 120 volt secondary (and a 120 volt primary) which is rated at a d-c current drain of 75 ma. This rating holds for both half and full wave operation. The circuit shown is a full-wave doubler circuit which will supply approximately 300 volts at 75 ma. This power is sufficient for receivers, low-power transmitters, and general experimentation. The filament circuit has a rating of 6.3 volts at 1.5 amps.

A filter is incorporated in the design so that external filtering is not required. The choke specified is rated at 80 ma which allows continuous operation without undue heating. The bleeder resistor is of a low enough value to drain the condenser charge quickly, yet is high enough in resistance that it does not take an appreciable current.

CONSTRUCTION

A standard 4 by 5 by 6 inch utility box houses the power supply quite nicely. If the layout shown in the photographs is followed, most of the wiring can be done before the box is put together.

All of the parts except the four binding posts, the a-c switch, R_2 and C_4 are mounted on one of the 5 by 6 inch removable sides. This side becomes the top of the power supply. Fig. 7 shows how the parts are placed. This photograph was made looking into the bottom of the power supply.

A two-point tie point is mounted at one end of the choke, and the junction of C_2 and C_3 connect here, as well as the junction of C_1 and R_1. Resistor R_1 is connected across the two points. The other ends of C_2 and C_3 connect to the selenium rectifiers, which are stacked so that adjacent terminals (a positive and a negative) may be connected together. The red terminal is the plus terminal.

In actual construction, mount and wire all parts on the 5 by 6 inch removable top and bring out 6 connecting wires—the a-c connections, the filament leads, and the d-c connections. Next, mount the binding posts, the a-c switch, and a rubber grommet on

LOAD CURRENT (ma)	OUTPUT VOLTAGE (VOLTS)
5	355
10	350
20	338
30	322
40	308
50	295
60	282
70	267
75	260

Fig. 5. Performance data for Utility Power Supply (110 volts on primary, filament winding fully loaded).

Electrical Circuit

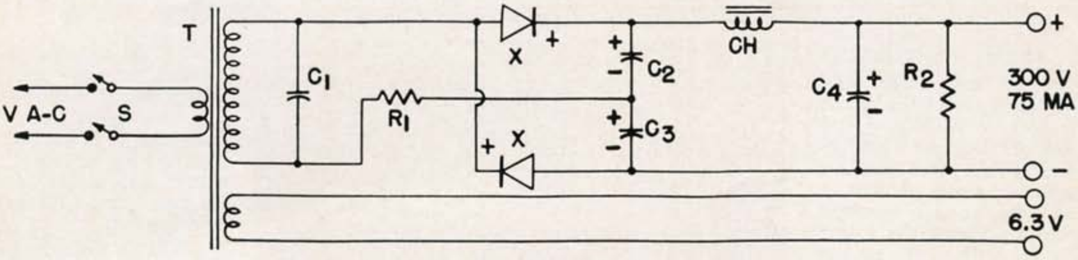


Fig. 6. Circuit diagram of the Utility Power Supply.

CIRCUIT CONSTANTS

C_1 . . . . 0.01 mf 400 volt paper
C_2, C_3 . . . . . 40 mf 150 volt electrolytic
C_4 . . . . 32 mf 450 volt electrolytic (two 16 mf units in parallel)
CH . . . . 12 Henry, 80 mil choke (Thordarson T-20C53)
R_1 . . . . 25 ohms 1 watt
R_2 . . . . 0.25 megohm 1 watt
S . . . . DPST Toggle Switch
T . . . . Power transformer, 120 volts at 75 mils, 6.3 volts at 1.5 amps. (Thordarson T-22R12)
X . . . . 75 mil selenium rectifier (G-E 6RS5GH1)

the front of the box. Condenser C_4, which is two condensers in parallel, connects across the d-c terminals, and the a-c cord is wired to the switch.

To assemble, place the top on the box, and solder the six loose wires to the proper points. Remember to use insulating washers when mounting the binding posts (except for the B minus terminal, which is grounded to the panel).

PERFORMANCE

The table in Fig. 5 indicates the voltage output versus load characteristic of the power supply. This data was taken with a line voltage of 110 volts, and with the filament winding delivering 1.5 amperes. The drop in voltage at high load currents is due primarily to the regulation characteristic of the selenium rectifiers.

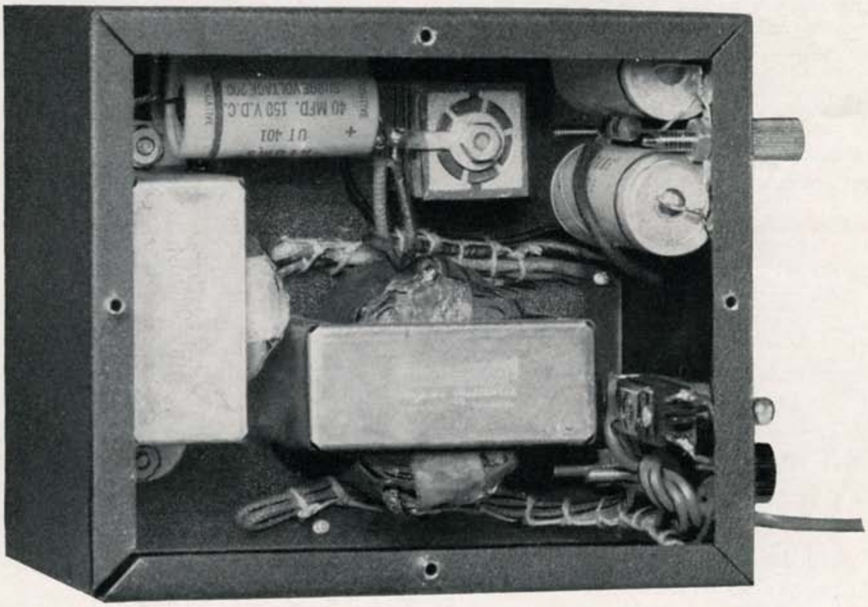


Fig. 7. Internal detail view of the Utility Power Supply.

How did you solve that last problem that almost had you stumped? Be it about tubes, antennas, circuits, etc., Lighthouse Larry would like to tell the rest of the hams about it. Send it in! For each "trick" published you win $10 worth of G-E Electronic Tubes. No entries returned. Mark your letter "Entry for Tricks and Topics" and send to Lighthouse Larry, Tube Division, Bldg. 269, General Electric Company, Schenectady, New York, or in Canada to Canadian General Electric Company, Ltd., Toronto, Ontario.

In the March-April 1949 Ham News, in the "Sweeping the Spectrum" column, I told of an idea of mine for placing nuts on inaccessible screws. The idea, briefly, involved placing the nut on an icepick, pressing the point of the icepick against the machine screw, then letting the nut slide down onto the screw.

Many other amateurs thought that my idea was all right, but they had better ones. Here are the results of their thoughts. Each amateur mentioned wins $10 worth of G-E tubes.—Lighthouse Larry.

Tricks & TOPICS

SOLDER VS. ICEPICK

One of my readers likes to use solder instead of an icepick. W3BIM suggests that I "replace the icepick with a piece of solder which is small enough in diameter to pass through the nut. Shape the solder for the path of the sliding nut so that it clears all obstructions."

BUS-BAR VS. ICEPICK

W8HAR uses a piece of bus-bar. He says, "The icepick idea is all right providing you have one small enough to pass your smallest size nut. I have found that a piece of bus-bar will accomplish the same thing and has the advantage that it can be bent to pass around parts which would interfere with the use of an icepick."

CUTTING THREADS IN SOLDER

W6AKQ, W6FYN and W9FPO all like to use solder in another manner. They suggest threading the solder into the nut so that the nut is held firmly, then snaking the solder down to the machine screw. Each has a slightly different slant on the subject.

W9FPO threads the nut onto a single piece of solder. W6FYN suggests bending the solder double so that the solder forms a tight fit in the nut (this is for 8-32 and 10-32 nuts).

The fanciest idea is given by W6AKQ, who writes: "Take a length of ordinary solder and flatten one end with pliers so that the width of the flat part is slightly larger than the diameter of the hole in the nut. Thread the nut onto the solder until one thread catches."

HAMMER AND PLIERS TECHNIQUE

Three of my readers like the brute force technique. Carl M. Retzlaff suggests holding the solder parallel with the nut and squashing the solder into the nut with a large pair of pliers. This squeezes the solder into a few of the threads and forms a strong joint.

VE3AZY does the same thing with a hammer: "Smartly rap with hammer so that solder is squashed into the first couple of threads."

W2ESO sent in a sort of history of ideas, including using glue to hold the nut to a dowel, and a magnetized tool, but he too ends up with "lay the solder across a nut and whack it with a hammer to expand the solder into the hole in the nut."

TWEEZER TECHNIQUE

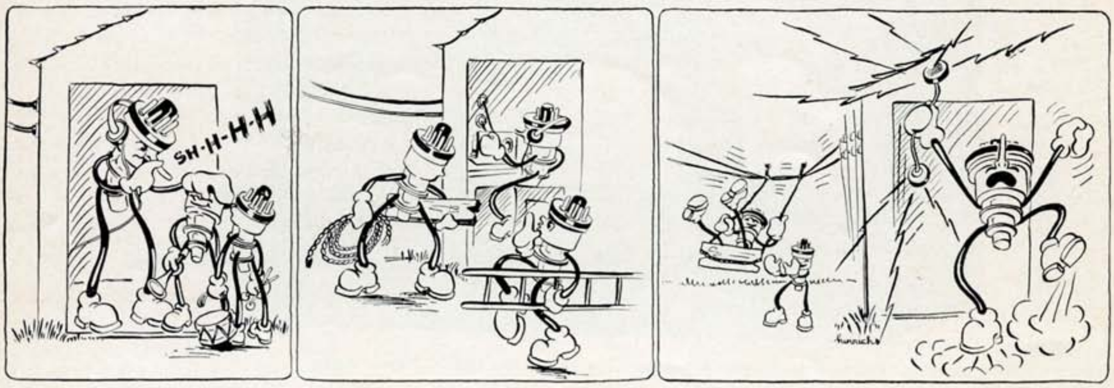
Commenting that my idea is perfectly all right if I have enough room, W6QIR goes on to say, "Use a pair of tweezers, placing the tips inside the nut and letting the spring of the tweezers hold the nut." He also points out that an ordinary match stick fits into a 6-32 nut snugly.

ADHESIVE TAPE TECHNIQUE

WφYSS has an entirely different approach. He suggests that the nut be put on first, and held by any sort of adhesive tape, either to the chassis or to the component being mounted. He prefers this to actually soldering the nut to the piece of equipment. If a hole is made in the tape to correspond to the screw hole, the nut will stay fastened while the screw is being tightened.

That's the story, from ten amateurs, on how to put a nut on a screw which is in an inaccessible spot. The only other answer seems to be—don't mount equipment so close to the edge of the chassis.

—*Lighthouse Larry*



SWEEPING *the* SPECTRUM

TVI is still a problem to the amateur but it should not be a major worry. It seems to me that sufficient information has been published to provide a solution for almost any case of TVI. If the solution is known, the problem can be solved. All it involves is some effort on the part of the amateur (even though, admittedly, it's not all his fault).

In many ways TVI problems are analogous to BCI problems. You old-timers will recall the trouble the 160-meter men had with BCI. Like so many things which seem so tragic at first glance, BCI turned out to be not so bad after all. Part of this was due to steps taken by the amateurs and part due to steps taken by radio receiver manufacturers.

It looks as though TVI is headed down the same path so that eventually TVI will be "that stuff we used to have back in nineteen-hundred and umptyumph." Amateurs are doing their part to get clean signals, and TV set manufacturers are doing their part to produce receivers which are as little susceptible to interference as possible.

Don't forget, however, that inexpensive broadcast sets are still made and are the big cause of BCI, so that inexpensive television receivers may continue to be causes of TVI. On the whole, however, the outlook is much brighter.

* * *

Manufacturers are alert to this difficulty. General Electric Co., for example, recently announced the availability of an i-f band rejection filter for use with 300 ohm line. This filter (Stock No. RLW-008) is designed to greatly attenuate any signal in the frequency band between 40 and 47 megacycles.

It is built as an enclosed unit and requires no special mounting bracket, as it mounts by connection to the antenna posts of the receiver. The tuning of the filter is fixed and requires no adjustment when installed.

If you want further data on it, write to the Receiver Division, Electronics Dept., General Electric Co., Syracuse, New York.

* * *

If you want to be protected by the latest in electronic radar, take a ride on a city of New York ferry operating between Manhattan and Staten Island. All ferries on this run are now equipped with X-band electronic navigators.

It must be a good business deal to sell radar equipment to be used in ferry boats, because there are two "forwards" and two "afts," depending on whether you are going to Manhattan or Staten Island, so that two radar equipments are required.

Which brings up a point. If the captain told you to go up to the bow of the boat you would have to know which way the boat was going before you could comply.

* * *

Some night while you are resting from ham radio and enjoying television you may notice a white or black arrow flitting about on the screen. Don't tear your hair and rush about for a solution, because it may be the new Electronic Pointer (Type TV-34-A) recently developed by the Commercial Equipment Division of the Electronics Dept.

This device enables a narrator or commentator to insert a black or white pointer about 30 lines high and seven lines wide at any point in the TV picture, to more effectively describe the action taking place.

The equipment consists of a rack mounted chassis and a control unit which is similar to the control stick of an airplane. A toggle switch selects either a white or black pointer.

Can't you just visualize a ham TV QSO of 1970? "Now I'll just swing the ike on the rig and point out a few features of interest. Here is the final," says he, adroitly bringing the black pointer to bear on his new cavity tube, "and here . . . ."

—*Lighthouse Larry*

Designer's CORNER

Full-wave Transformer Design

Evidently some of my readers have started to scrutinize the nameplates on the surplus transformers they have purchased, because I have had several letters asking me to explain the ratings. The point that seems to produce the most confusion is the question of the power rating of primary and secondary.

For example, one full-wave transformer a reader asked me about had a rating of 0.222 KVA for the primary and a rating of 0.310 KVA for the secondary. How, he asked, can the secondary have a higher rating than the primary? How can you get more power out of a transformer than you put in?

These are good questions, and there is an exact answer to them, because the ratings stated are exactly correct. Let's see why. The following discussion applies only to single-phase transformers rated for full-wave rectifier service.

Assume a hypothetical problem. A transformer has a secondary with twice as many turns as the primary, and the secondary has a center-tap. Each half of the secondary winding is therefore identical to the primary winding. In operation in full-wave service one-half of the secondary winding is carrying current through a rectifier while the other half remains idle. On the succeeding half cycle of operation, the currents in the secondary windings reverse, and the formerly idle half carries current while the formerly active half remains idle.

This means that each half of the secondary winding must be capable of handling the full output current. Also, we assumed that each half of the secondary winding has the same voltage as the primary. Since this is true, it looks as though the volt-ampere rating of the total secondary should be *twice* the volt-ampere rating of the primary. This is almost true, but not quite, and the reason it isn't true is that the duty cycle of the secondary has not been considered.

In a transformer of the sort we are discussing, a winding is rated by a factor which is the square root of the length of time it carries current, divided by the total time. For one-half of the secondary this factor is therefore the square root of one-half, divided by one, which is 0.707. For the entire secondary this factor is multiplied by two, and so becomes 1.414. The primary factor is 1.000.

Therefore, all single-phase transformers designed for full-wave rectifier service should have a KVA rating for the secondary which is 1.414 times the KVA rating for the primary.

In terms of the d-c voltage and d-c current, the KVA ratings for the primary and secondary are as follows.

Primary KVA rating equals d-c current times d-c voltage times 1.11.

Secondary KVA rating equals d-c current times d-c voltage times 1.57.

—*Lighthouse Larry*

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