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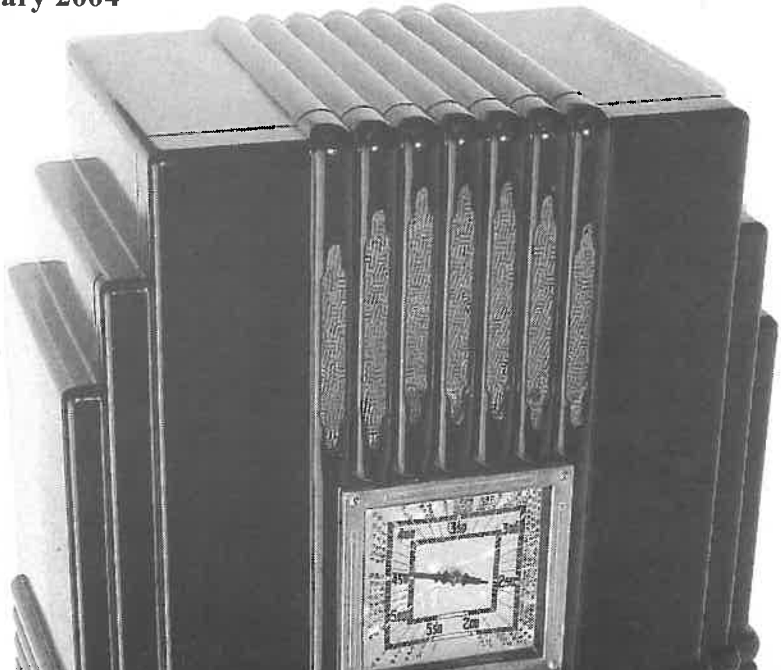

The Fisk Radiolette "Empire State"

FROM THE EDITOR

Between fantasy and construction we have a variety of contributions. Two articles cover ambitious though worthwhile projects and either could form the basis of a future article giving the constructor's experiences with the project.

Next issue will feature a world first captured by NZ; the first domestic receiver to bandspread the shortwave broadcast bands, the Columbus model 75. See the rear cover page of this issue .

Thanks to our contributors, keep up with the good work.

FROM THE TREASURER

Thank you to the BoP bulletin envelope stuffing team for their services over the past 5 years. This service has been appreciated but is now replaced by a more automated waterproof plastic enveloping process carried out by our printer. Not everyone has been impressed by this move. Some regard it as less "environment friendly" but those who, in the past, have suffered from the receipt of soggy bulletins have welcomed the move and, as one of our youngest members pointed out, "you can always cut off the end with scissors and use the plastic cover for storing components"!

The automated process has limited the more personal approach that we had with members so simple codes are now used on the address labels. "Sub oo" means you have still to take advantage of the economical subscription renewal and a yellow renewal form is included on the other side of the address form. "Sub OK" or a white address form with no notice indicates your subscription is current.

NEW MEMBERS

Cooney G P	Wellington
Fulton M	England
Phillips J	Auckland

THE FOLLOWING BOOKS AND OTHER ITEMS ARE AVAILABLE TO NZ MEMBERS AT DISCOUNT PRICES

From NZVRS Secretary, 2 Levy Road, Glen Eden, Auckland. paul.woodcock@opus.co.nz
HALLICRAFTERS $36
ZENITH TRANSOCEANIC $31
Packing and Postage - $5
10m lengths of 3 core Power Cable
$8 per length plus $4 P&P
Ivory 3 pin Power Plugs
$1 each plus $2 P&P for up to 4 plugs.
Club Badges.
$5 each plus 50c P&P

From NZVRS, P.O.Box 13873, Onehunga, Auckland 1006. office@nzvrs.pl.net
AUCKLAND RADIO - $30
70 YEARS OF RADIO VALVES - $46
GOLDEN AGE OF RADIO - $38
MORE GOLDEN AGE OF RADIO - $55
Packing and Postage - $5
Residual Current Detectors - $20 + $5 P&P
630V, Axial lead, Polyester Capacitors,
.1, .068, .047, .033, .01, .005, .001 uF.
1000V, Axial lead, Polyester Capacitors,
.082, .068, .018, .001 uF
All above capacitors 50c each plus $2 P&P
1500V oblong plastic cased,PC board mount.
.0091 uF, 5% tol.. - 20c each plus $2 P&P

Check first for availability. Please make out cheques to New Zealand Vintage Radio Society

CONTENTS

German Propaganda Receivers of the Third Reich – Part 2

This two part article, writtem by Jeremy Stevens, originally appeared in Electronics World of August 2003 and is reprinted with permission.

Switching on for the first time

The new capacitors having been fitted and the insulation of the mains wiring checked I switched on and eagerly awaited the results as the valves warmed up. I was disappointed to be greeted with a faint hum and nothing else. Prodding the control grid of the output valve indicated that at least this was working, but there was absolutely no response from the top cap grid of the AF7. At this point I noticed the absence of a reassuring glow from the heater. Unfortunately the valve proved to be soft. This temporary setback was soon overcome when I discovered Ian Wusten's web site. I was able to purchase a brand new AF7 and Ian supplied me with the data for all the valves used in my receiver. I, therefore had no need to initiate my back-up plan of installing an SP4, the nearest equivalent English valve, on to a side contact base.

It took a week to obtain the replacement AF7 and on fitting it the VE301 finally showed some slight signs of life. The audio quality was acceptable, certainly helped by the large loudspeaker. True to its designer's brief the sensitivity was poor; a long aerial was required to receive anything at all. On long wave there was not even a hint of signal on 198kHz (Radio 4). As I intended to put the receiver into daily use something had to be done!

Circuit Overview

The circuit of my VE301, with its AF7 pentode detector, is worth some detailed examination as it has some interesting features. The power supply employs an RGNI064 with both anodes strapped in parallel as a half-wave rectifier and returned to ground via a 450 ohm resistor. In this way a negative bias voltage is developed for the directly heated RESI64 output valve. A bleed resistor of 28k increases the overall current draw on the HT supply to boost the field current of the loudspeaker. (This component started to increase in value at an alarming rate when the set was once more put into use and on replacement was found to have reached a value of 43k) This resistor also has a swamping effect on variation of the speaker's field current as a result of changes in the anode current of the output valve. The back bias circuit develops around -12V with respect to the receiver's chassis. It has a residual 50Hz component that is not well filtered by the following 200k and 0.1 uF capacitor with the result that approximately 0.8V p-p ripple appears on the output valve's control grid. The presence of a 'humdinger' potentiometer allows for cancellation of injected hum from the AC energised, directly heated, cathode of the output valve. It is a pretty fundamental requirement in this design as any particular valve's emission will not be even along the length of its filament. The pot enables the hum to be nulled for all reasonable valve spreads and may well help to achieve an 'aggregate null' taking into account the hum injected by the grid bias supply, but with obvious limitations due to phase shifts, waveform distortion, etc.

The RESI64 output valve is specified for an anode current of 12mA at 250V and under these conditions has a mutual conductance (gm) of 1.4mA/V. The screen grid current draw is about lmA. Keeping comfortably away from saturation, an anode current swing of about 18mA p-p with a corresponding voltage swing of 300V p-p will develop an audio output power of about 0.9W RMS at the output valve's anode: 720mW at the loudspeaker. allowing for an output transformer efficiency of 80%. This implies that the anode load resistance is about 16k. With this in mind the anode filter capacitor (5000crn, 5500pF) results in a HF roll off (-3dB) in the output stage of 1.8kHz. Thinking this too low I disconnected the capacitor but found the receiver broke into oscillation! I had forgotten that this capacitor also had the job of filtering residual RF from the demodulated signal. It had, however, gone significantly high, it measured 7500pF on my bridge, so was replaced. Output stage voltage gain can be calculated by multiplying the mutual conductance by the anode load resistance i.e. 16k x 1.4mA/V= 22.4. One can deduce that for full audio output a p-p grid voltage of approximately 300V/22.4 = 13.4V is required. The output from the AF7 demodulator stage ('Audion') is capacitively coupled to the output stage's control grid with no attenuation other than an RF filter. There is no conventional volume control in this receiver. Volume (and to some extent selectivity) is controlled by adjusting the aerial input coupling, effected by rotating the input coil through 90°. This has the advantage that the possibility of overloading the AF7 on strong signals is minimised. In addition, not having a conventional potentiometer volume control means that gain adjustment does not suffer from crackling and noise.

So how does the detector work? The incoming RF is AC coupled to the AF7 grid by a high pass network, physically realised as a single component, with a cut-off frequency of about 700Hz. The RF signal is DC restored by diode action between the control grid and cathode of the AF7. A negative bias is therefore developed on the control grid, proportional to the amplitude of the RF envelope. The tuned circuit is only lightly loaded because, in the steady state, the grid current only flows at the most positive excursion of the RF input. The cut-off frequency of the input coupling network is such that grid voltage follows the modulation envelope of the RF carrier. As a larger RF input voltage develops a more negative grid voltage, the output at the AF7 becomes more positive, thus the output is in phase with the incoming RF envelope. The detector stage therefore not only demodulates the incoming RF waveform but also provides some useful audio gain as well.

As the output is positive going, the AF7 operating conditions must be chosen for a relatively low quiescent anode voltage and this has been achieved in this design by limiting the screen grid voltage. As the earthy side of the tuned circuit is grounded the cathode must also be returned directly to ground to avoid negative biasing of the detector diode formed by the grid and cathode of the AF7. This approach also saves an additional resistor and capacitor in the cathode circuit. From the voltage drops in the circuit it can be deduced that the anode and screen grid currents are approximately 400uA and 130uA respectively rather than the valve's rated currents of 8mA and 1mA respectively. By running the valve at a low anode current a high value anode load resistor may be used in order to maximise the voltage gain (A=gm x RL). The rated gm for an AF7 is 2.1 mA/V, even if this is reduced to *1*.5mA/V by operation at reduced screen grid potential, a respectable voltage gain of about 750 may be expected before applying reaction. Allowing for a DVM resistance of 10 megohms, the screen grid runs at about 24 V and the anode at about 70V with no signal. On a strong local signal in London the audio signal on the AF7 anode was approximately 50V p-p, grossly overdriving the output stage..

The screen decoupling capacitor is 0.2uF, a seemingly large value for RF frequencies. It must be remembered that the valve is amplifying the detected audio frequencies and the screen .grid must be at a good AC ground. It was found that a 0.047uF de-coupler produced noticeably less gain than the specified 0.21uF.

Gain and selectivity can be boosted in this type of circuit by applying a controlled amount of positive feedback (reaction). Residual RF at the anode of the AF7 is fed back to the input tuned circuit via a variable capacitor. The medium wave coil comprises two bank wound coils

sandwiching a single turn reaction winding. On long wave, the reaction winding occupies the bottom layer or so of the coil. The two reaction windings are wired in series. Taking into account the gains of both stages, for full output power without reaction, a RF envelope of about 19mV p-p is required at the AF7 grid.
Finally we reach the receiver's interface to the outside world, the aerial coupling coil. This has two taps and in conjunction with a 300cm capacitor, provides three possible aerial connection options facilitating matching to different aerials over the wide operating frequency range of the set (150kHz to 1.5MHz). In order to determine the inductance of the two sections of the coupling coil they were tuned with a 41nF capacitor and a resonant search performed. Thus the inductance for each of the two sections was found to be 33uH and 800uH.

Improving Performance
The biggest irritation with this receiver is the need for a long wire aerial. I decided to carry out a few experiments with separate ferrite rod aerial (removed from an old transistor radio) and pre-amplifier circuit. The pre-amplifier's supply could be borrowed from the -12V bias supply provided the current draw was less than 2mA. By adopting this approach, only one easily reversed modification to the VE301 was necessary. As well as improving the receiver's sensitivity a tuned pre-amplifier would also improve adjacent channel interference - often a problem with TRF sets.

In order to prevent the possibility of RF instability caused by the proximity of the ferrite rod to the receiver, it was decided to mount it remotely, using a 75Q coaxial line for coupling. Remote mounting would also facilitate rotation of the ferrite rod to suit the direction of the received signal. The next decision was what configuration of pre- amplifier to use? It had to be simple, match reasonably well to a coaxial line and interface to the available input and output coils; namely the aerial coils of the VE301 and ferrite rod antenna.

After some thought and consultation of the Mullard and Siemens data books, I decided to opt for a split cascode pair using bipolar transistors. With a maximum of 2mA available at 12V, the old- faithful BCIO9C or BC548C looked like good candidates at the frequencies of interest, both devices giving near identical performance. The best noise performance depends on source impedance and collector current and is generally at a lower collector current than that required for maximising the current gain. It is also necessary to consider the dependence of transition frequency on collector current as this falls with falling collector current. A good compromise between these conflicting requirements could be achieved at an operating current of 2 mA and a collector-emitter voltage of about 5V on each transistor.

A cascode pair consists of a common emitter input stage driving a common base output stage. The input and output impedance of a common base stage are highly interdependent, in general the input impedance is very low and the output impedance moderately high. The 800uH aerial coil of the VE301 presents a load impedance to the pre-amplifier of about 1kQ at 198kHz and 7.5k at 1500kHz. This is sufficiently low not to increase the input impedance of the common base stage much above 20 ohms over the frequency range of interest. Thus the coaxial line can be fairly well terminated by simply adding an appropriate resistor in series with the common base stage's emitter. The common emitter half of the cascade pair is mounted remotely along with the ferrite rod antenna and its collector is arranged to drive the coaxial line directly. As the coaxial line presents a low impedance, the voltage swing at the collector and hence the reverse coupling is minimized. In effect this stage provides current gain only. Under these conditions the input impedance of the transistor approximates to about 9k when operating at 2mA thus correctly loading the ferrite rod antenna, ensuring the "Q" and hence bandwidth are right. A pre-set trimmer was used to tune the LW coil to 198kHz with a variable capacitor on the MW coil. The two coupling coils were wired in series thus eliminating the need for a band-switch on the pre-amplifier. To avoid an additional wire for the power supply, the base bias for the common emitter stage is derived from the collector.

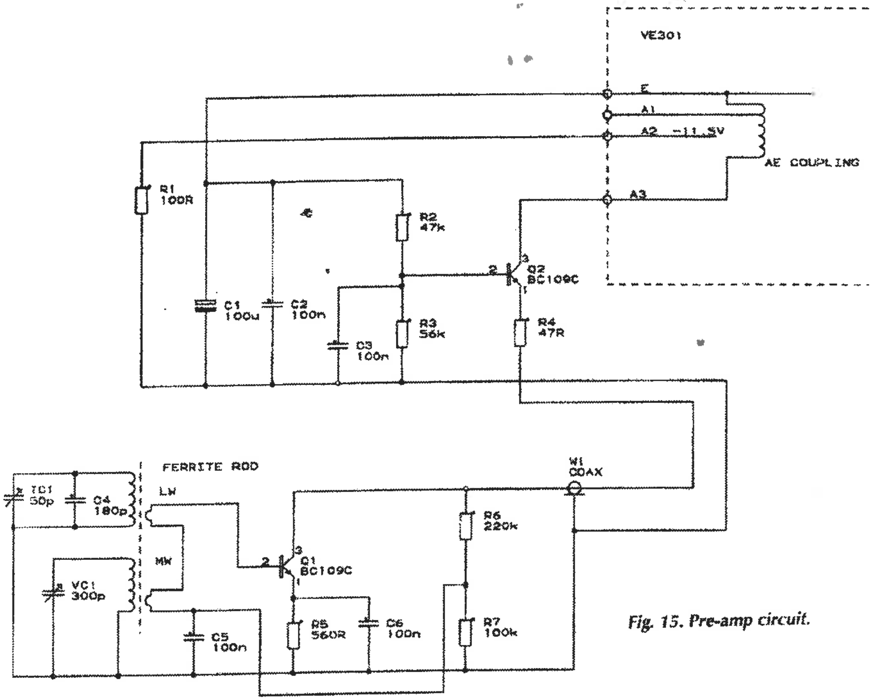

Fig. 15. Pre-amp circuit.

Some consideration was given to delivering more power to the aerial input coil of the VE301 by the use of transformer coupling. The common base stage has a fairly high output impedance, necessitating a large turns ratio in order to achieve an optimum power match and hence a large inductance on the transformer primary. There is a danger that the inherent collector capacitance might cause the transformer to resonate in the desired pass-band. This idea was therefore dropped. Although the output of the cascode stage is not optimally matched from a gain point of view, in practice the circuit works very well, is stable and meets its objective of eliminating the need for an external long wire aerial.

I have only outlined the design process for the pre-amplifier, as this could easily be the subject of another article. In the process of development I discovered the value of older books where the theory is dealt with in fundamental detail. I also found that the results from SPICE programs although useful should not be relied upon unless one understands the approximations within the library models.

References

Mullard, *Reference Manual of Transistor Circuits,* 2nd Edition 1961
Siemens Transistor Data Book (1981)