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Filtering Amateur Transmitters To Meet U. S. Regulations

By the Engineering Department, Aerovox Wireless Corporation

WITH the issuance of the new United States Amateur Regulations, late in 1930, considerable attention was centered on the importance of a properly filtered power supply as a means of eliminating interference due to frequency modulation.

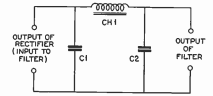

Fig. 1.

Clause (C), Section VI of the new regulations specifically rules as follows: "Amateur Stations must use adequately filtered direct current power supply or arrangements that produce equivalent effects to minimize frequency modulation and prevent the emission of broad signals."

There are a number of factors which contribute to produce frequency modulation by affecting the circuit constants of a transmitting circuit.

One of the most notorious causes of frequency modulation, often referred to as "frequency flutter" or "wobbulation" is insufficient filtering of the output of the power supply unit used as the power source for the transmitter.

The voltage output of a poorly filtered power supply unit varies considerably and the application of this varying voltage across the transmitter circuits affects the frequency of the output of the transmitter, because the frequency of oscillation depends to a certain extent on the voltage applied to the plate.

While it is possible, with very careful design and adjustment or by the use of crystal control to use raw a. c. or unfiltered rectified a. c. in transmitters, the simplest and most effective method to eliminate frequency instability and modulation is to use a properly designed filter of ample proportions.

There are a wide variety of circuits and combinations which can be used to filter the output of a rectifier but the two circuits shown in Figs. 1 and 2 are by far the most commonly used forms and can be depended upon to give satisfactory results for all ordinary purposes.

The single-section filter shown in Fig. 1 is usually sufficient for most amateur code transmitting purposes provided the choke coil and the condensers have the proper constants.

The double-section filter shown in Fig. 2, however, is more efficient for telephone work, where it is much more important that the plate supply be as nearly pure d. c. as possible.

It has been found, both from theoretical solutions and practical tests, that of the condensers used in such circuits the first filter condenser ("C1" in Fig. 1 and "C2" in Fig. 2) produces the greatest effect on voltage output and regulation, but comparatively little effect on the ripple.

The greater the capacity of the first condenser, within certain limits, the greater will be the voltage output of the filter circuit, and the better the voltage regulation. It has been found, however, that there is usually very little to be gained by increasing the capacity at that point beyond two mfds..

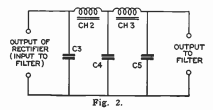

Fig. 2.

The second filter condenser ("C2" in Fig. 1 and "C4" in Fig. 2) has a lesser effect on voltage output and regulation but a very important effect on the ripple. There is little to be gained, however, by using more than two mfds. at "C2" of Fig. 1 for code transmission or more than two to four mfds. at "C4" of Fig. 2 for phone transmission.

The last condenser, "C5" in the two-section filter shown in Fig. 2 serves primarily as a reservoir to supply momentary high demands of the transmitter. For c. w.

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transmission little is to be gained by using more than one to two mfds. at "C5" of Fig. 2. For phone transmission, however, it is desirable to use a fairly high capacity of from four to eight mfds. at "C5" in order to produce a steady d. c. supply and a pure, clear signal.

Until recently paper condensers of the proper capacity and voltage ratings were used extensively in transmitter filter circuits. With the coming of the Hi-Farad DRY Electrolytic Condensers with their low cost per microfarad per volt rating characteristics and their surge-proof, self-healing features, paper condensers have been largely replaced by these electrolytic condensers in the new installations and for condenser replacements in existing transmitters.

The surge-proof, self-healing characteristics of electrolytic condensers are probably their most important features as far as their suitability for amateur transmitters are concerned. These features eliminate the high mortality rate of condensers in such filter circuits, because peaks which are ruinous for paper condensers do not permanently harm electrolytic condensers.

Their low cost for a given capacity and voltage rating, of course, is a feature that has endeared them to the hearts of amateurs all over the world.

Aerovox Hi-Farad DRY Electrolytic Condensers may be used across very high voltages by connecting enough units in series to make up a unit of the desired voltage characteristics.

In making up such a series combination, the individual units used to make up the combination should all be of the same capacity and voltage rating, and should be connected in the same manner as a number of batteries are connected in series, positive to negative, etc., because of the polarized features of electrolytic condensers, see Fig. 3.

We can, by a series connection of seven Hi-Farad condensers rated at 14 mfds. each and 500 volts d. c. peak, form a unit having a peak voltage rating of 3,500 volts, (seven times 500). The short, heavy electrodes represent the anodes or positive electrodes of the condensers while the light tray-shaped electrodes represent the cathodes or negative electrodes of the condensers.

The resultant capacity in such series combinations (using units of the same capacity and voltage ratings) is equal to the capacity of a single section divided by the number of sections connected in series. Thus the resultant capacity of seven 14-mfd. units is two mfds.

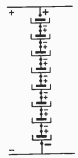

Fig. 3.

The resultant voltage rating of a series combination of a number of condensers having the same capacity and voltage characteristics is equal to the voltage rating of a single unit multiplied by the number of units connected in series. Thus the resultant peak voltage rating of seven 500-volt units connected in series is 3,500 volts.

When paper, mica, oil or other such dielectric material condensers are connected in series, uneven voltage distribution, due to the variation of insulation resistance of the various condensers which are connected in series, may result in breakdown of the condenser having the highest insulation resistance. This is due to the fact that the highest voltage will appear across the condenser having the highest insulation resistance. The breakdown of that condenser will result in throwing a higher proportional voltage across the remaining condensers with consequent disastrous results.

For this reason, it is usually necessary, when connecting such condensers in series, to either use balancing or equalizing resistors across each condenser or group of condensers, or to allow a higher factor of safety for each condenser.

Either of these methods result in higher cost and more bulky equipment.

The operating characteristics of Hi-Farad condensers, with respect to the change in leakage and consequently insulation characteristics of the units with changes of applied voltage (especially when operated at a point very close to their maximum peak voltage rating) tends to produce an equalizing effect which makes them far better suited for series connections than paper condensers.

In them, as with paper condensers, any tendency of the voltage to divide unequally across the condensers connected in series will tend to produce a higher voltage across the condenser having the highest insulation resistance. The application of a higher than normal voltage across such a unit, however, will tend to increase the leakage current, thereby decreasing the insulation resistance until it approaches that of the other condensers.

In tests made in our laboratory, several groups of units consisting of six 500-volt units per group connected in series to give a resultant rating of 3,000 volts for each group were applied across a test circuit having a peak voltage characteristic of 3,000 volts d. c. In order to approximate the worst possible conditions of operation, units were selected whose leakage characteristics and consequently insulation resistances varied considerably.

The units held up successfully over a period of 1,200 hours of operation, no trouble from breakdowns being experienced. This indicates that it is not necessary to make any allowances for uneven voltage distribution when using Hi-Farad electrolytic condensers of equal capacities.

To further test out this conclusion, a series of experiments was made to find out to what extent this equalization took place. These experiments brought out the fact that when two Hi-Farad condensers of equal capacity and voltage rating are conected in series, the combination will actually stand a somewhat higher total voltage than the combined critical voltages of the two units. Thus two 500-volt units whose leakage became excessive when more than 500 volts d. c. peak was applied to each unit separately, operated without excessive leakage current on 1,100 volts when connected in series.

It is recommended, however, that they be used at their rated voltages, using the extra margin as a factor of safety in series connections.

Because of the higher voltage rating of Hi-Farad DRY Electrolytic Condensers it is possible to obtain a given voltage and capacity rating with a fewer number of units and with a consequent savings in cost, space and weight.

To obtain a 3,500-volt combination, for instance, seven 500-volt Hi-Farad condensers are ample. If 14-mfd. units are used, the resultant capacity will be two mfds.

On the other hand, if 430-volt electrolytic condensers are employed, eight units will have to be used and the resultant capacity will be only 1.75 mfds. In addition, the cost of eight units will be higher, the space taken up by eight units will be greater and the weight, especially if wet electrolytic condensers are used, will be much more.

When Hi-Farad condensers are employed in transmitter circuits, the initial charging surge when high voltage is first impressed on the circuit is considerably less, due to their leakage characteristics. This results in lower keying surges, better voltage characteristics, improved voltage regulation, increased rectifier and transmitter tube life and better signal characteristics — advantages which are of great importance in amateur transmitters.

New Midget Mica Condensers Complete Aerovox Line of Mica Condensers

Type 1460.

The Aerovox Wireless Corporation announces three new mica condensers, Types 1462, 1463 and 1465.

This line now includes the standard Type 1460 with two insulated mounting holes and two

Type 1461.

terminals which can be used both as terminals and mountings. The Type 1461 is exactly the same as the Type 1460, except that it is provided with soldering lug terminals instead of the screw hole

Type 1462.

terminals of the Type 1460 unit. The Type 1462 unit is the same as the Type 1460 except that it has no insulated mounting holes and the Type 1463 is the same as the 1460 except that it is provided with a single mounting hole as shown.

Type 1463.

The Types 1460, 1461, 1462 and 1463 condensers in capacities up to .003 mfds. are rated at 1000 d. c. retest voltage and 500 d. c. working voltage. In capacities above .003 and up to .006 they

Type 1465.

are rated at 500 d. c. retest voltage and 250 d. c. working voltage.

The Type 1465 extra small units are available in capacities up to .0005 mfds. They are rated at 500 d. c. retest voltage and 250 d. c. working voltage.

Announcement Made of New Ultradyne Kit

A new, Model L-32 Ultradyne Kit with Dynatron oscillator has been announced by the Traul Radio Co., Inc.

Extremely high sensitivity coupled with sharp selectivity are the outstanding features of this receiver which, operating in New York City, is capable of bring in WLW, Cincinnati without a trace of interference from WOR, Newark; WMAQ, Chicago, through WEAF, New York; KGO, Oakland, Cal.; KSL, Salt Lake City, Utah; KFI, Los Angeles, Cal; KOA, Denver, Colo. and XEN, Mexico City, all without local interference.

One of the features of the receiver is that it can be used to bring in short wave stations in addition to those in the broadcast band.

The following are some of the outstanding features of the receiver:

- Operates entirely from the A.C. lines,
- Completely shielded throughout,
- Covers all wavelengths from 15 to 600 meters (20,000 to 500 kilocycles),
- Tunes as easily and smoothly on the short waves as it does on the broadcast band,
- 10 kilocycle selectivity on the entire band,
- Selectivity and sensitivity so great that distance range is unlimited,
- Power Detection,
- Push-Pull Amplification,
- Full Natural Tone,
- No Trace of Hum or Distortion,
- Steel Chassis,
- Simplified Construction.

Complete details on the features and construction of this receiver are contained in a booklet called the "Model L-32 Ultradyne Booklet" a copy of which can be obtained for 25 cents by writing to the Traul Radio Co., Inc., 1074 Atlantic Ave., Brooklyn, N. Y.