VACUUM TUBE VALLEY™

Issue 9
Spring 1998

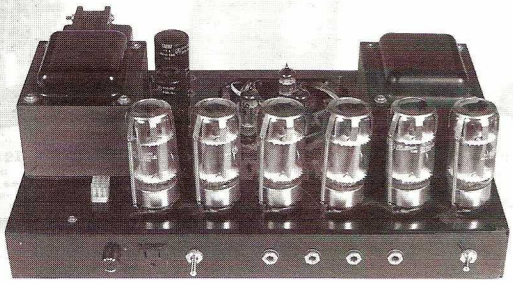
The Classic Electronics Reference Journal

Published Quarterly
Price $9.00

Big Triodes... Big Sound!

The Ampeg SVT

300 Watts of Badass Bass

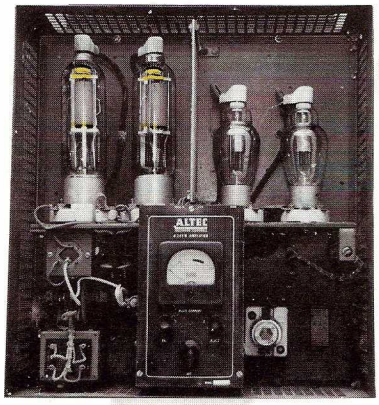


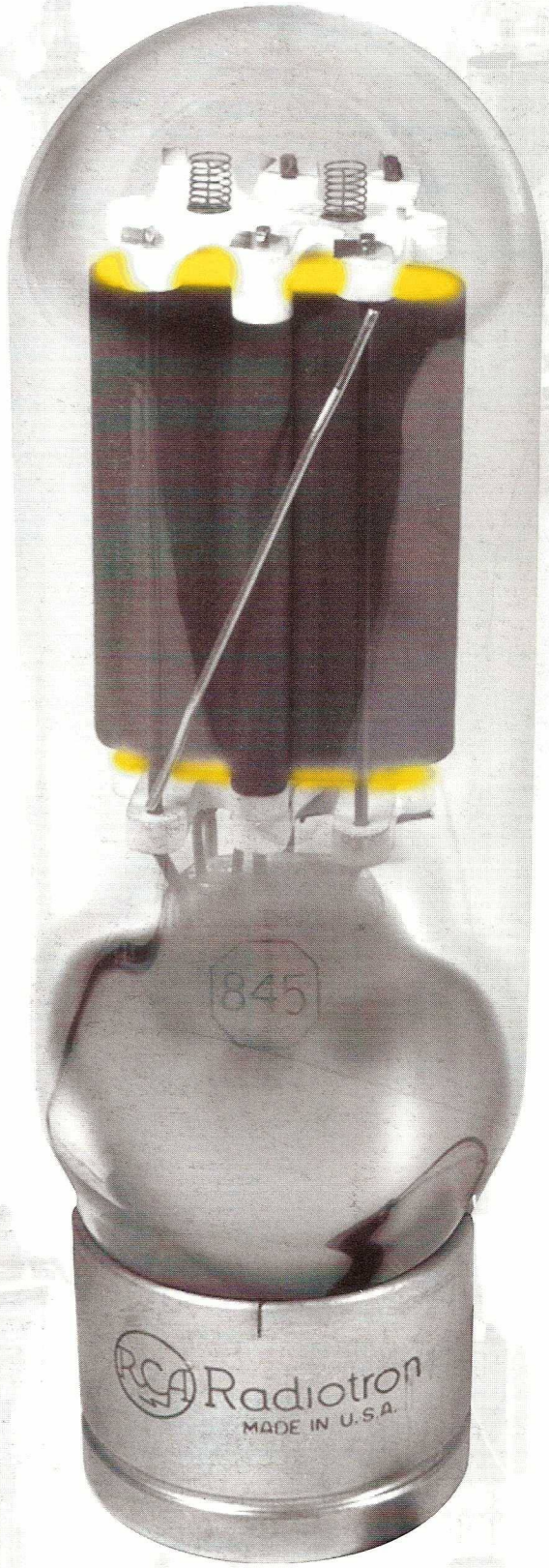
Bargain Vintage Hi-Fi

Great Tube Sound on a Budget

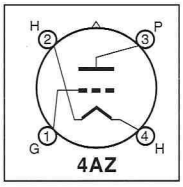
Waking the Gentle Giant

Restoration of an Altec 287W





Legacy of the 50 Watter: 211 & 845



By Eric Barbour

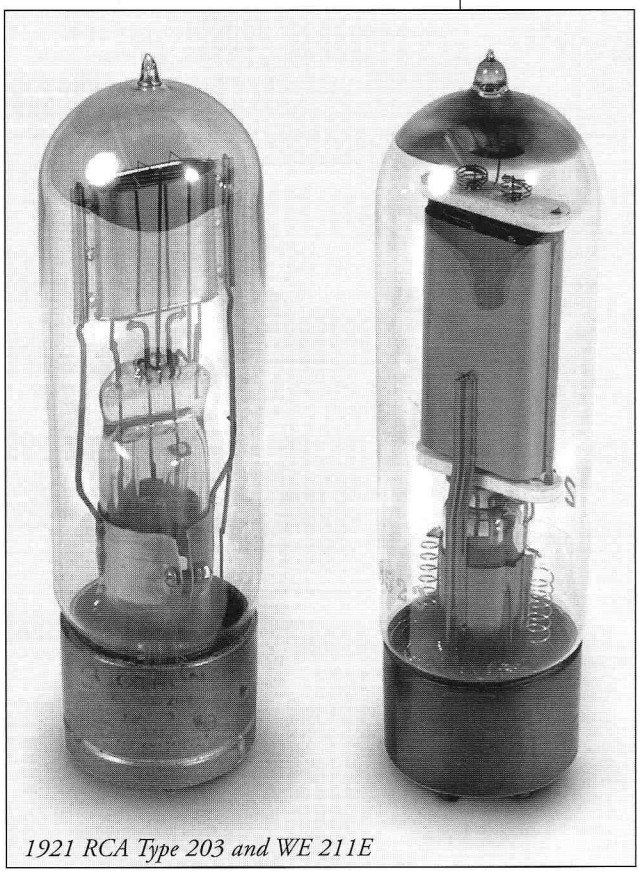
Intro

As usual, we have a story for you that doesn't unfold in a rational way. Once again, a tube family in common use today sprang from a line of industrial triodes, and became audio gold by sheer accident and random chance.

History

It begins with an experimental triode from 1917. General Electric had developed the "Type U Pliotron" for use in Navy radio transmitters; it was called CG-1144 when it was put into radios aboard seaplanes during World War I. After the war, the Type U became the UV-203. Introduced in March 1921 by RCA and made by GE, for use in AM radio transmitters, it had a mu of 25 and a pure tungsten filament. In short, it was primitive. Yet the 203 was one of the earliest large transmitting tubes in mass production. The plain-tungsten 203 was also made under various proprietary numbers, such as PG132 and HW15.

Unlike most other power tubes of the era, it was equipped with a standard base for easy change-out; previous power triodes were usually mounted on frames and attached to their circuits with flying leads. This large bayonet-lock base with 4 stubby pins, originally developed by Western Electric and often called the "jumbo," became a standard for power triodes.



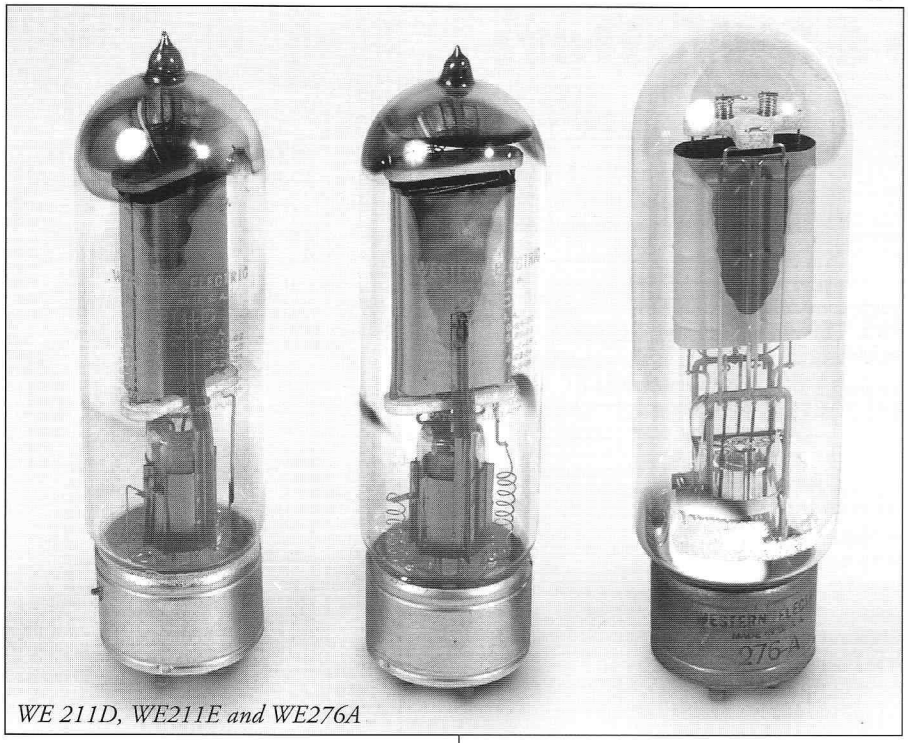
1921 RCA Type 203 and WE 211E

Thorium was a big improvement. The UV-203A, introduced in June 1923 by RCA and Westinghouse, was one of the first power tubes to be introduced with a thoriated filament. Its dissipation, rated at 100W, made it popular. Later it was cloned by Amperex, Deforest, GE, Sylvania and Taylor.

Not many other types were so widely copied and modified. A smattering of versions include the 203H for medical diathermy, with plate and grid caps; 303A was the United Electronics version; Taylor's T-125 was a 150w version with mu of 20 and plate and grid caps; Taylor's 303C/HD203A had a plate cap and mu of 25; 295A was the Western Electric version from 1933; T-203Z was a Taylor version with mu of 85; and there were too many other versions from other firms to list here. This helped cement the 4-pin jumbo base as a major industry standard in the very early days of radio broadcasting. Note: WE's 203 series of tubes were much smaller than industry-standard 203 types and not compatible.

Early 845 & 211 cartons

Eventually this led to the 211. It was developed by Western Electric from their experimental series G, with the first version 211A completed in late 1921, then copied in late 1923 by Westinghouse, and marketed by them and by RCA. With a mu of 12.5, it was intended for RF dielectric heating and audio modulators. A dull and pedestrian tube for dull everyday jobs. (If a radio engineer of the 1920s lived to see what old 211s are selling for today, he would probably die laughing.) 211 types were widely made by other firms, as they caught on in mundane industrial and medical applications.



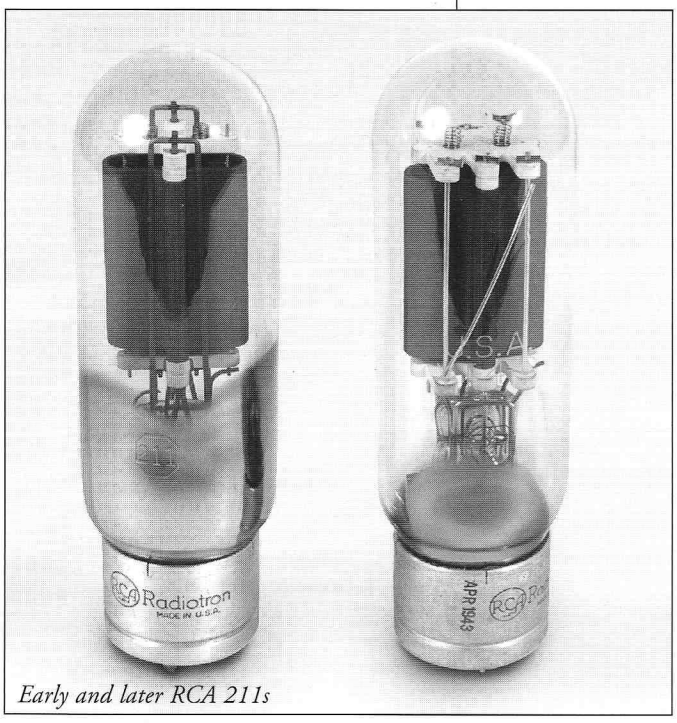
WE 211D, WE211E and WE276A

Western Electric's versions started with the 211A ; the 211B, C and D were just the same tube with different grades of filament. The 211E was notorious for its use in the WE 43A theater amplifier. A pair of small nichrome-wire inductors were installed in the filament circuit, inside the actual tube, to help stabilize it at high frequencies. This makes old 211Es highly collectible.

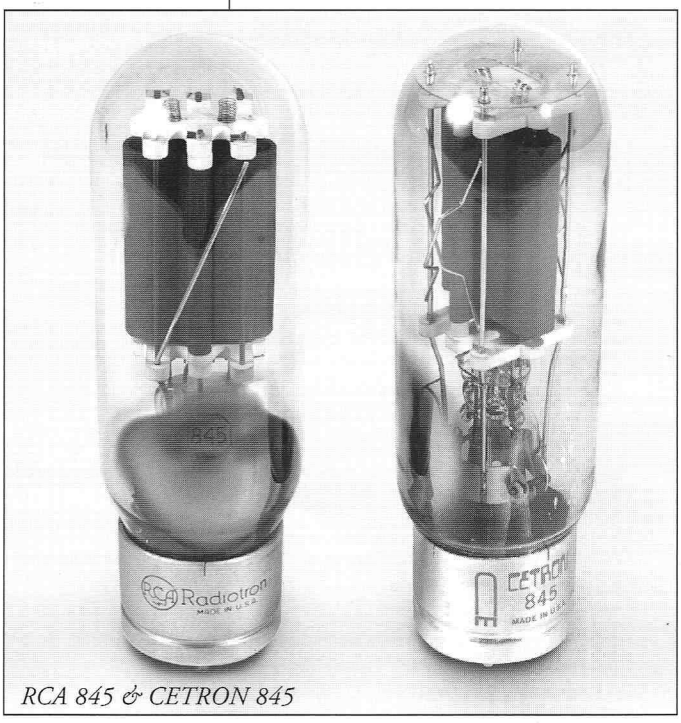
Some other versions of the 211 include the Western Electric 242A, used in WE's model 80A audio amp; 242B and C were aimed directly at audio equipment, especially the C, which found use in the D-90684 broadcast monitor amp; the WE 261A was used in early WE AM transmitters, while the WE 276A was a 100w-dissipation version; 214A, D and E were 211As without grids, for use as rectifiers; RCA's 217C from 1926 was like a 214E with a plate cap; 211H was Amperex version with a plate cap; United made a 311 series (311CH with plate cap), mainly for RF heating; RCA's 835 of 1937 was a low-capacitance version for the low end of the VHF band; and RCA's 838 was a variable-high-mu version for zero-bias Class B use. (That's right, it has a variable-mu grid, making it high in distortion in SE connection.) And all those VT-4Cs made by GE from 1938 to 1945 for aircraft transmitters, which became common and cheap surplus after the war.

This led to RCA's 805 and WE's 331A, which had variable high-mu grids and were intended for Class B AF modulators. It also led to 810 types and to a long series of Taylor types: T-125, T-155, T-200, 814, and 822, plus many, many variations and special-duty types.

The last development was the 845, believed to have entered development by RCA in 1927 and not released until 1931 as the UV845. In an era when transmitting triodes were headed toward high-mu design and grounded-grid or Class B operation, the UV845 was an aberration: a 75-watt power triode with a mu of 4.8. Later it was up-rated to 100 watts. Ridiculously archaic and difficult to drive, by 1945 it was obsolete except for its continued use in older RCA BTA-series transmitters as the audio modulator final amp, in a Class A push-pull pair. Such transmitters were often pressed into service after World War II by small local broadcasters, many carrying "race" music and programming. Millions of Americans



Early and later RCA 211s

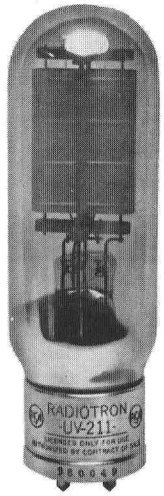


RCA 845 & CETRON 845

Original RCA 211 data sheet ca 1932

UV-211

RADIOTRON UV-211
TECHNICAL INFORMATION SHEET



GENERAL

Main Use—General Purpose.
Number of Electrodes.....5
Filament Voltage.....10 Volts
Current.....3.25 Amperes
Type.....Thoriated Tungsten

Average Characteristic Values Calculated at E_b=1000, E_c=-50, E_f=10 D-C
Plate Current.....072 Amperes
Amplification Factor.....12
Plate Resistance.....3400 Ohms
Grid-Plate Transconductance.....3530 Micromhos

Approximate Direct Interelectrode Capacities
Plate to Grid.....15 mmf.
Grid to Filament.....8 mmf.
Plate to Filament.....7 mmf.

Maximum Overall Dimensions
Length.....7¾ Inches
Diameter.....2 5/16 Inches

Type of Cooling.....Air

A-F POWER AMPLIFIER—CLASS A

Maximum Operating D-C Plate Voltage.....1250 Volts
Maximum Plate Dissipation.....75 Watts

Typical Operation
E_b=1000, E_c=-52; E_f=10 D-C
D-C Plate Current.....0.065 Amperes
Peak Grid Swing.....52 Volts
Load Impedance.....7000 Ohms
Output (5% Second Harmonic).....10 Watts

MODULATOR

Maximum Operating D-C Plate Voltage.....1250 Volts
Maximum Plate Dissipation.....75 Watts

Typical Operation
E_b=1000, E_c=-68; E_f=10 D-C (Modulation Factor 0.6)
Peak Grid Swing.....68 Volts
D-C Plate Current.....0.025 Amperes
Oscillator Input per Modulator Tube.....40 Watts

R-F POWER AMPLIFIER—CLASS B

Maximum Operating D-C Plate Voltage.....1250 Volts
Maximum Unmodulated D-C Plate Current.....0.150 Amperes
Maximum Plate Dissipation.....100 Watts
Maximum R-F Grid Current.....7.5 Amperes

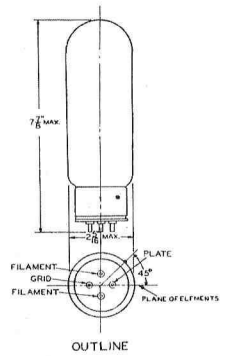
Typical Operation
E_b=1000, E_c=-75, E_f=10 D-C.
Unmodulated D-C Plate Current.....0.130 Amperes
Peak Output.....160 Watts
Carrier Output—Modulation Factor 1.0.....40 Watts

OSCILLATOR & R-F POWER AMPLIFIER—CLASS C

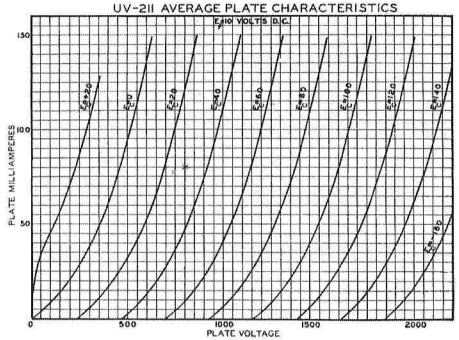
Maximum Operating Plate Voltage
Modulated D-C.....1000 Volts
Unmodulated D-C.....1250 Volts
Maximum D-C Plate Current.....0.175 Amperes
Maximum D-C Grid Current.....0.050 Amperes
Maximum Plate Dissipation.....100 Watts
Maximum R-F Grid Current.....7.5 Amperes

Typical Operation
E_b=1000, E_c=-200 (approx.), E_f=10.
Output.....100 Watts
Socket.....RCA Type 541

As tubes are used under many widely different conditions these figures should not be used for design purposes without confirmation from the manufacturer



OUTLINE



April, 1932

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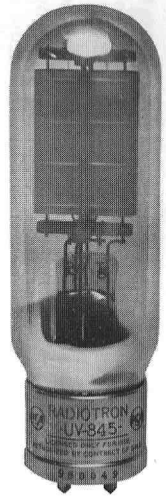
Original RCA 845 data sheet ca 1932

UV-845

RADIOTRON UV-845
TECHNICAL INFORMATION SHEET



GENERAL

Main Use.....A-F Power Amplifier or Modulator
Number of Electrodes.....5
Filament Voltage.....10 Volts
Current.....3.25 Amperes
Type.....Thoriated Tungsten

Average Characteristic Values Calculated at E_g=1000, E_a=-147 and E_f=10 d-c
Plate Current.....0.075 Amperes
Amplification Factor.....5
Plate Resistance.....1800 Ohms
Mutual Conductance.....3000 Micromhos

Approximate Direct Interelectrode Capacities
Plate to Grid.....15 mmf.
Grid to Filament.....8 mmf.
Plate to Filament.....7 mmf.

Maximum Overall Dimensions
Length.....7¾ Inches
Diameter.....2⅜ Inches
Type of Cooling.....Air

A-F POWER AMPLIFIER—CLASS A

Maximum Operating D-C Plate Voltage.....1250 Volts
Maximum Plate Dissipation.....75 Watts
Normal Operation
E_b=1000, E_a=-147 and E_f=10 D-C
Plate Current.....0.075 Amperes
Peak Grid Swing.....147 Volts
Load Impedance.....7500 Ohms
Output (5% Second Harmonic).....23 Watts

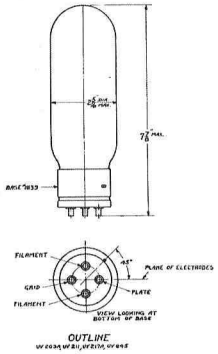
MODULATOR

Maximum Operating D-C Plate Voltage.....1250 Volts
Maximum Plate Dissipation.....75 Watts
Normal Operation:
E_b=1000, E_a=-148 and E_f=10 (Modulation Factor=0.6)
Peak Grid Swing.....148 Volts
D-C Plate Current.....0.071 Amperes
Oscillator Input Power per Modulator Tube...122 Watts

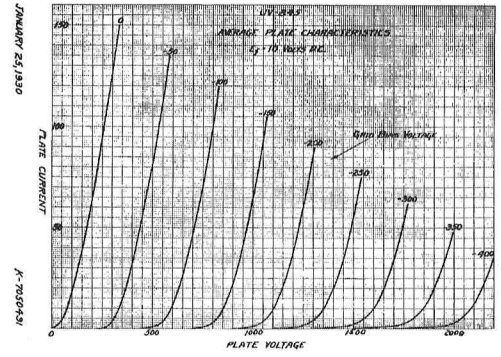
OSCILLATOR & R-F POWER AMPLIFIER—CLASS C

Data for reference only—other Radiotrons are recommended for this purpose.
Maximum Operating Plate Voltage
Modulated D-C.....1000 Volts
Unmodulated D-C.....1250 Volts
Maximum D-C Plate Current.....0.175 Amperes
Maximum Plate Dissipation.....100 Watts
Maximum R-F Grid Current.....7.5 Amperes
Normal Operation
E_b=1000, E_a=-250 (Approx.) and E_f=10
Output.....75 Watts

As tubes are used under many widely different conditions these figures should not be used for design purposes without confirmation from the manufacturer



OUTLINE



April, 1932

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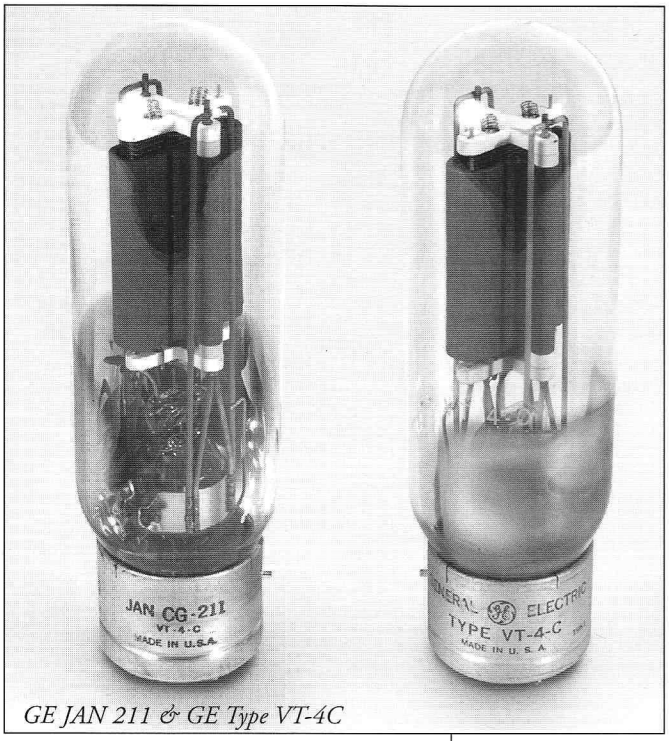
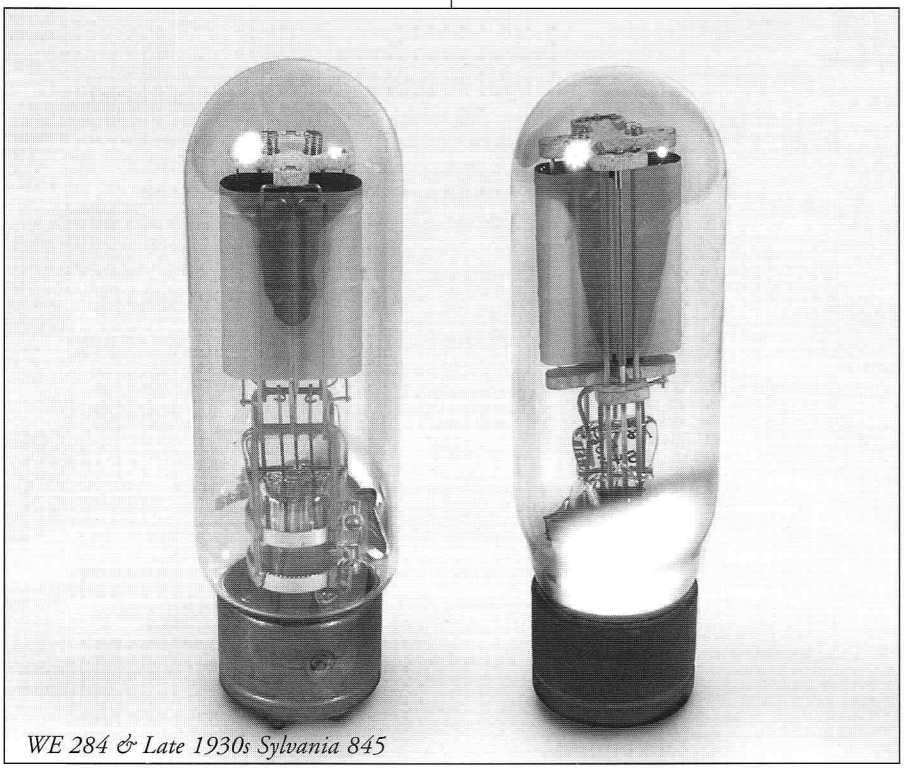


GE JAN 211 & GE Type VT-4C

were exposed to R&B and gospel music via the smooth sounds of push-pull 845s, driven by interstage transformers, with no negative feedback. Altec, RCA and WE also used the 845 in a few theater amps during the 1930s and 1940s..

Western Electric's 284 series was very similar to the 845 and enjoyed lengthy use in AM broadcast modulators. There were other manufacturer's designations for the 845, although it did not enjoy nearly as much popularity or variability as the 203 or 211. Its mu was too low to make it suitable for RF-heating power oscillators, and any continued manufacture was just to keep pre-1950 AM transmitters retubed.

High mu was the overwhelming trend after the war, and grounded-grid RF amplifiers were the last frontier for glass triodes--power tetrodes and pentodes elbowed them out of most other applications. The worm turned in the 1980s, and the last laugh is on the high-mu family. For although the 811A, 572B, 3-500Z and other high-mu types continue to be popular in RF applications, the large, crude 845 has become nearly a religious object to neurotic audiophiles, especially in Asia.



WE 284 & Late 1930s Sylvania 845

Today

Simply compiling a list of all the firms that made 211s in the past 70 years would be an impossible undertaking; 211s were astoundingly popular before 1950, then nearly became museum pieces. In spite of the wide manufacture of 50-watter tubes in their variegated forms, in the 21st century we are down to two manufacturers: a Chinese factory, and Richardson Electronics in Illinois. The Beijing "Sino" factory produces generic clones of the later GE 211/VT-4C and the late RCA 845, both with graphite plates and aluminum-shell bases. Richardson makes an 845, allegedly on the original RCA tooling, in small quantities and selling for a high price under the Cetron label. Manufacture of later relatives, such as the 805 and 810, continues in China and at Richardson.

Although the "true" 50-watter types have been reduced to two specialty manufacturers serving the high-end audio market, there is a similar tube from Russia: the Ulyanov GM-70. Its basing is unique and its mu is about 7, yet in many respects it is amazingly similar to the 211. This triode, made since the 1940s, is little-known outside of the Russian electronics industry.

Outro

So, it appears that the 50-watter is showing new life and continued manufacture into the 21st century. In spite of its sheer impracticality, the obsessive and demanding audiophile market continues to maintain its availability, and probably at prices that would shock our fathers. Remember, as recently as the early 1970s one could buy a WWII surplus VT-4C for as little as $4.

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4. **Saga of The Vacuum Tube**, Gerald F. J. Tyne (Howard W. Sams Publishing Co, Indianapolis IN, 1977), p. 150, 151, 287, 288.

Many thanks to Lauren Peckham of the Antique Wireless Association, Al Jones of the Transmitting Tube Museum, and Brother Pat Dowd for their invaluable assistance with the historical background.