the chokes in the filter is made very low so that the voltages at the second and third section are fairly high. In addition, the time lag which takes place before the 245 tubes heat up and draw current places an additional burden on the condensers which practically amounts to operation of the unit under no-load conditions.

This accounts for the seemingly high ratings of the condensers used in these two filter blocks. Unless these units are used trouble may be expected from condenser breakdown.

The A-800 and B-800 filter condenser blocks are designed for use with power supply units which are to be used in connection with receivers and power amplifiers which employ CX-310 or UX-210 power tubes in single or push-pull arrangement in the last stage. The output voltage required for the operation of such amplifiers allowing for a maximum of 425 volts for the plate supply and 35 volts for grid bias, may run as high as 460 volts and this output voltage at the required current of from 50 to 100 milliamperes is obtained by using a half or full wave rectifier, depending on the current requirements, with an input voltage of from 550 to 600 volts A.C. per anode to the rectifier.

A filter condenser, conservatively rated at 800 volts D.C. is sufficient at the first section while 600-volt D.C. condensers are ample at the second and third filter sections where the peak voltages are considerably reduced.

The A-1000 and B-1000 filter condenser blocks are designed for use in high power supply units such as are used in connection with power amplifiers employing CX-350 or UX-250 power tubes.

The output voltage required from the filter for the operation of these power tubes may run as high as 534 volts allowing 450 volts for the plate supply and 84 volts for the grid bias.

To obtain this output voltage from the rectifier, and to allow a sufficient excess to take care of the drop through the filter choke system, a rectifier system consisting of two CX-381 or UX-281 rectifiers, connected to give full wave rectification is employed. The A.C. voltage input to the rectifier system may run as high as 750 volts per anode and a condenser conservatively rated at 1000 volts D.C. working voltage is necessary at the first section of the filter. Condensers conservatively rated at 800 volts D.C. working voltage must be used at the second and third section of the filter.

To complete the condenser requirements of the average power supply unit, bypass condensers are required at the various taps of the voltage divider.

For this purpose three types of bypass blocks have been included in the Aerovox condenser block line. These bypass condenser blocks were designed to take care of the bypass requirements of the various types of power supply units.

The Type B-1 bypass condenser block consists of two, 1-mfd. condenser sections, one rated at 300 volts D.C. and the other rated at 200 volts D.C. working voltage. In view of the increasing use of the heater type tubes for both radio and audio frequency amplification, and the considerable time lag experienced before these tubes heat up and draw plate current, a 200-volt condenser is no longer a safe condenser to use for bypassing the 90 and 135 volt terminals of the power supply units, because of the higher voltages, exceeding 200 volts D.C. which obtain at these terminals under what amounts to a no-load condition. It is for this reason that higher rating condensers, 300 volts D.C. for bypassing 90 and 135 volt leads and 400 volts D.C. for bypassing 180 volt leads, now used to a considerable extent for the screen grid A.C. tubes, have been included in the Aerovox line of bypass blocks.

The Type B-1 block is suitable where only two terminals, a 90 or 135-volt terminal and a 45-volt terminal are used.

The Type B-2 block consists of three, 1-mfd. sections, one of which is rated at 400 volts D.C. and the other two at 300 volts D.C. This unit is suitable for use where one 180-volt and two lower voltage taps must be bypassed.

Continued on page 2, col. 3.

NEW FILTER CONDENSER BLOCKS

TYPE A-400
List Price—$6.75

Section No.	Capacity Mfd.	Working D.C.	Voltage A.C.
C1	2	400	250
C2	4	300	175
C3	4	300	175

TYPE B-400
List Price—$10.00

C1	2	400	250
C2	2	300	175
C3	2	300	175

TYPE A-600
List Price—$9.50

C1	2	600	350
C2	4	500	300
C3	4	400	250

TYPE B-600
List Price—$13.75

C1	2	600	350
C2	2	500	300
C3	2	400	250

TYPE A-800
List Price—$12.50

C1	2	800	440
C2	4	600	3.50
C3	4	600	350

TYPE B-800
List Price—$19.00

C1	2	800	440
C2	2	600	350
C3	2	600	350

TYPE A-1000
List Price—$17.00

C1	2	1000	600
C2	2	800	440
C3	2	800	440

TYPE B-1000
List Price—$26.00

C1	2	1000	600
C2	4	800	440
C3	4	800	440

TYPE B-1
List Price—$2.40

1	1	300	175
2	1	200	125

TYPE B-2
List Price—$4.20

1	1	400	250
2	1	300	175
3	1	300	175

TYPE B-3
List Price—$6.45

1	1	400	250
2	4	300	175
3	1	300	175

Fig. 2

1929 - 6

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Universal Resistor Kit Solves Adjustable Resistor Problem

By the Engineering Department, Aerovox Wireless Corp.

ONE of the most troublesome resistor problems of the average radio experimenter and radio engineer, namely that of keeping on hand a wide variety of resistors of comparatively high current carrying capacity, has been solved by the Aerovox Wireless Corporation with the introduction of its Type UR Universal Range resistors.

By providing himself with a resistor kit consisting of two fixed units and three tapped units, containing in all 12 different resistance values, it is possible for the experimenter to obtain any resistance value from 25 ohms to 102,375 ohms to within 12.5 ohms of the required value, by simple series connections of the various units.

The design of these units is based on the discovery that if a number of numerical values are taken in a geometrical progression such as 2,-4, 8, 16, 32, etc., in which each succeeding number is obtained by multiplying the preceding number by two, it is possible to obtain any number from the smallest number which starts the progression, to the sum of all the numbers in the progression in multiples of the smallest number by adding together a selected number of the individual units.

The manner in which this can be applied to a resistor or any similar problem is interesting to say the least.

If we start with a resistor of 10 ohms for instance, we can build up a geometrical progression starting with 10 ohms, as follows: 10, 20, 40, 80, 100, etc. With these five values of resistors, it is possible to obtain any value of resistor from 10 ohms, the smallest value, to 350 ohms the sum of all the individual resistors in the series (10+20+40+80+100= 250) in steps of 10 ohms. This means that with only five resistors it is possible to obtain the following values by simple series connections of the various units: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240 and 250, a total of 25 different resistance values. This also means that any given value of resistance can be obtained within five ohms of the required value for any value such as 25 would be only five ohms above 20 or below 30 ohms. Numbers in between any given ten points would be five or less ohms above or below an obtainable value.

If these values are made as sections of a tapped resistor, the cost of the units is lowered and the number of separate units required is reduced.

After careful consideration, it was decided to begin the geometrical

Universal Resistor Kit

RESISTOR NO. UR-1
Wound on a Type 994 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
1	25	270
2	50	270
3	100	270

RESISTOR NO. UR-2
Wound on a Type 996 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
4	200	166
5	400	120
6	800	100
7	1,600	85

RESISTOR NO. UR-3
Wound on a Type 996 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
8	3,200	70
9	6,400	50
10	12,800	42

RESISTOR NO. UR-4
Wound on a Type 996 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
11	25,600	42

RESISTOR NO. UR-5
Wound on a Type 996 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
12	51,200	35

progression for a universal resistor with 25 ohms, with each resistor having the maximum safe current carrying capacity indicated in the table for each section.

The first resistor consists of three sections having resistances of 25, 50 and 100 ohms respectively or a total of 175 ohms.

The second resistor consists of four sections having resistances of 200, 400, 800 and 1600 ohms respectively or a total of 3,000 ohms.

The third resistor consists of three sections having resistances of 3,200, 6,400, and 12,800 ohms respectively or a total of 25,600 ohms.

The fourth resistor consists of a single section of 25,600 ohms and the fifth resistor consists of a single section of 51,200 ohms.

With this series it is possible to obtain any resistor to within 12.5 ohms of any multiple of 25, from 25 to 102,375 ohms.

In selecting the proper sections to connect in series to obtain any required value of resistance, the first step is to select the nearest multiple of 25 within the range of the universal resistor.

If we require a resistance of 8,637 ohms for instance, the nearest multiple of 25 would be 8,650 ohms.

The next step is to select the closest next lower value of any section available. In this case, this would be section 9, the 6,400 ohm section of resistor No. 3. This would still leave a balance of 2,250 ohms required to make up the total of 8,650 ohms. The value available just below 2,250 ohms is 1,600 ohms (section 7 of Resistor No. 2) which, added to 6,400 would still leave 650 ohms to be added. This value of 650 ohms can be made up by connecting in series, section 5 (Resistor No. 2) which provides 400 ohms, section 4 (Resistor No. 2) which provides 200 ohms and section 2 (Resistor No. 1) which provides 50 ohms.

The total resistance can therefore be obtained by connecting in series, sections 2, 4, 5, 7 and 9 of 50, 200, 400, 1,600 and 6,400 ohms respectively.

The current carrying capacity of such a resistor would be limited by the current carrying capacity of the lowest current carrying capacity resistor of the series, in this case section 9 whose maximum safe current carrying capacity is 50 milliamperes.

Where very close adjustment of resistances is required, a 25-ohm rheostat can be used in series with the universal resistor and adjusted to the desired value. Where a rheostat is used, the value of resistance on the universal resistor should be the multiple of 25 of the nearest value below the required resistor, leaving the rheostat to make up the balance.

UNIVERSAL RESISTORS

RESISTOR NO. UR-10
Wound on a Type 994 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
1	50	166
2	100	166
3	200	85
4	400	85

RESISTOR NO. UR-11
Wound on a Type 994 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
1	250	85
2	500	85
3	1,000	85
4	2,000	60

RESISTOR NO. UR-12
Wound on a Type 996-4 Tube

Section No.	Resistance Ohms	Max. Current Milliamperes
1	1,000	70
2	2,000	35
3	4,000	35
4	8,000	35

In addition to this universal resistor which serves for all general purposes, other units based on the same principle have been provided which give values of resistance most commonly required in power supply circuits for voltage divider sections and grid bias resistors.

The UR-10 resistor for instance gives any value of resistance from 50 to 750 ohms, in multiples of 50 ohms such as: 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700 and 750 ohms.

The UR-11 resistor gives values of from 250 to 3,750 ohms in multiples of 250 ohms, such as 250, 500, 750, 1000, 1250, 1500, 1750, 2000, 2250, 2500, 2750, 3000, 3250, 3500 and 3750 ohms.

The UR-12 resistor gives values of from 1000 to 15000 ohms in multiples of 1000 ohms, such as: 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000, 11000, 12000, 13000, 14000 and 15000 ohms.

It is of course possible to connect two or more of these universal resistors in series to increase the range of the resistance values or to connect them in series-parallel to increase the current carrying capacity. Four resistors of any given value for instance can be connected in series-parallel arrangement to provide a resistor of twice the current carrying capacity, nine resistors of any given resistance value can be connected in series-parallel arrangement to provide a resistor of three times the current carrying capacity in a single resistor.

The number of resistors, all of a given size and current carrying capacity required to increase the current carrying capacity to any given value times that of one of them is always the square of the multiplier by which the current carrying capacity of one of them must be multiplied to obtain the required current carrying capacity.

It is possible by a proper selection of the initial value of resistance to obtain a series of resistors to fill any condition of accuracy or tolerance required in a series of resistors, to cover any desired range.

The value of the first member of the progression determines the difference in resistance between obtainable values in the series.

Continued from Page 4

The Type B-3 bypass condenser block consists of one 1-mfd. section rated at 400 volts D.C. for bypassing a 180-volt terminal; one 4mfd. section rated at 300 volts D.C. to give very good filtering action at the 90-volt terminal and one 1mfd. section rated at 300 volts D.C. for bypassing any other terminal of 135 volts or less.

It will be noted that in the B-2 and B-3 bypass blocks 300-volt condensers are used for the section which is ordinarily used to bypass the detector tap, instead of the 200-volt condensers.

This has been done so as to provide a condenser section which can be used either with the usual type of grid condenser and leak detector in which the plate voltage is usually 45 volts, or with the grid bias detector which is now so popular and with which a higher plate voltage is employed.

New Series of Filter Condenser Blocks Cover All Operating Requirements

AFTER very careful consideration of the requirements of the various types of power amplifiers and power supply units, the Aerovox line of filter condenser blocks has been enlarged to meet the demands of all popular units. In addition to the complete line of special units to be used with the Thordarson, AC-29 Magnaformer and other special power units and kits, a number of carefully selected blocks have been added which cover completely the needs of power supply units for filter and bypass condenser blocks.

To make the units as universal as possible in their application, without at the same time increasing the cost by the necessity of carrying an enormous stock of slightly different combinations of blocks, the condensers used in power supply units were divided into two distinct classes, namely filter condensers and bypass condensers.

A diagram representing the general characteristics of the average type of condenser input filter circuit is shown in Fig. 1. This shows the scheme of connections used in practically all of the half wave and full wave power supply circuits used with all types of power amplifiers and receivers.

The characteristics of condensers "C1", "C2" and "C3", as regards capacity and voltage rating, vary with different types of units. It is general practice, however, to use either a 2-2-2 or a 2-4-4 arrangement of capacities. In the 2-2-2 all three filter condensers have a capacity of two microfarads each. In the 2-4-4 filter, the first filter condenser "C1" has a capacity of two microfarads but the other two have a capacity of four microfarads each.

It is generally conceded that while slightly better filtering action and somewhat higher output voltage can be obtained by increasing the capacity of the first filter condenser "C1" to more than two microfarads, the results obtained when measured against the additional cost of higher capacity in this section, is hardly worth while, so that two microfarads has become general practice in the first filter section.

In the case of the second section "C2" and the third section "C3" higher capacities are desirable in that very good filtering action resulting in the elimination of practically all hum is obtained by increased capacities in those sections.

It has been found that when a circuit is properly designed and the values of voltages required from the power supply unit are not very critical, the use of two microfarads in each section of the filter is sufficient to give plenty of filtering action for all practical purposes. This is especially true of power supply units

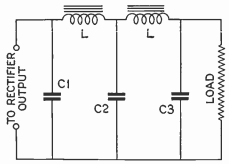

Fig. 1

in which a regulator tube is used to maintain a constant voltage at the 90-volt and lower voltage taps.

To take care of such requirements, the Aerovox line of filter condensers includes a complete series of filter blocks of the 2-2-2 type with voltage ratings to take care of all the standard power supply units for different types of receivers and amplifiers.

These units offer to experimenters and professional set builders a series of economical filter blocks which will fill all requirements for safe operation in connection with power supply units where absolutely hum-free operation is not of importance.

When very quiet operation is desired and somewhat higher cost is not of great importance, the 2-4-4 blocks should be used.

A table showing the characteristics of the standard filter blocks which fill all the requirements of the present for all types of power amplifiers and receivers is shown in Fig. 2.

The voltage ratings of the Type A-400 and B-400 are the same. A 2-2-2 filter, however, is used in the A-400 while a 2-4-4 filter is used in the B-400.

Either of these two units may be used with the average power transformer and filter circuit designed for use with a receiver and amplifier which employs CX-371A, UX-171A. CX-112A or UX-112A power tubes. The maximum output voltage requirements for such amplifiers, including the 180 volts or less required for the plate circuits and the maximum of 43 volts for the grid bias, rarely exceeds 223 volts output at a current drain of 85 milliamperes or less.

To obtain this output, with the usual full wave rectifier employing a CX-380 tube and a conventional filter choke circuit in which the chokes have a resistance of from 300 to 500 ohms each, rarely requires the use of a transformer of more than 300 to 325 A.C. each side of center-tap and a conservative voltage rating of 400 volts D.C. working voltge is sufficient for the first condenser of the filter.

When the power supply unit is operated under load, the peak voltages across the second and third filter condensers are only slightly higher than the D.C. voltages across the condensers and 300-volt D.C. working voltage condensers are sufficient at those points. These two condenser blocks, Types A-400 and B-400 take care of all the requirements of power transformer and choke circuits of the leading transformer and choke manufacturers such as Amertran, Dongan, General Radio, Jefferson, National, Thordarson, Todd, TCA, Samson and Silver-Marshall for use with single and push-pull —71A power amplifiers.

The A-600 and B-600 filter condenser blocks are designed for operation with power supply units which are to be used to operate receivers and power amplifiers employing the new CX-345 and UX-245 tubes. The rather heavy current requirements of these power tubes, makes it necessary to use the maximum A.C. voltage of 350 volts A.C. to the rectifier system so as to obtain the comparatively high output necessary to provide the 250 volts plate voltage and 51.5 grid bias voltage for these power tubes, at the high current drain requirements.

To obtain the high voltage at the output of the filter the resistance of