RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

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APPLICATION NOTE ON THE APPLICATION OF THE TYPE 79 TUBE

With the introduction of the type 79 tube, a new stimulus has been given to the use of Class "B" output amplifiers in automobile receivers. The 79 is a Class "B" Twin Amplifier, combining two high-mu triodes in one bulb.

The construction of the 79 offers special advantages in automobile receiver design where space requirements are at a premium. The 79 thus replaces with one tube the two formerly required for a Class "B" output stage. A more compact design for the receiver is, therefore, possible.

The 79 offers further advantages of sufficient importance to be considered in the selection of an output system. The use of the 79 requires only one socket for the Class "B" stage, so that the circuit wiring is reduced. Furthermore, the 79 requires only 0.6 ampere heater current, thus giving low "A" battery drain for a Class "B" output stage.

The 79, combining two tubes in one, has not required any sacrifice in power output. This is important because it has become increasingly desirable that the automobile radio set be capable of delivering adequate power output. The trend toward higher driving speeds has raised the noise level within the automobile. Tires, engine, and windage contribute to a high noise level. In addition, the absorption of sound waves by the occupants of the car, the upholstery, and the lining are factors which must be considered in the design of an automobile-radio receiver. It is obvious that, with speakers of moderate efficiency, high power output with good quality is essential for a satisfactory receiver.

The power output from the 79 will depend principally upon the plate-supply voltage available and the type of the tube used in the driver stage. Various types of tubes which are feasible as drivers include the 37, 41, 85, and 89. Because of the special requirements of Class "B" operation, it is important that the voltage regulation of the power supply be fairly good.

Table 1 gives a number of possible combinations of driver stage and a 79 in a Class "B" output stage. The combinations, as given, call for the same plate-supply voltage for both the driver and the output stage. Variations in sensitivity, in total harmonic distortion, in maximum power output available, and in plate current requirements due the different combinations are clearly illustrated in Table 1. The current per plate of the 79 varies greatly with the signal impressed on the grid. Table 1 shows the value of current per plate of the 79 with no signal on the grid, and also with a signal of sufficient amplitude to give full output from the 79. The values of current per plate with signal correspond to the maximum power output values which are normally of short duration. The filter condenser in the d-c plate voltage supply system assists in supplying the momentary peaks of plate current. The average audio output required for usual broadcast reception is considerably less than that required for maximum volume. It follows that the d-c current requirements, per plate, on the average, are also lower than the values shown in Table 1 under average milliamperes, with signal.

Arrangement 1, with 180 volts on the plates of the 79, gives good power output and a relatively low amount of distortion, but requires a large input signal to the 89. The plate current for the 89 under these conditions is high, being approximately 17 ma. (The plate current for the driver tube is shown in Table 2).

Arrangement 2, with 180 volts on the plates of the 79 and an 85 as driver, gives a low power output and low distortion, but requires only a small input signal to the driver. The plate current requirements of both the driver and the output stage are very moderate.

Arrangement 3, similar to arrangement 2 except for higher plate voltages on the driver and the 79, gives high power output; but the distortion and required signal voltage are large. The plate current requirements are moderate.

TABLE 1 - CLASS B COMBINATIONS

Driver Stage						Transformer		Output Stage, 1-79, Grid Volts=0					
Arrangement	Tube Type	Used As	Plate Volts *	Grid Volts *	Input Signal Volts RMS	Voltage Ratio Pri./ 1/2 Sec.	Peak Power % Eff.	Plate Volts	Plate to Plate Load Ohms	Av. Ma. per plate** No Sig.	Sig.	Output Watts	Total Distortion %
1	89	triode	160.0	-20.0	14.2	2.14	75	180	10000	3.5	20.5	5.11	7.8
2	85	triode	167.5	-12.5	8.8	2.66	70	180	14000	3.5	15.0	3.72	8.0
3	85	triode	204.0	-16.0	11.3	2.66	70	220	14000	4.5	20.0	6.20	10.8
4	37	triode	185.5	-14.5	10.3	2.66	70	200	14000	4.0	17.0	4.76	10.6
5	41	pentode	167.5	-12.5	8.75	4.28	#	180	7000	3.5	25.0	5.24	11.0
6	41	pentode	167.5	-12.5	8.75	3.30	#	180	8000	3.5	27.3	6.96	16.0

\# Primary of transformer (approx. 70% eff.) shunted by a resistor of 15000 ohms.
* Sum of voltages for plate and grid is the same as the plate voltage for the 79.
** The value of d-c plate current with full output.

TABLE 2 - CLASS B COMBINATIONS WITH SPECIFIED TRANSFORMERS

Driver Stage								Transformer	Output Stage, 1-79, Grid Volts=0		
Arrangement	Tube Type	Used As	Plate Volts	Grid Volts	Screen Volts	Screen Ma.	Plate Ma.	Identification	Plate Volts	Plate-to-Plate Load - Ohms	Av. Ma. per Plate No Sig.
1	89	triode	160.0	-20.0	-	-	17.0	S-45-A	180	10000	3.5
2	89	pentode	163.0	-17.0	163.0	2.5	17.0	S-74°	180	7000	3.5
3	85	triode	185.5	-14.5	-	-	6.0	S-75	200	12000	4.0
4	37	triode	185.5	-14.5	-	-	4.0	S-75	200	12000	4.5
5	41	pentode	167.5	-12.5	167.5	3.0	17.0	S-74°	180	8800	3.5

° Primary of S-74 input transformer shunted by a resistor of 15000-20000 ohms.

Arrangement 4, with the 37 as a driver, gives a relatively low power output and requires a relatively large input signal. However, the plate current requirements of this combination are the lowest of any shown.

Arrangement 5, with the 41 as a driver, gives a fairly high power output with moderate signal voltage input, but requires high plate current.

Arrangement 6, similar to Arrangement 5 with the exception of the plate load resistor for the 79, gives very high power output with moderate signal input. However, the distortion is very high; the plate current drain for this combination is also the highest for any combination considered.

A study of these combinations will reveal certain advantages for each. Where low plate current drain is the prime consideration, arrangements 1 and 4 will give perhaps the best results. Where power output is the governing factor, arrangements 3 and 5 are of interest. Where maximum sensitivity is required, arrangements 2, 5 and 6 merit attention. In making a selection of any combination of driver and output stage, the engineer must be careful to give full consideration to all the requirements of the application. From the arrangements shown, a judicious choice will yield a combination best suited to any particular requirement.

INTERSTAGE-TRANSFORMER DESIGNS

The combinations of Table 1 were obtained from laboratory interstage-transformers adjusted to the general requirements for service in an automobile receiver. Since these data were obtained, transformers specially adapted to the needs of this class of service have been designed, constructed, and tested. The design constants of three different transformers, identified by our numbers, S-45-A ,S-74, and S-75, are included in this note. The power output and distortion obtained with these transformers will approximate the values shown in Table 1.

Table 2 shows the operating conditions for several combinations of driver stage and one 79 in a Class "B" output stage with transformers S-45-A, S-74, and S-75.

Arrangement 1 of Table 2 is similar to Arrangement 1 of Table 1.

Arrangement 2 employs an 89 operated as a pentode in the driver stage. An output of 7.0 watts, with 16.5 percent total harmonic distortion, is obtained with this arrangement.

Arrangement 3, with a plate-voltage supply of 200 volts, uses an 85 as a driver. The power output obtainable with this arrangement is approximately 4.6 watts.

Arrangement 4 is similar to Arrangement 4 of Table 1 with the exception that the load resistance in this case is 12,000 ohms. It was found that this value of load resistance gives better results with the transformer S-75 than does the 14,000 ohm plate-to-plate load shown in Table 1.

Arrangement 5 employs a type 41 pentode as the driver. The optimum load resistance is found to be 8,800 ohms when transformer S-74 is used. A power output of approximately 6.0 watts with 15.0 per cent total harmonic distortion is obtained with this combination.

OPERATION CHARACTERISTICS

On attached sheets are shown curves of power output, plate current requirements, and total harmonic distortion for the 79 versus the input-signal voltage to the driver. The conditions for each set of curves are noted at the top of the curves.

Also shown are curves of power output, plate current, and distortion versus plate supply volts for a typical combination using the 85 as a driver. The effect of increasing the plate voltage for the driver tube and the 79 are clearly indicated by these curves. Since the power output obtainable with a type 85 driver approximates that obtainable with a 37 driver, these curves may be used to estimate the performance of an arrangement employing the 37 as a driver. (This particular curve shows power outputs for the 79 as high as 8.0 watts. It should be remembered that these are peak values. The 79 is not recommended for continuous operation at such high values of power output.)

TRANSFORMER S-45a*

Core: Material-Grade Audio B Gauge #26, Allegheny Steel Company or equivalent

Punching	EI-625
Window	15/16" x 5/16"
Tongue	5/8"
Stack	3/4"
Joint	Butt
Net Section	2.72 sq. cm.
Mean length mag. circuit	11.1 cm.
Weight	0.41 lb.

Winding: Traverse and Margin 1/16" + 25/32" + 1/16"
Form (inside dimensions) 21/32" x 25/32" x length 29/32"

Primary:

Turns	2500 #39 enameled
Location	over insulated secondary
Turns per layer	180
Layers	14
Insulation between layers	0.001" paper
Insulation over winding	0.012" "
Mean length of turn	4.37"
Resistance at 25°C.	824 ohms

Secondary:

Turns	2340 #37 enameled, tap at 1170 turns
Location	next to core
Turns per layer	140
Layers	17
Insulation between layers	0.001" paper
Insulation under winding	0.045" "
Insulation over winding	0.015" "
Mean length of turn	3.60"
Resistance at 25°C.	392 ohms

Inductance of primary at 10 volts 60 cycles and 17 ma.d.c. is 11 henries.

* Our design identification number.

TRANSFORMER S-74*

Core: Material-Grade Audio B Gauge #26, Allegheny Steel Company or equivalent

Punching	EI - 625
Window	15/16" x 5/16"
Tongue	5/8"
Stack	3/4"
Joint	0.002" paper per leg
Net Section	2.72 sq. cm.
Mean length mag. circuit	11.1 cm.
Weight	0.41 lb.

Winding: Traverse and Margin 1/16" + 25/32" + 1/16"
Form (inside dimensions) 21/32" x 25/32" x length 29/32"

Primary:

Turns	4500 #40 enameled
Location	over insulated secondary
Turns per layer	200
Layers	23
Insulation between layers	0.001" paper
Insulation over winding	0.012" "
Mean length of turn	4.37"
Resistance at 25°C.	1850 ohms

Secondary:

Turns	2650 #39 enameled, tap at 1325 turns
Location	next to core
Turns per layer	180
Layers	15
Insulation between layers	0.001" paper
Insulation under winding	0.045" "
Insulation over winding	0.015" "
Mean length of turn	3.6"
Resistance at 25°C.	695 ohms total

Inductance of primary at 10 volts 60 cycles and 17 ma.d.c. is 30 henries.

* Our design identification number

TRANSFORMER S-75*

Core:	Material - Grade Audio B Gauge #26, Allegheny Steel Company or equivalent	
	Punching	EI-625
	Window	15/16" x 5/16"
	Tongue	5/8"
	Stack	3/4"
	Joint	Butt
	Net Section	2.72 sq. cm.
	Mean length mag. circuit	11.1 cm.
	Weight	0.41 lbs.
Winding:	Traverse and margin	1/16" + 25/32" + 1/16"
	Form (inside dimensions)	21/32" x 25/32" x length 29/32"
Primary:	Turns	3600 #39 enameled
	Location	over insulated secondary
	Turns per layer	180
	Layers	20
	Insulation between layers	0.001" paper
	" over winding	0.012" "
	Mean length of turn	4.37"
	Resistance at 25°C.	1142 ohms
Secondary:	Turns	2820 #38 enameled, tap at 1410 turns
	Location	next to core
	Turns per layer	157
	Layers	18
	Insulation between layers	0.001" paper
	" under winding	0.045" "
	" over winding	0.015" "
	Mean length of turn	3.6"
	Resistance at 25°C	570 ohms total

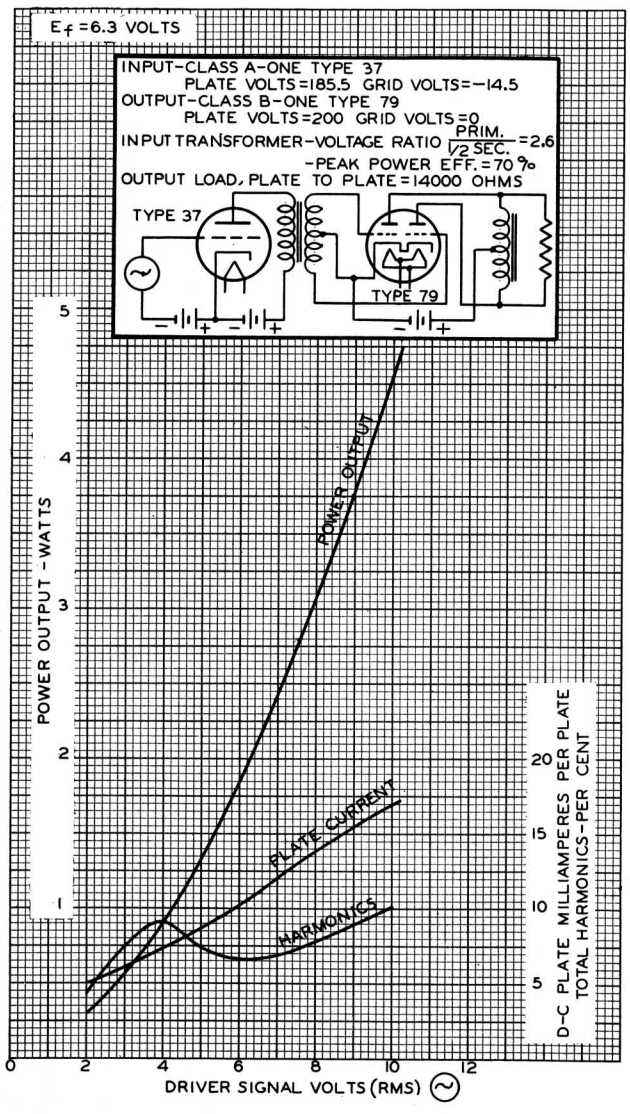
Inductance of the primary at 10 volts 60 cycles and 5 ma.d.c. is 26 henries.

* Our design identification number.

RCA Cunningham Radiotron RADIO TUBES

RCA-79

OPERATION CHARACTERISTICS

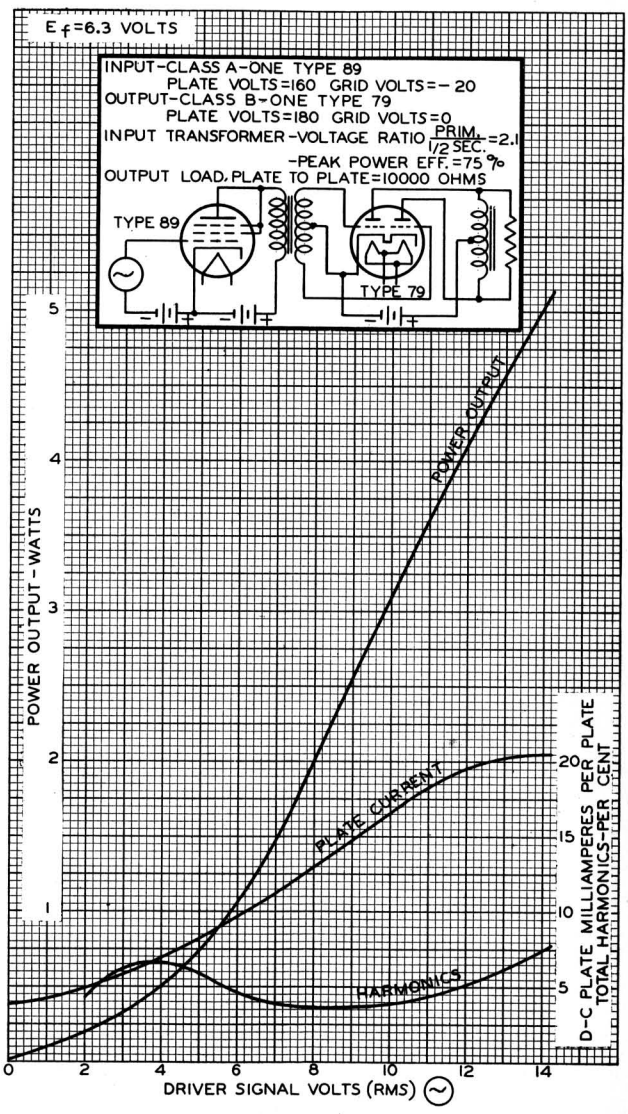


FEB. 15, 1933 RCA RADIOTRON DIVISION RCA MANUFACTURING COMPANY, INC. 92S-5262

RCA Cunningham Radiotron RADIO TUBES

RCA-79

OPERATION CHARACTERISTICS

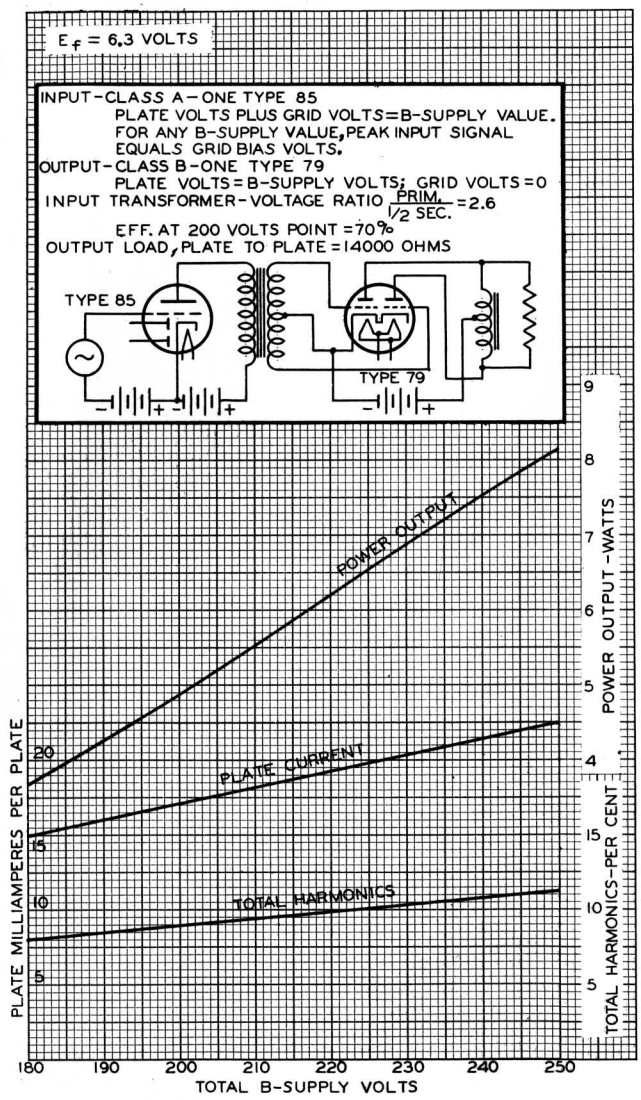


FEB. 15, 1933 RCA RADIOTRON DIVISION RCA MANUFACTURING COMPANY, INC. 92S-5263

RCA Cunningham Radiotron RADIO TUBES

RCA-79

OPERATION CHARACTERISTICS

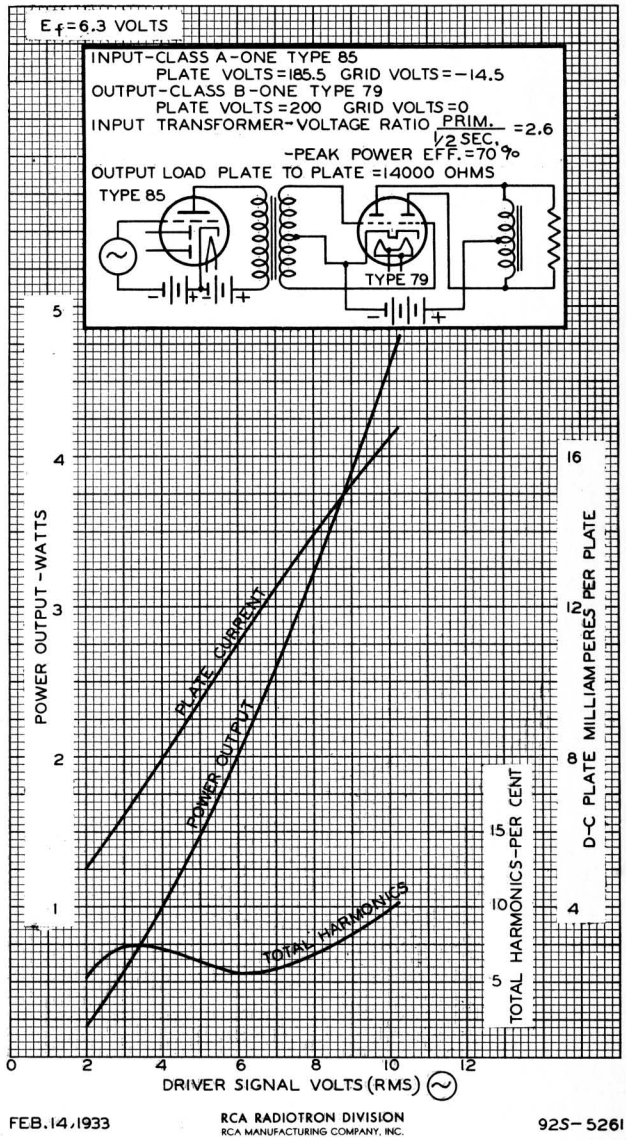


JUNE 19, 1933 RCA RADIOTRON DIVISION RCA MANUFACTURING COMPANY, INC. 92S-5260R1

RCA Cunningham Radiotron RADIO TUBES

RCA-79

OPERATION CHARACTERISTICS



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