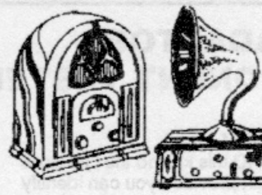
Vintage Radio

by PETER LANKSHEAR



A decade of radio development — 2

As we saw in the previous article, the primitive receivers of 1925, typified by the American made Stewart Warner 300, provided plenty of scope for development. This time we look at its lineal descendant, the 1935 model R-136 'Ferrodyne' chassis.

By the way, these American receivers have been selected because they were typical of their period, and Stewart Warner was one of the comparatively few manufacturers in business in 1925 who were able to survive the depression and thereby provide a continuity of models. I must emphasise that by 1935, locally made receivers compared very favourably with their US counterparts.

Continuous development

Each season there were such significant developments that often design details and cabinet fashion are sufficient to date receivers to the exact year of manufacture. Inevitably some ideas were abandoned after a brief trial, but by the mid 1930's, design had stabilised with features still to be found in receivers today.

Many historians regard 1930 as the transition year between the pioneering efforts and the 'modern' radio. By then, chassis construction, mains operation, and ganged tuning were standard, with increasing use of screen grid tetrodes and audio pentodes. Cabinets had become pieces of furniture, with integral moving coil speakers driven with adequate audio power.

Late in 1930, RCA relinquished its monopoly of the superheterodyne and within a year, other types were obsolete. Then followed variable-mu RF valves, RF pentodes, shortwave band switching, multi-function valves and much greater use of automatic gain control.

The golden years

There was a wide range of models available during the 1930's, ranging from elaborate 'top end of the market' receivers right through to budget priced rather 'low tech' models at the bottom end. Better grade broadcast receivers from this period can still hold their own alongside today's domestic radios.

By 1935, what may be called the standard superheterodyne had evolved. Thereafter, right to the end of the valve era, there were few major advances in domestic receiver technology. Of course there were still regular changes, but these were mostly in detail or cosmetic to meet the requirements of the marketing departments and simplification for economy. Design remained static during World War II and despite expectations to the contrary, few of the wartime developments in electronic technology had any significant influence on post war domestic AM receivers.

Later, smaller valves, which were not always as reliable as the older types, and better components became available, and in general receivers became simpler and cheaper, but not necessarily better. An example of a development that did nothing to improve valve receivers was the printed circuit. It is difficult to imagine solid state and integrated circuit technology without printed circuits, but boards in valve receivers were often carbonised from overheating by output valves and rectifiers, and cracks in the copper tracks were a problem.

But I digress. Let's compare Stewart Warner's R-136 receiver of 1935 with its predecessor of 1925.

First impressions

Seen side by side, it is difficult to believe that only 10 years separate the two receivers. The 300 is just a functional box with three large direct drive knobs, and covers only the medium wave broadcast band; but the cabinet of the R-136 has become a piece of furniture, featuring an elaborate 'Magic Dial' about 100mm in diameter. Frequency coverage is continuous in three bands, from 540kHz to 18.0MHz.

At this time, the term 'Magic' was in vogue, with receivers having 'magic eye' tuning indicators, 'magic brains' and in this case a magic dial. Stewart Warner had in fact used the description a couple of years earlier, to describe a dial in which the scales changed with band switching. In this case 'magic' refers to the scales being practically invisible unless the dial is lit!

The dial calibrations are accurate and colour coded for each band. Mechanically, the dial is an elaborate combination of gears and a planetary drive, with two concentric tuning knobs. In high ratio, 4.25 turns of the outer knob are required to rotate the tuning capacitor through 180°, whilst at the same time, a small single ended pointer rotates four times around a 360° logging scale. For fine tuning the planetary drive multiplies the gearing by a ratio of 5:1. Matching the bronze escutcheon, the main pointer

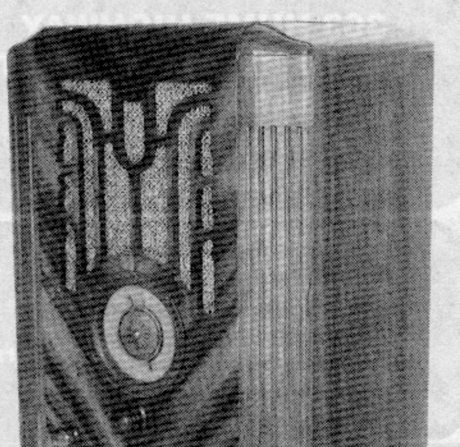
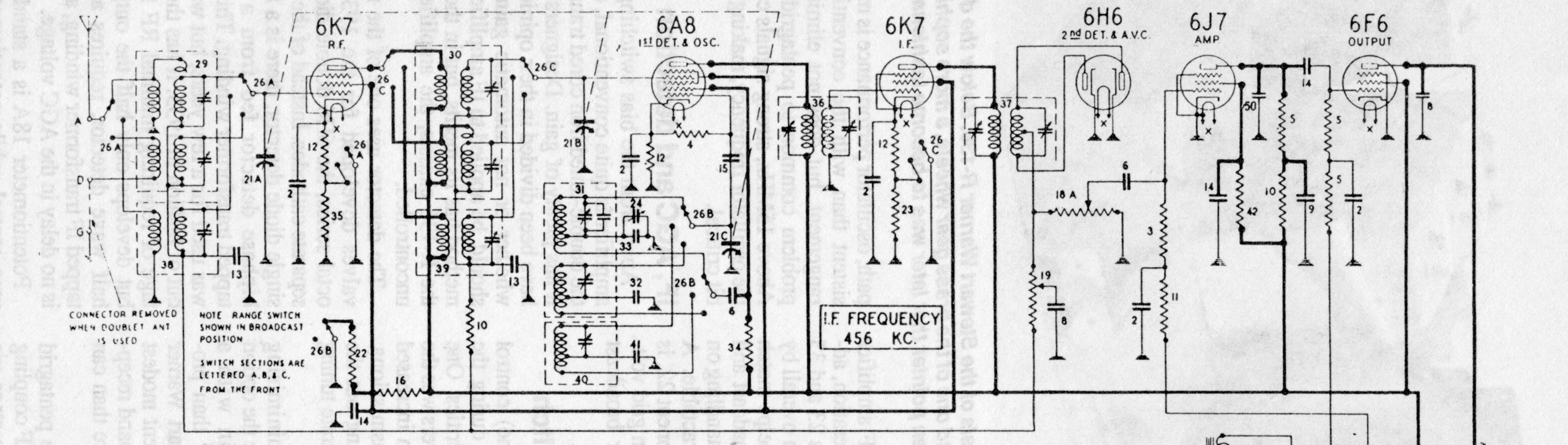
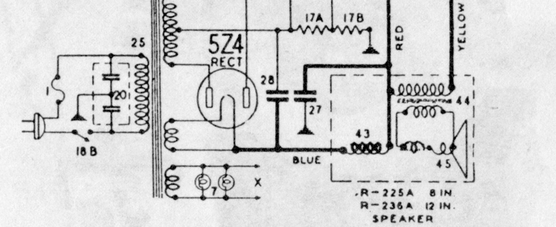
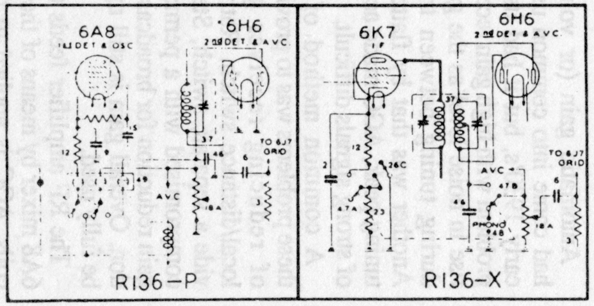


Fig.1: This mantel set was one of a number of Stewart Warner models using the R-136 chassis. Typical of 1935 fashion, its walnut veneered cabinet is finished in highly polished nitrocellulose lacquer with turned wooden knobs.

STEWART-WARNER MODEL R-136 CHASSIS (RECEIVER MODELS 1361 to 1369)







PHONOGRAPH MODEL CIRCUITS

R-136 PARTS LIST

Diagram No.	Part No.	DESCRIPTION	List Price
1	38841	Fuse, 1 amp.	$0.10
2	81630	.1 mfd. 175 volt paper condenser	.30
3	83072	510,000 ohm 1/4 watt carbon resistor	.20
4	83080	51,000 ohm 1/4 watt carbon resistor	.20
5	83082	260,000 ohm 1/4 watt carbon resistor	.20
6	83219	.01 mfd. 600 volt paper condenser	.30
7	83278	Dial lamp 6.3 volt	.15
8	83706	.006 mfd. 600 volt paper condenser	.35
9	83974	.1 mfd. 200 volt paper condenser	.25
10	84198	110,000 ohm 1/4 watt carbon resistor	.30
11	84235	1.1 megohm 1/4 watt carbon resistor	.20
	84312	Output transformer (R-225-A 8" spkr.)	2.50
	84504	Diaphragm and shell assembly (R-225-A 8 inch speaker)	2.50
	84505	Field coil assembly (R-225-A 8" spkr.)	3.75
12	84888	300 ohm 1/2 watt wire wound resistor	.15
13	85053	.05 mfd. 100 volt paper condenser	.35
14	85059	.05 mfd. 300 volt paper condenser	.35
15	85061	.000051 mfd. mica condenser	.15
16	85063	15,000 ohm 2 watt carbon resistor	.25
17-A 17-B	85067	{275 ohm wire wound bias resistor 25 ohm wire wound bias resistor} one unit	.50

Prices subject to change without notice

R-136 PARTS LIST — CONT'D.

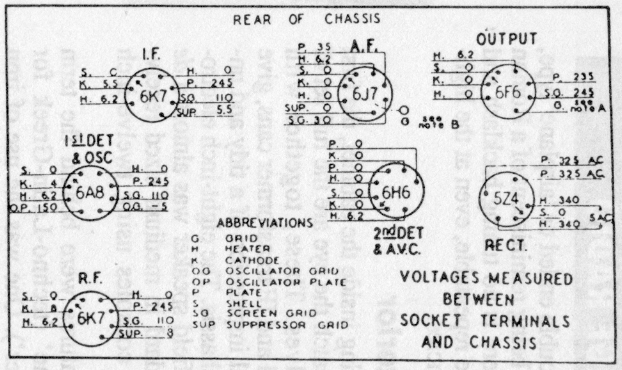
Diagram No.	Part No.	DESCRIPTION	List Price
18-A 18-B	85073	{250,000 ohm volume control Line switch} one unit	$1.25
19	85074	500,000 ohm tone control	.85
20	85075	Dual .01 mfd. 750 volt A.C. paper cond.	1.00
21A to C	85084	3 Gang variable condenser	4.50
22	85116	25,000 ohm 1/2 watt carbon resistor	.15
23	85117	1,000 ohm 1/2 watt carbon resistor	.20
24	85285	Padding trimmer	.40
25	85428	Power trans. 115 V 60 cycle (136-A only) (See 85760 for other voltages and frequencies)	5.50
26A to C	85429	Three deck range switch	3.00
27	85430	16 mfd. 300 volt electrolytic condenser	1.25
28	85431	16 mfd. 400 volt electrolytic condenser	1.25
29	85432	Antenna coil and shield assembly (B & No. 3 S.W.)	2.75
30	85433	R. F. coil and shield assembly (B & No. 3 S.W.)	3.00
31	85434	Oscillator coil and shield assembly (B & No. 3 S.W.)	3.00
32	85440	.00351 mfd. mica condenser	.40
33	85441	.00042 mfd. mica condenser	.25
34	85442	21,000 ohm 1/2 watt carbon resistor	.20
35	85443	2,000 ohm 1/2 watt carbon resistor	.20
36	85452	1st I.F. transformer	2.50
37	85453	2nd I.F. transformer	2.50
38	85455	Antenna coil assembly (No. 2 S.W.)	1.50
39	85456	R.F. coil assembly (No. 2 S.W.)	1.50
40	85457	Oscillator coil assembly (No. 2 S.W.)	1.25
41	85467	.00137 mfd. mica condenser	.30
42	85472	1.6 megohm 1/4 watt carbon resistor	.15
43	85478	Field coil assembly (R-236-A spkr.) (See 84505 for R-225-A 8" spkr.)	5.00
44	85482	Output transformer (R-236-A 12" spkr.) (See 84312 on R-225-A 8" spkr.)	2.50
45	85592	Diaphragm and shell assembly (R-236-A 12" spkr.) (See 84504 for R-225-A 8 inch speaker)	3.50
50	84370	.00011 mfd. mica condenser	.15

R-136P AND R-136X PARTS

Diagram No.	Part No.	DESCRIPTION	List Price
46	83539	.00026 mfd. mica cond. (136P & 136X)	$0.25
47A & B	84404	Phono toggle switch D.P.D.T. (136X)	1.10
48	84407	Phono terminal strip (136X)	.12
49	84112	3 lug terminal strip (136P)	.03
	85760	Power transformer 136X & 136-P only. (100 to 240 volts) (25 to 133 cycles)	8.50

SOCKET VOLTAGES

LINE VOLTAGE 115 VOLTS Volume Control on Full ANTENNA GROUNDED
RANGE SWITCH SET ON BROADCAST POSITION DIAL TUNED TO 540 KC.



IMPORTANT: Use a high resistance meter of 1000 ohms per volt.
NOTE A: The grid bias on the 6F6 output tube is —16.5 volts, measured across the resistors 17A and 17B.
NOTE B: The grid bias on the 6J7 amplifier tube is —1.7 volts measured across resistor 17B.
Speaker field resistance is 1300 ohms with coil warm.

Compare the R-136 circuit schematic shown here with that for the 1925 set given in the previous article, to see the tremendous progress made in receiver design during that 10 year period. Locally produced sets of 1935 were very similar.

is of the double ended or 'airplane' type, the centre being reminiscent of a Roman shield. There is no tuning backlash and settings are repeatable, even at the highest frequencies.

Tidy interior

On looking inside the cabinet, the first things to catch the eye are the full set of metal valves. These, together with square coil and IF transformer cans, give the general impression of a tidy and uncluttered chassis. The eight-inch electromagnetic field speaker was almost a *de facto* standard in medium sized receivers, with consoles using twelve-inch speakers.

Two features were behind the term 'Ferrodyne' (techno-Latin-Greek for 'iron power'). One was the use of iron dust cores in the IF transformers — today used universally to improve efficiency in high frequency coils and inductors of all types. Stewart Warner has been credited with pioneering the use of iron cores, and these were first used in the R-136 chassis.

The other ferrous application was the use of the octal based metal series of valves. In May 1935, General Electric had marked their return to radio manufacturing by announcing their intention to equip their receivers with a full range of specially developed metal valves. In September, the first of these GE receivers appeared, and the circuit of the Stewart Warner R-136 chassis was published. It should be noted that despite the advertising fanfare and publicity surrounding the first series of metal valves, most were in fact existing types in new packaging.

Circuit details

Even a casual comparison of the circuit with that of the model 300 is sufficient to show that design had come a long way in 10 years, and readers may be interested in a detailed description of the R-136. Note that components are identified on the circuit by part numbers.

The aerial is switched between the primaries of the three aerial transformers. The broadcast and 6-17MHz coils are in shield can number 29, with the 1.5-6MHz coils in 38. A good feature is the provision for a balanced doublet aerial for the top band. The aerial transformer secondaries are connected at their lower ends to the AGC line and are switched to the tuning capacitor and the grid of the 6K7 RF amplifier valve by the band switch.

An interesting feature is the operating

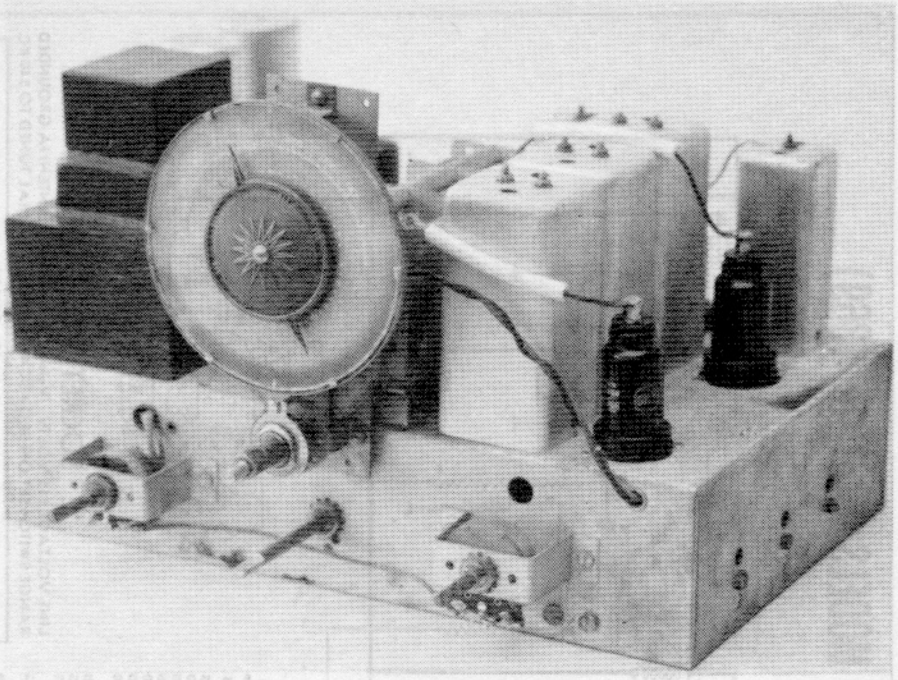


Fig.2: The uncluttered chassis of the Stewart Warner R-136. Below the dial is the planetary reduction drive and one of the brass gear wheels, a more sophisticated system than the string-driven pointer that later was to become fashionable.

conditions for this and the IF amplifier valve. For broadcast band operation, additional cathode bias resistors 23 and 35 are switched in to reduce gain overall by something like 15dB. This helps match performance between the broadcast and shortwave bands, and makes handling on the broadcast band more tractable. A compensating resistor, component 22, is switched in to keep the screen grid voltages correct with the higher broadcast band bias.

No local/distance switch

Automatic gain (or volume) control had come into common use during the early 1930's, but it had its critics. One problem with high gain receivers was the rise in noise level as the gain increased during tuning between transmissions. Another was that by flattening out the tuning peak, AGC made accurate tuning of strong signals difficult.

A common method of minimising these problems was to provide the option of reducing receiver gain with a local/distance switch. Rather than provide a separate switch, Stewart Warner compromised with a permanent modest gain reduction for broadcast band reception. Overall gain is still more than can be fully used.

The RF amplifier feeds the pentagrid 6A8 mixer by means of the RF coupling coils. AGC is applied to this stage via resistor 10. By using a form of Hartley oscillator with the padder in the feedback path, oscillator performance is more consistent than with the conventional arrangement, but does not eliminate one problem common to pentagrid mixers. Above 15MHz, strong signals can 'pull' the oscillator frequency, making tuning a bit critical.

IF, AGC and detection

Apart from the bias switching, the IF amplifier is quite conventional, and with the double-tuned iron cored transformers it has plenty of gain. Designers seem to have been divided in their opinions as to whether or not automatic gain control should be applied to IF amplifiers. Each method has its merits, but in the case of the R-136 chassis, the amplifier is left uncontrolled.

The detector uses one of the few new valves developed for the 1935 metal octal series, the 6H6 double diode with separate cathodes. Instead of the familiar single diode detector, there is a fullwave biphase detector fed from a centre-tapped transformer winding. This system was used for a few years, but was going out of fashion in 1935. It has the advantage of requiring minimal RF filtering, but develops only half the output of a half wave detector, requires a centre-tapped IF transformer winding, and there is no delay in the AGC voltage.

Potentiometer 18A is a standard volume control, while potentiometer 19 is used as a combination AGC filter resistor and tone control.

High gain audio

The audio output of the R-136 is rated at 3 watts — 200 times the power capability of the 01A valve of the model 300. The resistance-coupled 6J7 and 6F6 valves used in the audio amplifier were the same internally as the existing 6C6/77 and 42 pentodes.

A minor criticism is that with only about 0.15 volts needed on the grid of the 6J7 to drive the 6F6 to full output, there is an embarrassment of gain which is quite unnecessary even with weak shortwave signals. This results in the use of no more than the first 30° of the volume control's range. A smaller value of load resistor for the 6J7 would make the receiver more docile.

By 1935, power supply design had become standardised. Filtering is provided by two 16uF capacitors (27 and 28) and the field winding of the electromagnetic speaker. The diagram shows a smaller field winding in series with the voice coil and output transformer. This is the 'hum bucking' coil, a few turns of heavy wire producing an out of phase voltage to cancel hum generated by the ripple in the HT current flowing in the main field winding.

Grid bias for the audio stages is provided by the voltage drop across resistors 17A and 17B in the negative return of the power supply. Cathode bias for audio amplifiers, although preferable technically, was not very popular during the 1930's, probably because low voltage electrolytic bypass capacitors were then rather unreliable.

The 5Z4 rectifier used here was the one unsuccessful member of the introductory range of metal valves. It proved to be unreliable and pending its redesign, the old faithful 80 was recalled as a stop gap. Given an octal base, and renamed the 5Y3G, it continued to be used for many more years.

In the 10 years following 1925, radio technology made tremendous advances. Whereas the Stewart Warner model 300 is just an interesting museum piece, receivers like the R-136 are still capable of providing good service, with a performance that compares very favourably with their modern counterparts. ■

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