HAM TIPS from RCA

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PUSH-PULL RCA-806's TAKE FULL KILOWATT INPUT

WIN $5.00!

Does your transmitter use RCA tubes throughout?

If so, send us a photograph and a brief description of it. Photos of final amplifier stages are also suitable. We should like to publish one or more such photos in each issue of HAM TIPS. Those published win $5.00 cash. "Commercial type" rigs are *not* given preference—what have you?

(This offer good in Western Hemisphere, Hawaii, and the Philippine Islands.)

RCA-806 GIVES 450 WATTS OUTPUT ON CW—400 ON 'PHONE

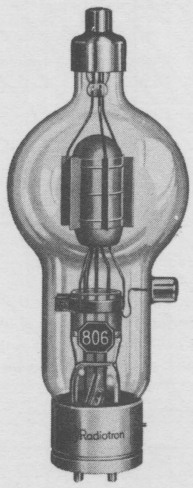
Has Real "Oomph" on 10- and 20-meter Bands

For amateurs who wish to use a final-amplifier power input of 500 to 600 watts, a single RCA-806 is well suited—especially where operation in the 20- and 10-meter bands is desired. In cw service, a maximum power input of 600 watts can be used with a power output of about 450 watts. In plate-modulated telephony service, a maximum power input of 500 watts can be employed with a useful power output of about 390 watts.

A typical, single-ended r-f amplifier stage using one 806 is shown in circuit UC-21. For the driver stage, a single 809 operated at maximum rated input (75 watts) is recommended. The peak r-f grid voltage required by the 806 in circuit UC-21 is 870 volts. Obviously, an r-f plate-voltage swing of this amplitude cannot be obtained from an 809 operating at a d-c plate voltage of only 750 volts. However, the required 870-volt swing can be obtained from the 809 by tapping the 809 plate lead a short distance down from the plate end of the driver-stage tank coil. The grid condenser (C_1) of the 806 is, of course, tied to the extreme top of the 809 plate tank. With this "auto-transformer" arrangement, the r-f driving

(Continued on page 3, column 1)

OOMPH!



For pushing an R-9 plus signal into remote spots, the RCA-806 "has what it takes." This fine tube has a totally enclosed anode for longer life and greater efficiency—an RCA First. The attractive net price is only $22.00.

BIG TANTALUM PLATE TRIODE FB FOR HIGH POWER HAM RIGS

Can Be Used at Maximum Input up to 30 Mc. and 50% of Full Input at 100 Mc.

"Breathes there a ham with a soul so dead—" that he has not, at one time or another, fervently wished for that last word in a ham rig—a one-kilowatt job? The RCA-806 is a logical choice for high-frequency transmitters in this power class; two 806's in push-pull will take a full kilowatt input in plate-modulated telephony service, and 1200 watts in cw service.

The husky, 50-watt thoriated-tungsten filament and tantalum-plate construction of the 806 insures ample electron-emitting capability, long gas-free operation, and outstanding ability to take severe punishment. The special, enclosed-anode design prevents stray electrons from bombarding the clear glass bulb and provides a considerable increase in efficiency and power output at the higher amateur frequencies. Grid and plate connections, brought out to side and top caps with short, heavy leads, provide low tube capacitances and simplify grid- and plate-circuit wiring. The 806 is especially well suited for high-frequency operation. It can be used with maximum rated input at frequencies up to 30 Mc., and at 75% of full input up to 50 Mc.

Plate-Modulated Push-pull Amplifier

Circuit UC-20 shows a typical push-pull 806 r-f amplifier designed for plate-modulated telephony service with a full kilowatt input. Under the operating conditions shown, the driving power dissipated by the 806's is 32 watts per tube (see 806 technical bulletin or TT-3 Manual), or 64 watts for two tubes. The actual power output of the driver stage must, of course, be considerably more than 64 watts in order to provide adequate regulation of the r-f grid voltage and to compensate for circuit losses. Experience indicates that by multiplying the driving power shown for a tube by a factor of 2, or slightly

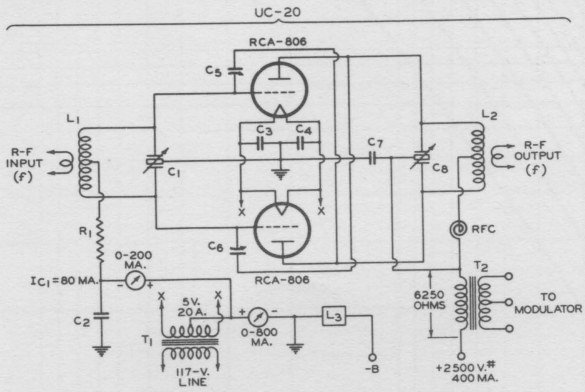
(Continued on page 3, column 3)

"HAM TIPS" SEEKS AMATEUR'S HELP

Tube Prizes Awarded for Good "Tips"

Yessir! The editors of HAM TIPS want your co-operation in improving this amateur publication. The circuits and other tube information which have been published in past issues of HAM TIPS are intended to be of interest and of practical use to you. However, there are unquestionably other subjects which you would like to see covered. If so, or if you have any other suggestions as to how this publication can be made more

(Continued on page 4, column 1)

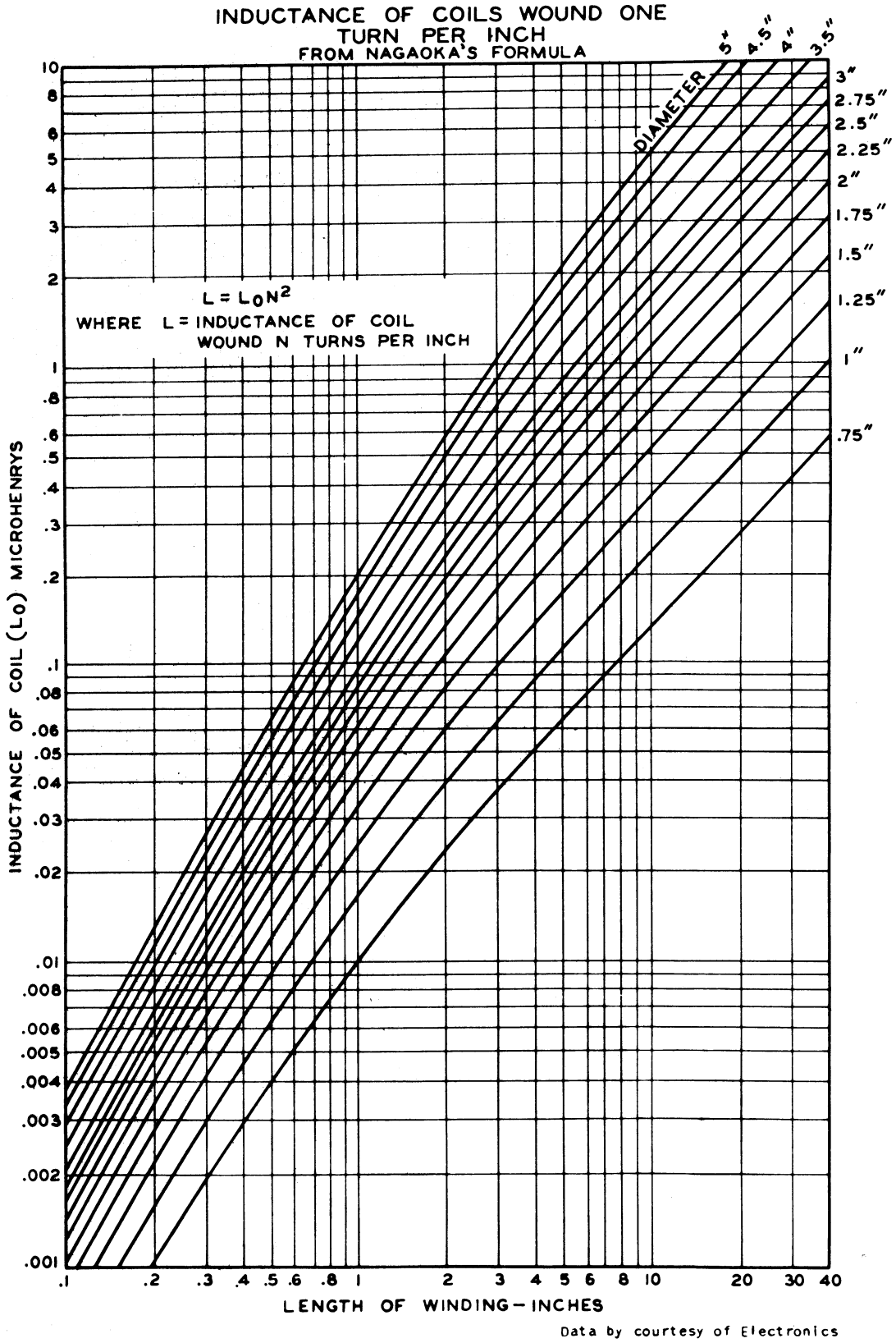


"ONE-KILOWATT" PLATE-MODULATED R-F AMPLIFIER

(Power Output 780 Watts*)

C_1 = 0.7 μμf/meter/section.*
C_2, C_3, C_4 = 0.005 μf mica.
C_5, C_8 = 3.4 μμf*, high-voltage.
C_7 = 0.002 μf mica, 7500 volts.
C_8 = 1 μμf/meter/section*†.
R_1 = 7500 ohms, 80 watts.
RFC = R-f choke, 500 ma.
T_1 = Filament transformer.
T_2 = Modulation transformer, 500 watts.
L_1, L_2 = Tune to frequency "f".
L_3 = D-c overload relay, 600 ma.**

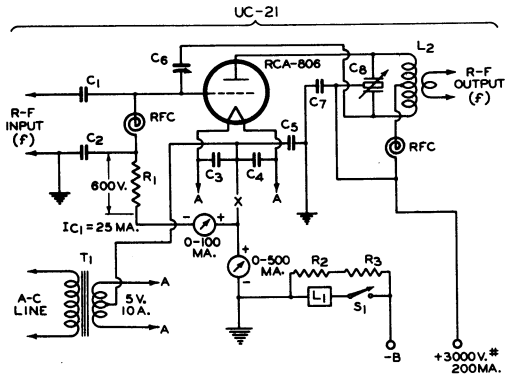
f = Operating frequency.
* Approximate.
† Capacitance in actual use.
# Maximum value for plate-modulated telephony.
** Contacts of L_3 should break the primary circuit of the high-voltage supply.
NOTE: Rotor shaft of C_8 is at the d-c plate potential. An insulated coupling shaft must be inserted between the rotor shaft of C_8 and its control dial.



Data by courtesy of Electronics

REPRINTED FROM RCA TT-3 TRANSMITTING TUBE MANUAL

(See page 4 for use of chart)



R-F POWER AMPLIFIER

(Class C Telegraph Power Output 450 Watts*)

C_1 = 0.0005 μf mica, 2000 V.
C_2 = 0.002 μf mica, 1000 V.
C_3, C_4 = 0.005 μf mica.
C_5, C_7 = 0.002 μf mica, 5000 V.
C_6 = 3.4 μμf* high-voltage.††
C_8 = 0.5 μμf/meter/section.†**
R_1 = 24,000 ohms, 25 watts.##
R_2, R_3 = 5000 ohms, 100 watts.
L_1 = D-c overload relay, 300 ma.
L_2 = Tune to frequency "f".
S_1 = S.P.S.T high-voltage switch.
RFC = R-f choke.
f = Operating frequency.
T_1 = Filament transformer, 5000-volt insulation.
X = Insert keying relay here.
* Approximate.
† Capacitance in actual use.
†† Minimum air-gap should be 0.25 inch.
** Minimum air-gap should be 0.1 inch.
# Reduce to 2500 volts for plate-modulated telephony.
Reduce to 15,000 ohms for plate-modulated telephony.

NOTE: Rotor shaft of C_8 is at the d-c plate potential. An insulated coupling shaft must be inserted between the rotor shaft of C_8 and its control dial.

RCA-806 Gives 450 Watts Output On CW—400 On 'Phone

(*Continued from page 1, column 1*)

voltage can be suitably stepped up for the 806 grid. Phrased differently, the low-impedance plate circuit of the 809 is matched to the high-impedance grid circuit of the 806 by using the 809 plate tank as an impedance-matching network.

RCA-808 is suitable

A 1250-volt tube such as the 808 could be used for the driver in a conventional circuit, but it would have much more than the necessary driving power. If a tuned grid circuit were used in the 806 stage, the r-f voltage across the grid coil could also be stepped up by a suitable choice of LC constants (high L and low C).

The method of metering the grid and plate d-c currents in circuit UC-21 is worthy of mention. Connected as shown, the 100-ma. meter will measure d-c grid current only, and the 500-ma. meter will measure the d-c plate current only. If the grid meter were returned *directly to ground*, the plate meter would measure the *sum* of the d-c grid current and the d-c plate current—an arrangement not especially desirable. The advantage of the connections shown is that both meters are essentially at ground potential; thus, the hazard of having a "hot" plate meter in the +B lead is eliminated.

Particular attention should be given to the manner in which the keying relay and the filament by-pass condensers are connected. When the key is open, the filament, the filament-transformer winding, and the filament by-pass condensers (C_3 and C_4) assume the full d-c plate potential with respect to ground. If, as shown in many circuits, the key is inserted next to the center tap of T_1, and the mid-point of C_3 and C_4 is permanently grounded, the full plate voltage appears across C_3 and C_4 when the key is open. Thus, both C_3 and C_4 would have to be high-voltage condensers. The connections shown are preferable, because only one high-voltage filament by-pass condenser (C_5) is required.

Overload Relay Recommended

The use of a d-c overload relay (L_1) is recommended to protect the 806 and its auxiliary apparatus in case the r-f grid excitation should fail, or the plate-tank circuit should accidentally be detuned from resonance. In either case, the d-c plate current will "soar" to an excessive value which may cause serious damage to the equipment. The protective

(*Continued on page 4, column 4*)

Big Tantalum Plate Triode FB For High Power Ham Rigs

(*Continued from page 1, column 4*)

more, we obtain a value which closely approximates the required power output of the driver stage. In this case, therefore, a driver-stage power output of 2 x 64, or 128 watts, is indicated.

A single RCA-810 is an excellent choice for the driver stage. Its amateur net price is only $13.50 and it has a large surplus of power for this particular application. An 810 operating at only 1250 volts and 200 ma. (250 watts) should provide more than enough excitation for push-pull 806's, even at 10 meters. A surplus of driving power is nearly always desirable.

RCA-814 may be used for driver

The RCA-814 beam power tube is another possibility for the driver stage. It has the worthwhile advantages of not requiring neutralization and of being extremely easy to excite. However, because its nominal power output of 130 watts is just on the border line of the actual amount required, the 814 may not fully drive the 806's at 30 megacycles, where circuit and tube losses are considerably higher than at the lower amateur frequencies.

Incidentally, those amateurs who happen to have already available an RCA-860 will find that this screen-grid tube makes a fine driver for a 1-kw final amplifier. The 860 has ample power output and has the advantage of not requiring neutralization. In addition, it can be operated at 2500 or 3000 volts from the *same power supply* that furnishes the push-pull 806's. A single 500-ma., 2500-volt supply will operate both the 860 driver stage and the 1-kw final amplifier. This tube combination is used by many high-power stations for this very reason.

In circuit UC-20 it should be noted that the direct wire connection between the +B lead and the rotor of plate-tank condenser C_8 places the rotor frame and rotor shaft at the full d-c and a-f plate potential. This arrangement, as has been explained in QST (Dec. 1938), enormously reduces the flash-over potential applied between adjacent condenser plates on modulation peaks, inasmuch as it removes the 2500-volt d-c and 2500-volt a-f voltage components (5000-volts total) from across the condenser. Without this connection, a peak potential of 7000 to 10,000 volts is applied between the condenser plates. With the arrangement shown, only the peak r-f voltage of 3000 to 4000 volts remains. The air-gap of the plates in condenser C_8 should be at least 0.294 inch if the rotor connection to +B is omitted, but can be reduced to about half this value if the circuit is used as shown. The saving thus made in both the size and cost of the plate-tank condenser is no minor item.

A spacing of 0.06 or 0.07 inch is adequate for the grid-tank condenser, C_1. The neutralizing condensers, C_5 and C_6, should have an air-gap of at least 0.5 inch at the required capacitance setting of approximately 3.4 μμf.

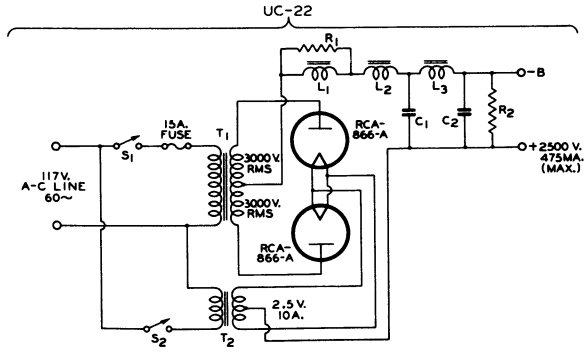
Meter near ground potential

The plate-current meter of circuit UC-20 is operated near ground potential, instead of being placed in the hot +B lead. Connected as shown, the plate meter will read plate current only, and not the sum of plate current and grid current, as it would if the grid meter were returned directly to ground.

To modulate this r-f amplifier 100%, an audio power of 500 watts is required. This power can conveniently and economically be obtained from two RCA-810's in class B. A suitable circuit for the modulator is shown in circuit UC-12 in the November, 1938 issue of "Ham Tips." To drive class B 810's properly, four 2A3's in push-pull-parallel are recommended. The 2A3's should be operated at a plate voltage of 300 volts and at a fixed bias of −62 volts.

In order to protect the 806's, the plate meter, and the rectifier equipment against accidental overloads, a d-c overload relay (L_3) should be included in the circuit. L_3 can be placed in the −B lead, as shown, provided the final amplifier is the only stage operated from the 2500-volt supply. If the r-f driver stage or any other stage is operated from the same supply, L_3 should be placed between the plate meter and ground. In the latter case, the holding coil of L_3 should be suitably shunted by a large electrolytic condenser to by-pass the a-f components of the plate current.

A 1-kw power amplifier of the type described is capable of giving outstanding results. If it is coupled to a 2- or 3-element rotary beam, the fortunate ham at the mike can say with justifiable pride—"Look out, fellows, here I come." Under favorable conditions, R/9+ voice signals in remote European countries is a reasonable expectancy on the 10- and 20-meter amateur bands.



HIGH-VOLTAGE POWER SUPPLY FOR PUSH-PULL 806's

(D-C Power Output 1200 Watts*)

C_1 = 1 μf, 4000 V.
C_2 = 4 μf, 4000 V.
L_1 = Antenna change-over relay coil (optional).†
L_2 = 8-17 henry, 500-ma. filter choke, 70 ohms (swinging type).
L_3 = 12 henry, 500-ma. filter choke, 75 ohms.
R_1 = Optional (see footnote).†
R_2 = 100,000 ohms, 100 wats.
T_1 = Power transformer, 500 ma.
T_2 = Filament transformer, 5000-volt insulation.
S_1, S_2 = S.P.S.T. line switch.
* Approximate.
† Adjust value of R_1 so that L_1 receives rated d-c current. L_1 is useful where the transmitting antenna is also to be used for the receiver.

INDUCTANCE CHART HAS MANY USES FOR EXPERIMENTERS

Other Useful Information Available in TT-3 Manual

The inductance chart shown on page 2 is but one of the many useful items in the RCA TT-3 Manual. This chart is easily read and supplies information that all experimenters need in the performance of their work.

In order to determine the approximate design of a single-layer coil to give a desired inductance, the chart shown can be employed as indicated in the following example.

Assume that the desired coil is to be wound with 3/16-inch copper tubing spaced 3 turns to the inch and is to have an inductance of 4.5 microhenrys (μh). Then, from the equation

$L = L_0N^2$, or $L_0 = L/N^2$

it is found that $L_0 = 4.5/(3)^2 = 0.5$ μh. Applying this value of L_0 to the chart, we find that a coil 2½ inches in diameter should be about 4.2 inches long to give the proper inductance. The total number of turns necessary is 4.2 N, or (4.2) (3) = 12.6 turns. The length of the coil for other diameters can readily be found from the chart, and the total number of turns determined by multiplying the length by N, *the number of turns per inch.*

The chart can be used equally well to find the inductance of a coil of known specifications. For example, it is desired to determine the inductance of a coil 2½ inches in diameter wound with 90 turns of No. 24 D.C.C. wire. The wire tables show that this size of wire has a winding factor of 33.6 turns per inch, from which the length of the coil is found to be 90/33.6 = 2.68 inches. From the chart, L_0 is found to be about 0.29 μh for a 2½-inch coil 2.68 inches long. Because $L = L_0N^2$, the inductance of the coil is (0.29) $(33.6)^2$, or 327 μh (approximately).

"Ham Tips" Seeks Amateur's Help

(*Continued from page 1, column 3*)

interesting and useful, we shall appreciate your comments. A QSL card may suffice to get your ideas across.

Many amateurs will remember our earlier ham publication, "Dots and Dashes," which was published in 1935 and 1936. Most of the material for "Dots and Dashes" was contributed by hams themselves, in the form of useful hints, kinks, techniques, circuits, methods, etc. Acceptable suggestions were published along with the call letters of the author, and a transmitting tube was given in return. HAM TIPS now makes the same offer. **For each "tip" accepted for publication, HAM TIPS will give one RCA tube of the following types (you choose the type desired): 801, 802, 807, 809, 954, 955, 956, 866, or 866-A.**

(This offer good in Western Hemisphere, Hawaii and the Philippine Islands.)

HOLD EVERYTHING!

• The October issue of HAM TIPS and the November issues of QST and RADIO will contain announcements of far-reaching importance to every radio amateur.

HAM TIPS HAS FIRST BIRTHDAY

Copies of All Back Issues Available

With the September, 1939 issue, HAM TIPS celebrates its first birthday!

Judging by the large number of inquiries received by both RCA Power Tube Distributors and the headquarters staff at the Camden and Harrison offices, the first year of HAM TIPS has been a very successful one. Not to be outdone, the editors promise an even more interesting group of issues for the second year. Complete information on new tube types as they are introduced as well as more detailed application information on older types is the goal of your editor.

For those amateurs and experimenters who have not kept a complete file of HAM TIPS, there is still time to round out your file of copies. You may request back issues either from any RCA Parts Distributor, or if they do not have them, then an inquiry to the Commercial Engineering Section, RCA Mfg. Co., Harrison, New Jersey, will bring you the back copies you need to bring your file up to date.

During 1938 and 1939 the various issues of HAM TIPS covered a wide variety of subjects. These were:

Vol. 1 No. 1—September, 1938—Circuit Information on RCA 809.

Vol. 1 No. 2—October, 1938—Circuit Information on RCA 814.

Vol. 1 No. 3—November, 1938—Circuit Information on RCA 810.

Vol. 1 No. 4—December, 1938—High-Power Crystal Rig Using RCA 813.

Vol. 2 No. 1—January-February, 1939—Additional Information on RCA 813, RCA 802 and RCA 921.

Vol. 2 No. 2—March-April, 1939—Circuit Information on RCA 807 with Special Tube and Impedance Charts.

Vol. 2 No. 3—May-June, 1939—Circuit Information on RCA 808.

The information given in the foregoing issues is of a very practical character. The actual operating information for the circuits shown is given—values and wattage of resistors, details of capacitors, etc.

NEW RCA 2051 GAS TRIODE IS EXCELLENT FOR RELAY CIRCUIT

Operates Relay Direct From Phototube

A new hot-cathode gas tetrode known as the RCA 2051 has just been announced to amateurs and experimenters. It is particularly adapted for use in control devices actuated either by phototubes or radio signals.

Grid current is extremely low, permitting high grid resistance to be used in the grid circuit. The resulting

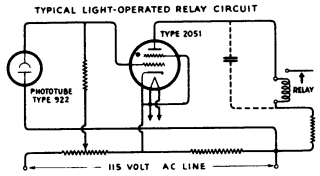


FIGURE 1

high sensitivity permits the tube to be operated directly by a vacuum-type phototube, as shown in Figure 1, thus eliminating one or more tubes previously required in conventional circuits (Figure 2).

The control characteristic is very steep, having a control ratio of approximately 325. Only low values of grid-bias voltage are required. A very small grid-anode capacitance makes the tubes insensitive to line

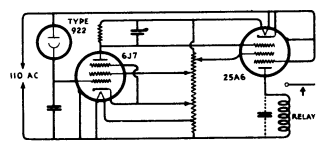


FIGURE 2

voltage surges and minimizes the undesirable effect of capacitance current flowing through the grid resistance.

CHARACTERISTICS

Heater Voltage . . . . 6.3 Volts
Heater Current . . . 0.6 Amperes
Peak Anode Voltage (Max.) 350 Volts
Peak Anode Current (Max.), 375 Ma.
Average Anode Current (Max.) . . . . . 75 Ma.
Grid Resistor (Max.) . 10 Megohms

This tube may be obtained through any RCA Power Tube Distributor. Further engineering information may be obtained from RCA Commercial Engineering Section, Harrison, New Jersey.

RCA-806 Gives 450 Watts Output On CW—400 On 'Phone

(*Continued from page 3, column 2*)

resistors, R_2 and R_3, can be switched into the –B circuit whenever the amplifier is being adjusted or tuned. In this way, the plate power input can be limited to a reasonably safe value if the circuit adjustments are incorrect. Overload relay L_1 should be set to open at 300 ma. (maximum), this value being 50% in excess of the d-c plate current rating of the 806.

Although circuit UC-21 shows the popular "center-tap" method of keying the final amplifier, this method does not lend itself to "break-in" operation. Many amateurs prefer to use break-in, by keying the crystal or e-c oscillator directly and by operating all stages following the oscillator at or near cut-off bias. In order to change circuit UC-21 for this type of operation, the grid bias should be obtained partially from a fixed source, such as a battery or bias rectifier of good regulation, and partially from a grid leak. About –250 volts of fixed bias is required in conjunction with a grid leak (R_1) of 14,000 ohms (25-watt size) in order to maintain the amplifier plate current near cut-off when the key in the oscillator stage is up.

TT-3 MANUAL

Of all the information on transmitting tubes in the amateur's library, perhaps none is more valuable than that contained in the TT-3 Tube Manual. This interesting book may be obtained from all RCA Power Tube Distributors or direct from the RCA Commercial Engineering Section at Harrison, New Jersey, by enclosing a remittance of 25c.

Supplementing the complete information on all RCA air-cooled transmitting types are chapters on the construction of tubes, the various advantages of different metals used in tubes, together with information on properly installing them. Also, a section on transmitting tube application explains the operation of the various circuits.

Many diagrams with complete details of the components are included with practically every type of circuit. This book has 192 pages and is an unusually handy reference book.

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