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RADIO BYGONES

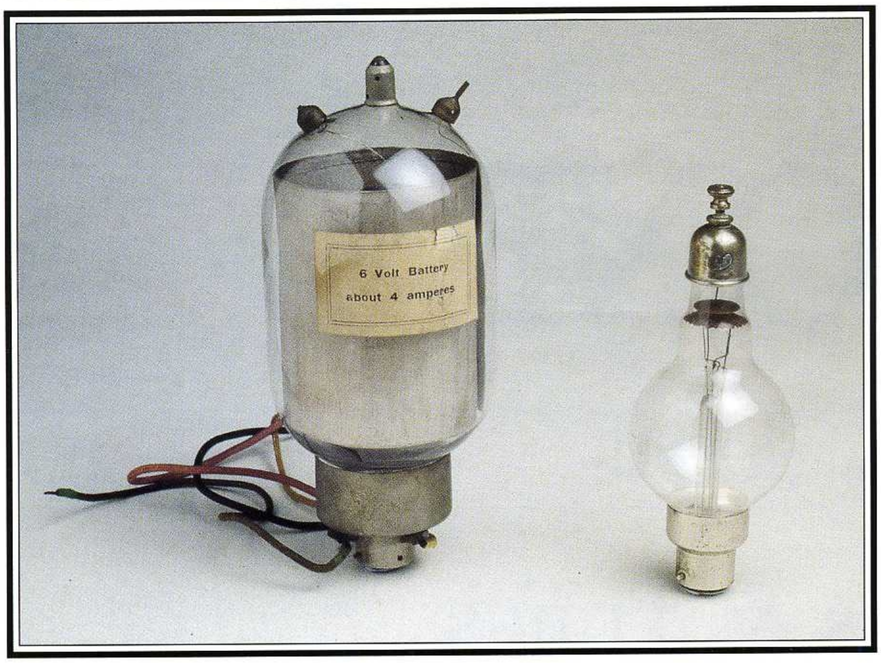
No. 9 – February/March 1991

Radio Valves & Tubes
Type Codes & Equivalents – 1

RAF Communications Receiver Type 1084 ☐

Why Q? – A Look at its Origins ☐

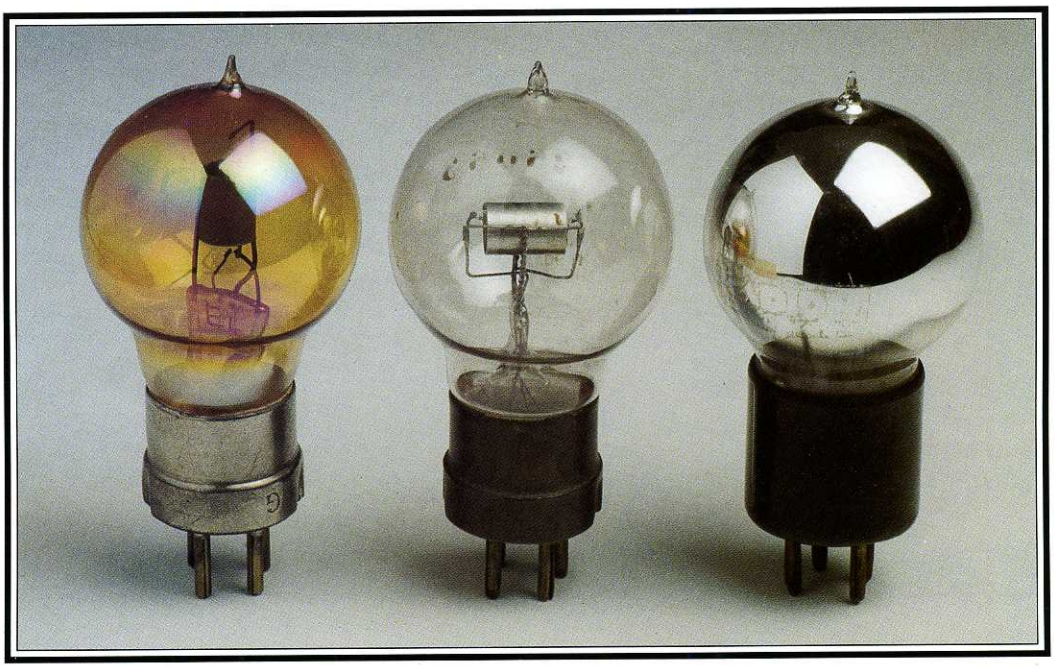
The Start of Wireless Broadcasting in the UK ☐



Two 'soft' valves from around 1916. On the left, the Round TF-HC-3F, a triode having three filaments completely surrounded by a cylindrical mesh grid. On the right is a White valve, used in the Mk III Amplifier intended for use with the Mk III Short Wave Tuner (see *RB* No. 2)

MUSEUM PIECES

This month featuring valves from the period 1910 – 1930, selected from the Historic Wireless Collection of Bill Journeaux of Poole, Dorset



Three examples of the R valve, one of the earliest 'hard' (high-vacuum) receiving valves. On the left, one with a vertical element arrangement. The maker is unknown, but the glass is marked 'Repaired by Radions Ltd'. The multi-coloured effect results from the use of a phosphorous getter. In the centre is the classic Osram R valve with horizontal element arrangement, and on the right a Radion version

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FOR INFORMATION ON OUR FRONT COVER PHOTO, SEE PAGE 7

Anyone who is involved in radio and electronics, either professionally or as a hobby, will sometimes be confronted with a piece of equipment for which no circuit diagram, service data, etc., is available. This is nowhere more true than in the vintage radio field. With a little experience and knowledge and a nose for technical detective work, it's usually possible to discover at least the outline of the circuitry.

The ability to recognise components is a necessity, of course, and generally not too difficult a task, though occasionally in old-fashioned sets you may come across a component in a strange guise. Study of well-illustrated early books and magazines on home construction is a particular help here. Modern components, too, can sometimes be a puzzle. I recall an occasion not many years ago, when I was totally baffled on first opening up a set containing a new pattern of tubular capacitors which looked exactly like resistors, right down to the colour-code bands!

Most vintage radio enthusiasts will be familiar with the appearance of valves (or tubes, to give them their transatlantic name), though you do come across one or two in a strange guise. The first time you encounter a Catkin valve, for example, may have you scratching your head! Recognising what sort a valve may be, simply by reading its type number markings, can be an enormous help in that detective work I mentioned earlier.

Some may be instantly recognisable, like well-known faces – PM1LF, PX4, X61M, EF39, 6K7, 807, VR150-30 and their ilk. I would agree that it's a lot easier when you've lived through the valve era; grown up with them, learning as you went along, as I have. The sheer number of different systems for allocating type numbers to valves and tubes is daunting for the newcomer, but it is well worth while learning at least the outline of the most common codes, and having tables and reference books to hand for the less common.

In this issue we begin a short series of features on valve type coding with details of European and US numbering systems. In succeeding issues, military equivalents will be the topic. I hope that you will find the information useful.

Geoff Arnold

In This Issue

News & Events

2MT Writtle Hut Moved

Readers of the *Daily Telegraph* of 4 September 1990 might have caught an article picked up from the local Essex press concerning the move of the original 2MT Writtle Hut.

Donated to the Kings Road Junior School in Chelmsford back in 1960, the 'original' 2MT Hut has ever since acted as their sports pavilion.

Considering its age and history the hut had survived reasonably well, although somewhere in the past seventy years it had lost some 20ft from one end and been re-roofed. To make way for a new building the hut was dismantled during the last week of July/first week in August 1990 and placed under cover in a council store.

Dr. Geoffrey Bowles, Industrial Museum Officer to the Essex Local Authority, explained that the eventual 'hope' is to restore and rebuild the hut (possibly indoors) as a permanent museum to the birthplace of British Broadcasting and indeed the BBC.

As a personal note I hope that this piece of radio history does survive the shifting fortunes of council budgets. I was pleased to have the opportunity to give several lectures in the hut last summer as part of the BVWS international meeting.

Having lived with the Writtle story for some years, being able to retell the story and playing Peter Eckersley's famous 'Hello CQ 2MT Wr-rrittle Calling' tape in the actual 2MT transmitter room will remain a vivid memory for the rest of my life. The atmosphere generated was nothing short of magic and for a while I could feel some ghosts listening in over my shoulder. I hope they find a permanent home. *Tim Wander*

Bank Holiday Fair

A **South West Vintage Communications Fair** is being held on Monday, 27 May 1991 from 10am – 4pm at Bampton Public Hall, off Brook Street, Bampton, Devon. Admission costs 50p, but children get in free. Bampton is 6 miles north of Tiverton on the A396, near Junction 27 of the M5.

The event is being held in conjunction with the opening of the Bampton Telephone Museum (just around the corner), which contains a wonderful collection of vintage and modern telephones and radios, plus TV, toys, ephemera and local history. Also in town will be a craft fair, with traction engines, vintage cars, country pubs, cream teas, etc. A great day out for all the family!

Kit Set?

Does anyone recognise the origins of this set which Dave Hooper picked up for a few pounds in a Dublin junk market. It appears to be home-made, possibly from a kit.

For Your Diary

Amateur Radio rallies and conventions can provide a useful source of equipment and components from bygone days, as well as their usual function of a sales arena for the more modern technology. You may like to make a note of the following events which are scheduled for 1991. Come along and meet the *Radio Bygones* team while you're there.

The **London Amateur Radio Show, Saturday March 9 and Sunday March 10.** Following the very successful first staging of this event in 1990, the venue will once again be the Picketts Lock Centre, adjacent to the A10 and A406 in North London and convenient to the M1, M11 and M25 motorways. Note the change of opening days, which now avoid the Friday traffic congestion in London.

Opening times are 10am to 6pm on the Saturday, and 10am to 5pm on the Sunday. Picketts Lock Centre is a large, bright, modern exhibition and sports complex, with free parking for 3000 cars.

The annual **RSGB National Convention** will be held on **Saturday April 27 and Sunday April 28** at the National Exhibition Centre, Birmingham. More details later.

The **Longleat Amateur Radio Rally, Sunday June 30.** This popular event will be held as usual in the grounds of Longleat House, Warminster, Wilts. A new departure for this year is the addition of a Craft Fair for 'the non-radio orientated members of the family'. More details later.

'The Vintage Radio Circle'

This is a group of enthusiasts who hold approximately four meetings a year in the Swindon, Wiltshire area. As well as a swapmeet, auction and bring-and-buy, early 405-line television is always represented with a working display.

Details of future meetings are available from Mr G. Williams, telephone 0285 885725.

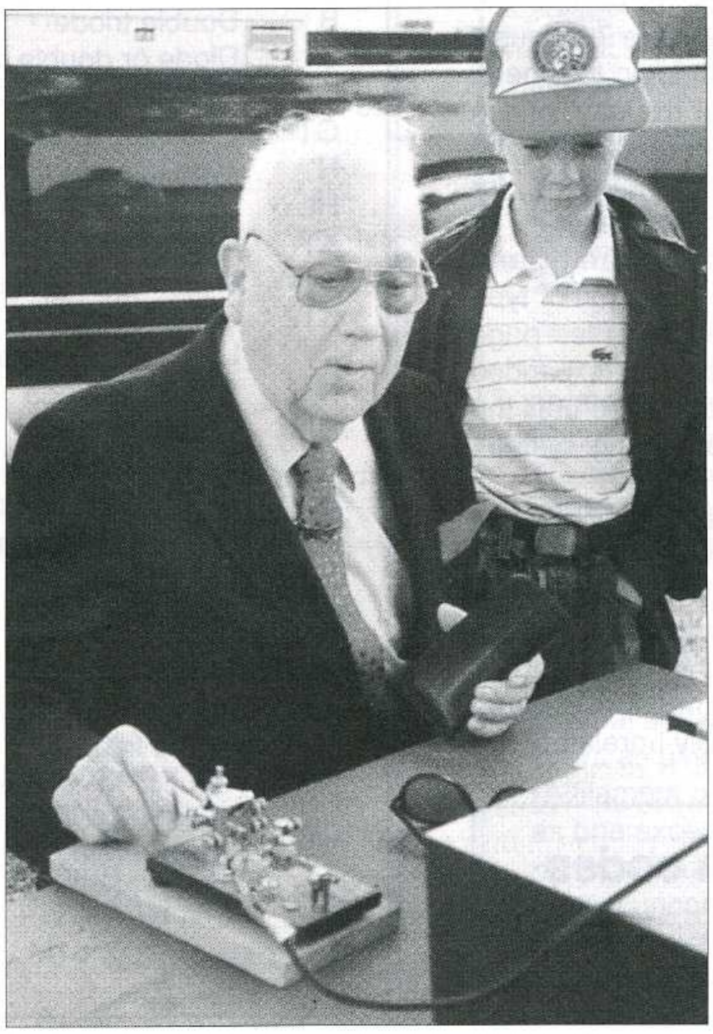
Code Runs in his Family

Samuel F. B. Morse III, holder of amateur radio callsign W6FZZ, can at the age of 87, still reportedly copy code at 60wpm, have breakfast and hold a conversation – all at the same time! The photograph (from *QST*, Journal of the American Radio Relay League, September 1990) shows him operating a special-event station at Orange, California celebrating the 199th birthday of his great-grandfather, the man who started it all for CW fans. Looking on is future radio amateur Joseph Adling, age 11, of Garden Grove, California, son of Paul N6JII.

During 1991, on April 27, we mark the 200th birthday of the first Samuel Finley Breese Morse, with many events planned in celebration around the world. The current issue of our sister magazine *Morsum Magnificat* has details of many of those events.

The next *MM*, due out at the beginning of April, will be a 'Bicentennial Special' containing authoritative articles about the great man himself and his original invention; the development of the code, from the numerical system of 1832 to the Continental version of 1850; plus many others covering various aspects of early Morse telegraphy. There will also be a last-minute round-up and reminder of all reported celebration activities.

All Morse enthusiasts should have a copy of this special issue on their bookshelves. Single copies may be obtained if required. See the *Morsum Magnificat* advertisement in this issue for details. Please tell your friends about it, or order them a copy as a gift!



Eddystone Users Group

The November/December 1990 issue of the EUG Newsletter has the 670 as the featured model, but there are also several pages of tips and hints on other Eddystone models, a Christmas crossword, and Part 1 of a history of the Stratton Company, originators of the Eddystone range.

As a result of the continuing growth in membership of the group, formed last year, plans are now being laid for its present photocopied newsletter to be transformed into a commercially printed magazine, hopefully during 1991.

Membership, including the bi-monthly newsletter, costs £7.50 in the UK and £10.00 sterling abroad. Cheques should be made payable to EUG. Further details (SAE please) from **W. E. Moore, 112 Edgeside Lane, Waterfoot, Rossendale, Lancs BB4 9TR**.

TV Bygones

If you're particularly interested in the vision side of vintage communications, you should be reading *405 Alive*, an established 64-page quarterly magazine for TV enthusiasts. It doesn't deal only with 405-line equipment, as the name might imply, but also with early 625-line and other standards too. Send an SAE for details or £2.50 for a sample copy, to **Andrew Emmerson, 71 Falcutt Way, Northampton NN2 8PH**.

Sound Retrieval

Do you have a recording of some past happening, family event or whatever, tucked away in a box or cupboard? Do you long to get it out and listen, to wallow in nostalgia for a brief while, but you no longer have the equipment to play it.

Your dilemma could be solved by a new audio transfer bureau set up by Philip L. Farlow. Philip has many years of experience as an audio technician in a government archive unit, and has now established his own business. He can handle sound retrieval from older formats such as acetate discs and ¼in reel-to-reel tapes, coping with problems such as warped and worn discs, tapes that have become brittle with age, or too out of shape to go through the usual guide assemblies. Even with the nightmare of tapes that have been spliced (albeit well meaningly) with Sellotape which has subsequently oozed out onto adjacent layers.

As Philip says, much valuable privately recorded material (including broadcast) is at present in danger of being lost for ever if not transferred to a more stable format. Some of that material is literally 'one-off', having been chance-recorded over the years.

If you have old recordings that you would like to preserve, why not have a chat with Philip Farlow at **Audio Services, 41 Glebe Gardens, New Malden, Surrey KT3 5RU, telephone 081-942 6788**.

Where is it? - No. 5

A better response to the puzzle picture in our last issue, but then it has appeared in many places before! It was of course Marconi's experimental station at the Haven Hotel in Sandbanks, Poole, Dorset, as it appeared in 1900.

First entry out drawn of the Editor's hat came from Mr H. E. Chamberlain of Newark-on-Trent, who wins a one-year subscription to *Radio Bygones*. Another puzzle in our next issue.

Radio Valves and Tubes – 1

Numbering Systems

by Geoff Arnold

In the pioneering days of radio, the stage was soon reached where the latest valve to emerge from the laboratory could no longer be adequately identified by the name of its inventor, or some fancy name dreamed up by him. Beginning with just a single letter, valve type numbers were born!

It is fascinating to try to divine the reasons behind the selection of those earliest numbers. Many were obviously chosen quite arbitrarily, but there is a certain logic to others. Some are well documented in the records of the day, or are glaringly obvious from the study of advertisements, etc. The prefix 'DE' for dull emitter valves from the MO Valve Co., for example. But why on earth 'FE' for their bright emitters?

Among the first attempts to bring some sanity and standardisation into the whole affair were the systems of type numbering devised by the British Armed Services (see page 8) around the end of the First World War. These were expanded to take account of new devices, and remained in use until the introduction of the 'CV' (Common Valve) numbering system, first published in December 1944.

It was inevitable that numbering systems devised by different manufacturers or official bodies should clash. Perhaps one of the most confusing examples is the prefix 'VT'. In the RAF system it indicates 'Valve, Transmitting', in the British Post Office system, 'Valve, Thermionic', and in the system used by the US Army from 1917 to about 1943 it stands for 'Vacuum Tube'. Numbers in the three systems are totally unrelated.

Miscellaneous early British codes

A selection of some of those codes from the era of British 4, 5 and 7-pin based valves, and also Mazda Octals. Some codes were used by one manufacturer only, some by more than one.

We have tried to limit this table to those codes that, in general, always had the same meaning, though some had different shades of meaning under different brand names. Sometimes code letters were combined to identify a multiple valve, for example the AC/2PenDD, a double-diode output pentode with 4V heater from Mazda.

AC	4-volt heater
D	Single or double diode
DD	Double diode
DDT	Double-diode triode
FC	Frequency changer
H	High-impedance triode
M	4-volt heater
ME	'Magic eye' tuning indicator
Pen	Output pentode
PM	Philips/Mullard
PP	Power (output) pentode
PT	Output pentode
R	Full-wave rectifier
SP	Straight RF pentode
TH	Triode-heptode or triode-hexode
TP	Triode-pentode
U	Rectifier (usually half-wave)
UU	Full-wave rectifier
VP	Variable-mu RF pentode

GEC/Osram/MO Receiving valves

(i) Construction

A	Valve for specialised industrial application
B	Double triode
D	Diode or double diode
GU	Gas-filled rectifier
GT	Gas-filled triode (thyratron)
H	High impedance triode
HL	Medium impedance triode
KT	Kinkless tetrode (beam tetrode)
KTW	Vari-mu RF kinkless tetrode
KTZ	Sharp cut-off RF kinkless tetrode
L	Low impedance triode
N	Output pentode
PX	Output triode
U	Rectifier
W	Vari-mu RF pentode
X	Frequency changer
Y	Tuning indicator
Z	Sharp cut-off RF pentode

(ii) Serial number

- One figure for early valves
- Two or three figures for later valves

NOTE – Suffix 'M' indicates external metallising

eg:

(i)	(ii)
B	309
KTW	63
X	61M

MAZDA Receiving valves

(i) Filament or heater rating

1	1.4V
6	6.3V
10	100mA
20	200mA
30	300mA

(ii) Construction

C	Frequency changer with special oscillator section
D	Signal diode(s)
F	Voltage amplifier tetrode or pentode
K	Small gas triode or tetrode
L	Voltage amplifier triode or double triode, including oscillator triode
M	Tuning indicator
P	Power amplifier tetrode or pentode

NOTE – two letters may be used for multiple valves

(iii) **Serial number**

- One or two figures

eg:

(i)	(ii)	(iii)
6	F	13
30	FL	1

PRO-ELECTRON/European Receiving valves

Pro-Electron, based in Brussels, is a European organisation which maintains registers and allocates type numbers for valves and semiconductors. Once they have been registered by one manufacturer, other manufacturers can 'second-source' devices to the same specification and with the same type number.

(i) Filament or heater rating

A	4V
B	180mA
C	200mA
D	0V–1.5V *(previously 1.4V)*
E	6.3V
F	12.6V
G	Misc. *(previously 5V)*
H	150mA
K	2V
L	450mA
P	300mA
T	7.4V
U	100mA
V	50mA
X	600mA
Y	450mA

(ii) Construction

A	Diode (excluding rectifier)
B	Double diode with common cathode (excluding rectifier)
C	Triode (excluding power output)
D	Power output triode
E	Tetrode (excluding power output)
F	Pentode (excluding power output)
H	Hexode or heptode (of the hexode type)
K	Octode or heptode (of the octode type)
L	Power output tetrode or pentode
M	Tuning indicator
N	Thyratron
Q	Nonode
Y	Half-wave rectifier
Z	Full-wave rectifier

NOTE – For multiple valves, 2 or 3 letters may be used, in alphabetical sequence

(iii) Base type

1	Miscellaneous
2	B10B *(previously B8B/B8G (Loctal))*
3	International Octal
4	B8A (Rim-fit)
5	B9D (Magnoval) & Noval *(previously B9G)*
6	Various sub-miniature or wired-in bases
7	ditto
8	B9A (Noval)
9	B7G (Miniature 7-pin)

(iv) Serial number

•One figure for early valves
•Two figures for later entertainment valves
•Three or four figures for later professional valves.

NOTE – In some 3-figure type numbers commencing with a '1', the second digit indicates the base type

eg:	(i)	(ii)	(iii)	(iv)
	E	F	9	1
	G	Z	3	0
	P	CL	8	2
	U	Y	4	1

USA RMA Receiving valves

This coding scheme, and the one on the following page for Special-purpose Tubes, were devised by the Radio Manufacturers Association (RMA), now renamed the Electronic Industries Association (EIA).

(i) Filament or heater rating

0	Cold cathode
1	Up to 1.6V
5	4.5–5.6V
6	5.6–6.6V
7	5.6–6.6V with Loctal base

•Above this, figures represent the nominal working voltage

NOTE – For tapped filaments or heaters, the figure indicates rating with sections in series

(ii) Serial & code letters

•Allotted in sequence commencing with A (omitting I and O). Rectifiers follow the sequence backwards commencing at Z.
•When all the single letters are exhausted, the sequence continues using two letters commencing with AB (combinations of identical letters are not normally used).
•Single-ended valves usually have the first letter S. The second letter may be that of the nearest equivalent double-ended valve.
•The initial letter L indicates a lock-in type in the battery range.

(iii) Number of 'Useful elements' brought out

•Metal valve envelopes, lock-in metal bases and internal screens on separate and exclusive terminals count as useful elements.
•A filament or heater, whether single or tapped, counts as one except for unequally-rated tapped sections.
•In octal-based glass valves, count pin No. 1 as one, even if unconnected.
•Combinations of elements connected to the same pin count as one

(iv) Suffix letters

•A, B, C, etc., indicate a later/modified version which can be substituted for a previous one but not vice-versa.
•W indicates a military version.
•X indicates a low-loss base.
•Y indicates a medium-loss base.
In Octal valves, the envelope type is indicated as follows:
•G indicates a large glass bulb.
•GT indicates a smaller glass tube.
•M indicates a metal-coated glass bulb.
•No-suffix indicates a metal envelope

eg:	(i)	(ii)	(iii)	(iv)
	0	Z	4	
	5	R	4	GY
	6	SN	7	GT
	25	L	6	

In the examples given in these tables, the spaces between the various parts of the type number are included to emphasise the relationship of each part to the listed codes. Normally, the type numbers are printed without spaces.

USA RMA Special-purpose valves

(i) Filament or heater rating (watts)

1	Cold cathode/no filament or heater
2	Up to 10W
3	>10 to 20W
4	>20 to 50W
5	>50 to 100W
6	>100 to 200W
7	>200 to 500W
8	>500 to 1000W
9	>1000W

(ii) Type of device

A	Single-element (ballasts, vacuum resistors, etc.)
B	Diode (including protective tubes, voltage regulators, etc.)
C	Triode
D	Tetrode
F	Hexode
G	Heptode
H	Octode
J	Magnetically controlled (magnetron)
K	Electrostatically controlled (klystron)
L	Vacuum capacitor
N	Crystal rectifier *(later used for all solid-state devices)*
P	Photo-emissive
Q	Cavity
R	Ignitron, pool tube
S	Switch
T	Storage, radial beam
V	Photoflash
W	Travelling-wave
X	X-ray
Y	Thermionic converter

NOTE – Although allocated, letters T – Y were probably never used

(iii) Serial number

•A 2-figure number assigned sequentially, beginning at 21 to avoid confusion with RMA receiving valves

eg:	(i)	(ii)	(iii)
	2	C	43
	2	K	25

This code was used from about 1942 to 1950, and was superseded by a system of simple 4-digit numbers.

It found a new lease of life with the arrival of the transistor. The first number was re-defined: '1' had always applied to crystal diodes, '2' now covered triode transistors, '3' described tetrode or dual-gate transistors, and '4' or '6' referred to multi-lead devices like diode-phototransistor opto-isolators.

The '1N' numbers reached about 1N6300; '2N' about 2N6800, '3N' about 3N260, '4N' about 4N50, '6N' around 6N140. A changeover to non-registered (manufacturer-assigned) numbers slowly occurred, and was largely complete by the time integrated circuits arrived.

The above data is based on an article which appeared in the October 1990 issue of *The Old Timer's Bulletin*, official journal of the Antique Wireless Association, Inc., of America, by kind permission.

MULLARD Transmitting valves (old system)

(i) Functional class

B	Backward-wave tube
J	Magnetron
K	Klystron
L	Travelling-wave tube
M	LF amplifier or modulator triode
P	RF power pentode
Q	RF power tetrode
R	Power rectifier
T	RF power triode
X	Large thyratron

NOTE – Two letters may be used for multiple valves

(ii) Structural property

A	Backward & travelling wave tubes, output <1W
B	Backward & travelling wave tubes, output ≥1W
D	Disc-seal construction
G	Mercury-vapour filled
H	Hydrogen-filled
N	Magnetron (external magnet)
P	Magnetron (packaged magnet)
R	Inert-gas filled
S	Klystron (reflex type)
T	Klystron (multi-resonator)
V	Indirectly-heated, oxide-coated cathode
X	Directly-heated tungsten filament
Y	Directly-heated, thoriated-tungsten filament
Z	Directly-heated, oxide-coated filament

(iii) Rating (1)

•Approx. V_a in kV* for transmitting valves and rectifiers (peak voltage for pulse valves)
•Approx. PIV in kV* for thyratrons
•Approx. operating frequency in GHz for microwave devices

***NOTE** – Below 1kV, zero followed by a figure indicating hundreds of volts. For example, 06 = 600V

(iv) Rating (2)

•Approx. maximum anode dissipation in W for transmitting valves (total for all sections in multiple valves)
•Max. I_{pk} in A for pulse transmitting valves, prefixed by P
•Output power in mW or W for backward and travelling-wave tubes.
•Pulse output power in kW for magnetrons
•Output power in mW for klystrons
•Output current in mA for rectifiers
•Max $I_{A\ MEAN}$ in mA for thyratrons

(v) Suffix

•A letter (A, B, C, etc.) indicating a later design or development

eg:	(i)	(ii)	(iii)	(iv)	(v)
	K	S	9	- 20	A
	QQ	V	06	- 40	A
	Q	Y	3	- 125	

In the examples given in these tables, the spaces between the various parts of the type number are included to emphasise the relationship of each part to the listed codes. Normally, the type numbers are printed without spaces.

MULLARD Transmitting and industrial valves (new system)

(i) Class

X Photo-sensitive tube
Y Vacuum valve or tube
Z Gas-filled valve or tube

(ii) Construction

A Diode
C Trigger tube
D Triode or double triode
G Miscellaneous
H Travelling-wave tube
J Magnetron
K Klystron
L Tetrode, pentode, double tetrode or double pentode
M Cold-cathode indicator or counter tube
P Photo-multiplier or radiation counter tube
Q Camera tube
T Thyratron
X Ignitron, image intensifier or image converter
Y Rectifier
Z Voltage stabiliser

(iii) Serial number

•A group of 4 figures. The final figure is 0 for the basic tube, changing to 1, 2, 3, etc., for variants

eg: **(i) (ii) (iii)**

Y L 1130

Special Quality valves

These are electrically similar to a number of standard types, but have improved mechanical construction to reduce microphony and vibration failures. They are also more closely controlled in manufacture and testing.

NUMBERING SYSTEMS

USA

•System 1: A 4-figure reference number. For example, a 6060 is a special quality 12AT7

•System 2: The RMA system followed by the suffix W indicating a military type. For example, a 12AT7WA is a special quality 12AT7.

Marconi-Osram

•The prefix Q is added to the standard type number. For example, the QZ77 is a special-quality Z77.

Mullard

•System 1: Uses the Pro-Electron code, but with the figures for base type and serial number placed after the letter for filament or heater rating. For example, the E88CC is a special quality ECC88.

•System 2: An initial letter M followed by a 4-figure serial number. For example an M8083 is a high-quality EF91.

UK Military

•Most special quality valves used in military equipment have 'Common Valve' numbers in the CV4000 group.

Voltage stabilisers

As for other types of valve, a wide range of different numbering systems have been used. For shunt gas-filled stabilisers, among the most commonly encountered are:

USA

•System 1: The prefix VR followed by two numbers separated by a dash or an oblique stroke, depending on manufacturer. The first number indicates the nominal working voltage and the second number indicates the maximum rated current. For example, a VR150-30, a 150V stabilisiser with a maximum current of 30mA. Presumably because of improvements in design or manufacture, the VR150-30 was later uprated to 40mA maximum current, without a change of type number.

•System 2: Based on the RMA Receiving valve system, the type number for more recent tubes begins with the figure 0 (indicating a cold-cathode tube), followed by a reference letter, followed by the figure 2 for simple 2-electrode tubes or the figure 3 for tubes incorporating a primer electrode or link. For example, the 0D3, a VR150-30 under its new name!

•System 3: This was apparently a transitional system, combining the first two, under which the VR150-30 became an 0D3/VR150.

UK

•System 1: The prefix QS followed by two numbers separated by an oblique stroke. The first number indicates the nominal working voltage and the second number indicates the maximum rated current. For example, a QS150/40, a 150V stabilisiser with a maximum current of 40mA, equivalent to the 0D3.

•System 2: The prefix QS followed by a 4-figure serial number. For example the QS1215.

•System 3: A number, followed by a single letter (A, B, C, etc.), followed by a single figure. The first number indicates the nominal working voltage. The remainder of the type number has no apparent significance. For example, the 150C3 (equivalent to our old friend the OD3).

Our front cover picture

On the left, an Audion of US manufacture dating from about 1914, bearing an original label stating 'Audion Amplifier, 3½ volts, Hudson Filament, for second & third step only, Pat. Feb. 18, 1908'.

The Hudson filament used fine tantalum wire wrapped around a tungsten filament to form a cathode in which the tungsten carried the current to heat the tantalum, which was an efficient emitter of electrons. The tungsten wire was more mechanically robust than the plain tantalum wire previously used for the filament, which had a tendency to warp out of its original plane, in some cases touching the grid and rendering the valve useless.

On the right of the picture is a Naval triode Type NT.9X of about 1920, manufactured by the MO Valve Co. Ltd, GEC, and bearing the crown and anchor badge. The filament connections are made via the E12 screw base and two wires stretching up the outside of the valve to the top.

British Armed Services valves

Prior to the introduction of the Common Valve (CV) Register, each of the three British Armed Services had its own type numbering system. Although there was a certain similarity between them in the abbreviations used, there was no correspondence whatever between the serial number suffixes issued to the same valve when used by the three services.

The 'Construction' prefix reveals in each case what the main application of the valve might be. However, as in any system which aims to sort items into categories, there were the inevitable 'grey areas', so that some receiving valves were allocated VT numbers by the RAF. The prefixes are self-obvious, except for the use of 'U' as an identifier for rectifiers, necessary since 'R' has already been used to indicate 'receiving'. It stood for 'uni-directional' – obvious when you know!

Royal Navy

Construction

NGT	Gas triode
NR	Receiving
NS	Stabilising/regulating
NT	Transmitting
NU	Rectifier
NC	Cathode ray tube

Serial number
Assigned sequentially, beginning at 1

Army

Construction

ACR	Cathode ray tube
AR	Triode or triode with diode(s)
ARD	Diode
ARDD	Double diode
ARH	Hexode or heptode
ARP	Pentode
ARS	Screen grid (tetrode)
ARTH	Triode hexode
ARTP	Triode pentode
AT	Transmitting triode
ATP	Transmitting pentode
ATS	Transmitting tetrode
AU	Rectifier
AW	Stabiliser or tuning indicator

Serial number
Assigned sequentially, beginning at 1

RAF

Construction

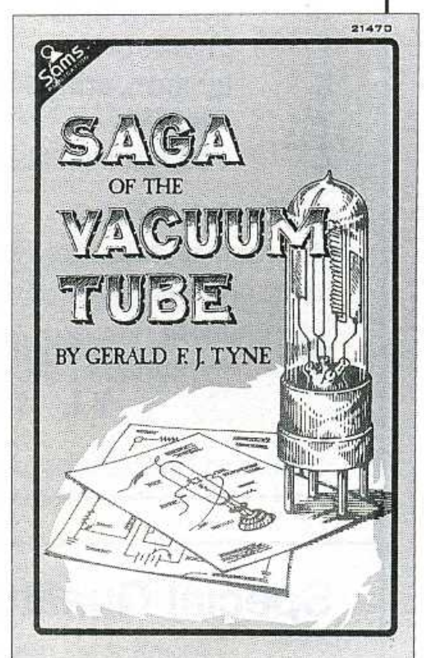
VCR	Cathode ray tube
VGT	Gas triode
VI	Neon or tuning indicator
VR	Receiving
VS	Stabiliser
VT	Transmitting
VU	Rectifier
VW	Wavemeter (?)

Serial number
Assigned sequentially, beginning at 1

Numerical systems

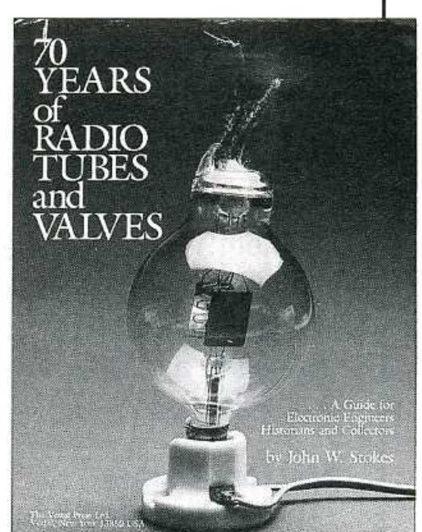
In valve type codes comprised exclusively of figures, the numbers are merely serial numbers and have no hidden significance. In the 1920s, American valve manufacturers produced the same valve under different type numbers such as 145, 245, 345, etc. From about 1930, the first figure was dropped, and the valve was known by only the two latter figures, regardless of manufacturer.
More recently, special-purpose valves manufactured in the United States (and elsewhere to similar specifications) have been allotted 4-figure type numbers (see also the item on Special Quality valves).

Further Reading



Valve data-books are hard to come by nowadays. Enthusiasts should certainly have at least one edition of the Wireless World/Iliffe *Radio Valve (and Transistor) Data* on their bookshelves, plus any manufacturers' data-books that they can lay hands on at second-hand book shops, sales or radio rallies.

For an in-depth treatment of the development of radio valve technology, I would recommend two books. First, *Saga of the Vacuum Tube* by Gerald F. J. Tyne, published by Howard W. Sams, Inc., Indianapolis – a wealth of information and photographs covering developments world-wide up to 1930, and with an excellent index. Second, *70 Years of Radio Tubes and Valves* by John W. Stokes, published by The Vestal Press Ltd., New York – again, an enthralling work covering the period up to the years after WWII. I just wish it had a more comprehensive index.



Both these titles contain further information on early valve type numbering.

Towards the Modern Era...

Are you, too, fascinated by valve numbering systems and the thinking behind them? Do your interests also extend to semiconductor equipment?

If so, see the April 1991 issue of *Ham Radio Today* magazine, due out on UK newsagents' shelves on March 1st, for an article on transistor and diode numbering systems.

Geoff Arnold

The Vintage Years of Amateur Wireless
Part 7
by Stan Crabtree

In the early weeks of 1910 Mr W. J. Shaw of Twickenham had virtually taken over as the most knowledgeable exponent on experimental wireless in the *English Mechanic & World of Science*. In the January 14 issue he wrote: 'Any *English Mechanic* correspondents with wireless telegraphy stations within 20 miles of Twickenham – let me know. They could give a call for the purpose of enabling adjustments to be made as I can tell pretty well by ear how the spark should sound.'

Two constructional articles in the *Model Engineer* in January still gave the amount of wire needed to build a spark coil in weight. Specifying a value in inductance had still not caught on. The fact that the possession of a load of wire was assumed to be halfway in getting the owner on the air seems to have been the reason for a rather inane letter from 'DET' in an April issue of the *English Mechanic & World of Science*. 'DET' wanted 'drawings and particulars of different parts of wireless apparatus suitable for a distance of five miles'. The writer admitted he had 'little knowledge of wireless work but fairly good mechanical and electrical knowledge.' What had apparently kindled the idea of experimenting with wireless was the fact that he already possessed some material. This came to light when he mentioned: 'I have a quantity of copper wire varying from 23 to 40 gauge!'

In general the experimenters appeared to be quick to catch on to the latest innovations in the art of wireless. This is surprising as there are no records of any wireless clubs in operation at this time, although there may well have been a few 'wireless' men forming a group within an existing model engineering club. Expertise and knowledge was gained by keenly scrutinising the related journals giving space to wireless telegraphy articles and if necessary submitting letters describing any problems. One chap who may well have been a late developer was 'EWB' (Stow Bardolph) who wrote in a March edition of the *Model Engineer* asking if it was necessary for two stations to be at the same elevation before they could communicate with each other!

G. G. Blake, respected writer and historian of wireless telegraphy at this time, contributed an interesting article to a March edition of the *Model Engineer* in which he discussed various means of measuring the current in the aerial. These ranged from an inductively coupled pea-lamp to a rather novel, home constructed hot-wire ammeter using a 3in length of Eureka wire (**Fig. 1**). Blake explained that the meter was used by connecting it between the transmitting inductance and earth. But he warned that once the apparatus had been tuned up the meter must be short circuited 'with a piece of good stout wire' or else disconnected altogether and the inductance connected directly to earth. Apparently with the meter left in circuit the Eureka wire would 'damp the current and so weaken the signals!'

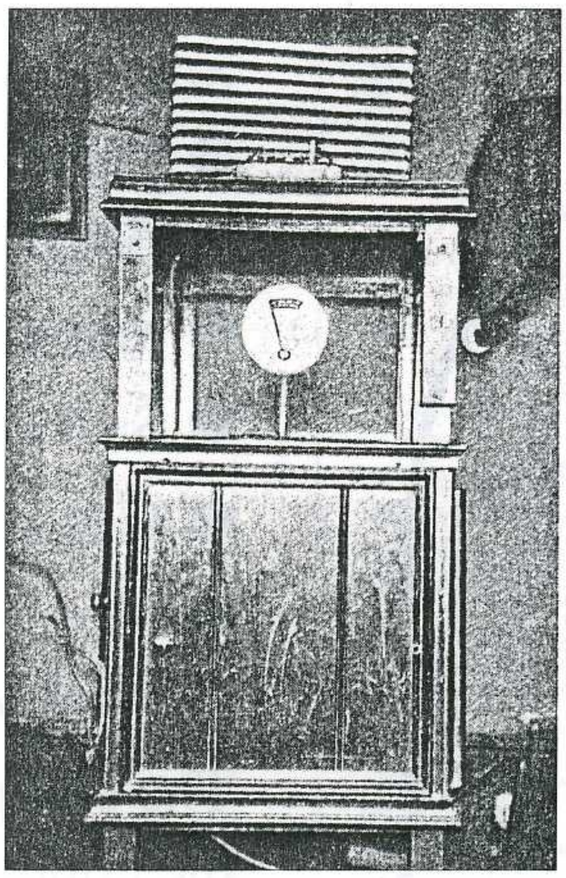


Fig. 1 - The cabinet holding G. G. Blake's station. The aerial inductance is on the top with the experimenter's home built hot-wire ammeter positioned just below it

The electrolytic detector and various forms of crystal seem to have almost completely replaced the coherer for receiving wireless signals in amateur stations at this time. However, Arthur E. R. Bottone, following in his father's footsteps, continued to extol the virtues of the coherer and its ancillary devices, possibly because of a large stock of unsold items, wasting away in the cellar of his Wallington shop since his father's day. Replying to a question from 'BM' in an April, 1910 edition of the *English Mechanic* he ended with the observation. 'Using a crystal substance and telephone detector you will of course only hear faint clicks ... if you wish to copy messages you must use a decent coherer, relay and Morse inker.' In effect he was pointing out that whereas the coherer had been the lazy man's passport to wireless, with any other type of detector a knowledge of the Morse code was needed.

'Freeman Lee', writing in a February 1910 issue of the *Model Engineer* gave a summary of what was achievable at this time for the average station. The information was given in reply to 'LC' (Ramsgate) who wrote in the *Model Engineer* querying some points on tuning. Freeman Lee first suggested that 'LC' should disregard altogether the filing coherer for long distance work. In its place he recommended the electrolytic detector or detectors using molybdenum, silicon or Carborundum. With these detectors a distance of 3000 miles should be covered with quite simple apparatus. This is interesting, if it was in fact true, as it implies that apart from Eastern Europe, the occasional American East Coast station may have been copied; and certainly the North Atlantic passenger liners. An essential component in the station using this type of detector was a pair of high resistance telephones; the emphasis had shifted from the sensitivity in the rectifying device to the sensitivity of the reproducer. It was recommended that telephone earpieces having a resistance of between 1000Ω and 3000Ω should be used for best results.

A Mr E. Daubney seems to have taken some time to digest this information and then finally got hold of the wrong end of the stick. In a letter to the *Model Engineer* of April 21 he refers to the February issue and asks for information on how to use the electrolytic detector and details on the length of spark required to cover a distance of 3000 miles! The editor must have contacted Freeman Lee immediately as the latter's comments appeared in print below the question. He pointed out that when he mentioned a distance of 3000 miles he was referring to the reception of wireless waves only. To transmit this distance a spark coil would not be suitable; the greatest attainable range being about 100 or so miles with a 10in or 12in coil. For greater distances it was necessary to use transformers to work directly from the electric supply mains. To make his point, Freeman Lee stressed that the cost of transmitting plant for any given distance was much greater than the plant for receiving over the same distance. He ended with: 'A station to receive 100 miles can be constructed for £4 but efficient apparatus to transmit this distance could cost up to £30.'

Freeman Lee gave a lucid description of a simple crystal detector which is shown in **Fig. 2**. He also went on to describe a tuner for amateur use. This consisted of a circular block of well-seasoned wood, 12in long by 3in diameter. This was wound with No. 24 gauge, silk-covered copper wire 'well insulated with paraffin wax.' A ½in wide strip along the length of the coil is bared of insulation in order that a slider, fitted on a rod supported ½in away from the length of the coil, is able to make contact with the turns at any point.

'EHL' (Bexley) writing in the same edition queried the requirements for two stations to work over a distance of 1¼ miles. He wondered if 30ft high aerials would suffice and the use of a 1in spark coil. He wanted if possible to 'do away with tuning' as 'my pocket is very limited and I want to do the above at as small expense as possible.'

The editor replied that all his suggestions appeared to be in order. He also agreed that worries about coils could be ignored as 'tuning is hardly suitable for amateurs!'

The situation in the USA was viewed with some concern by the editor of the *Model Engineer* in his column of 7 April 1910. He reported that American amateurs were acquiring a terrible reputation by interfering with government wireless stations. He quoted from a report in the *Boston Herald* which said that some amateurs 'absolutely refuse to give way' to government and commercial stations near Boston and there was apparently nothing that could be done about it.

The newspaper listed amateur station 'R' owned and operated by Ralph A. Wood of Cambridge, Massachusetts as continually calling ship stations, commercial and Navy. Some of the language, it was claimed, was 'displeasing' and it was hinted that some of the commercial operators might find it necessary to settle the matter with Mr Wood personally!

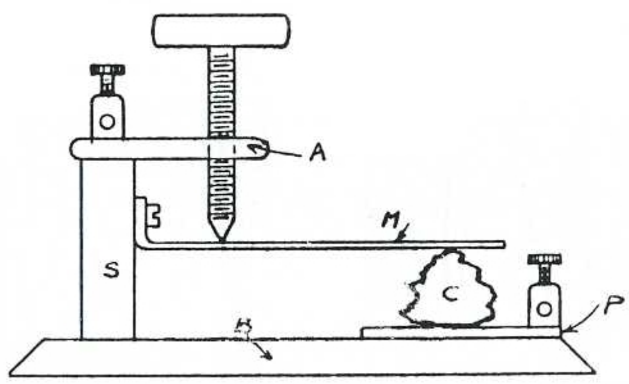


Fig. 2 - Freeman Lee's crystal detector. The unit is mounted on an ebonite base B, which supports a pillar S also of ebonite. A brass top piece A carries a thumb-screw which regulates the pressure of the brass spring M on the crystal substance C. The crystal rests on a copper plate P which also holds a terminal

Another report told of a derelict ship *Henry B Fiske*, upside down and being towed to Acushnet by the relief vessel *Gresham*. There was a need for further assistance to get both vessels out of the path of the transatlantic liners but interference prevented the *Gresham* from communicating with the Navy Yard. The Navy asked the *Boston Herald* which sported a wireless telegraphy system to ask four amateurs to 'clear the air' but urgent appeals appeared to fall on deaf ears. At one stage, the amateur working dropped off for a few minutes but just when it seemed the *Gresham* would be picked up an amateur would break in with: 'You finished yet?'

The editor of the *Model Engineer* was obviously aghast at this report and as may be expected he concluded:

'From the foregoing it seems likely that some decided measures will be taken by the authorities to limit the operations of amateur workers, a step which does not seem to be altogether needless. We do not think that the amateur wireless stations of this country have given much trouble, and we doubt if they are likely to do so under the system of official licensing to which they are subjected.'

At this time, of course, there was no legislation restricting the use of wireless in the United States and this state of affairs was to continue until the Alexander Bill was signed by President Taft in August 1912.

Wireless had now reached the stage where it was generally accepted by the public. It was no longer a mysterious knowledge put to use by a learned few. How it worked was not so important as what it could achieve. An example of this is the rather frivolous antics of some of the North Atlantic liners. A newspaper report in June of that year published the fact that the chief officer on the Cunard liner *Ultonia* had beaten the third officer of the Austrian steamship *Laura* in a game of chess. It was emphasised that there was no sighting between the two vessels. The fact that this could only have taken place with the acquiescence of the respective ships' wireless operators must have made the public envy the role of those fortunate to be a member of this new profession.

During May and June of 1910, all holders of experimental licences were allocated their individual callsigns. In the letter, amateurs were told they should begin their signal with the callsign of the station they wished to communicate with and end with their own call signal. With the death of Edward VII the Edwardian era came to an end in 1910 and the courtesy in correspondence has deteriorated ever since. As an example, note this opening text from a Government Department to a member of the public:

'The Postmaster General proposes, if you have no objection, to allot to your station the call sign 'X' and he will be glad to have an assurance that you will employ the appropriate signal in the manner indicated above.'

All calls were of three letters and ended in 'X'. Amongst those issued was 'TWX' to correspondent Mr W. J. Shaw of Twickenham.

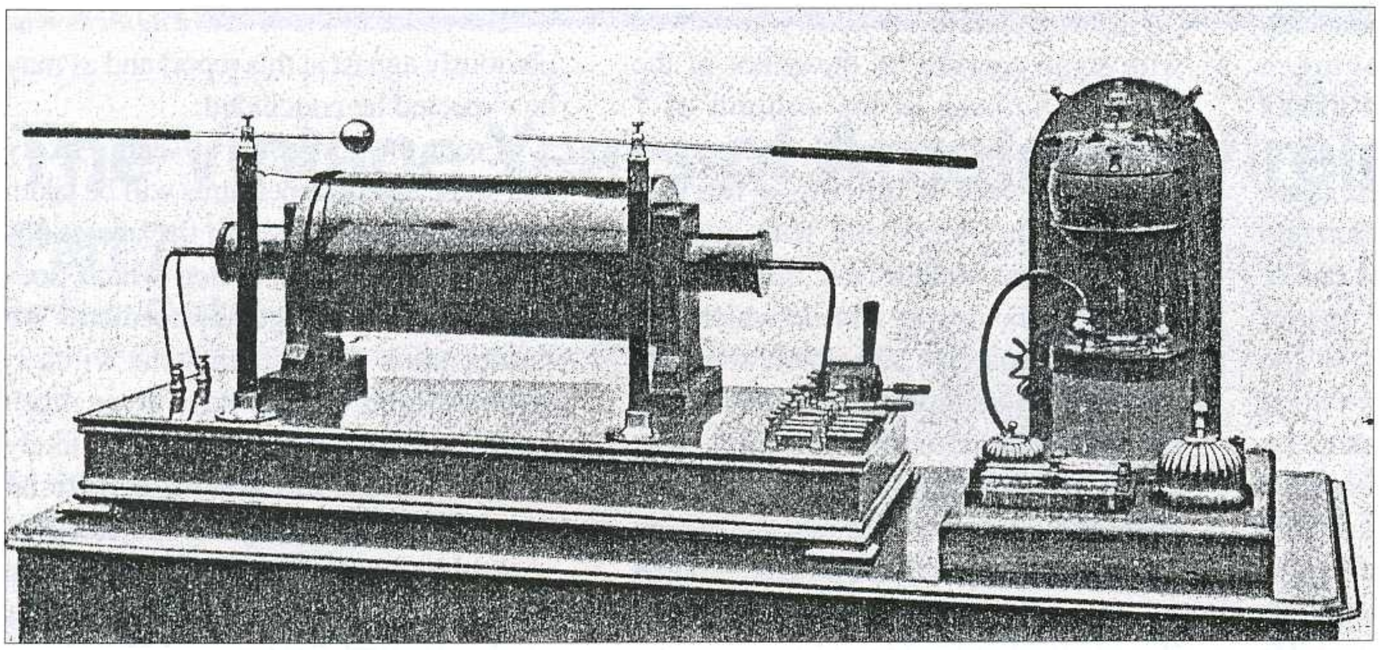


Fig. 3 - Mr Ernest P. Farrow's 12 inch coil and turbine interrupter

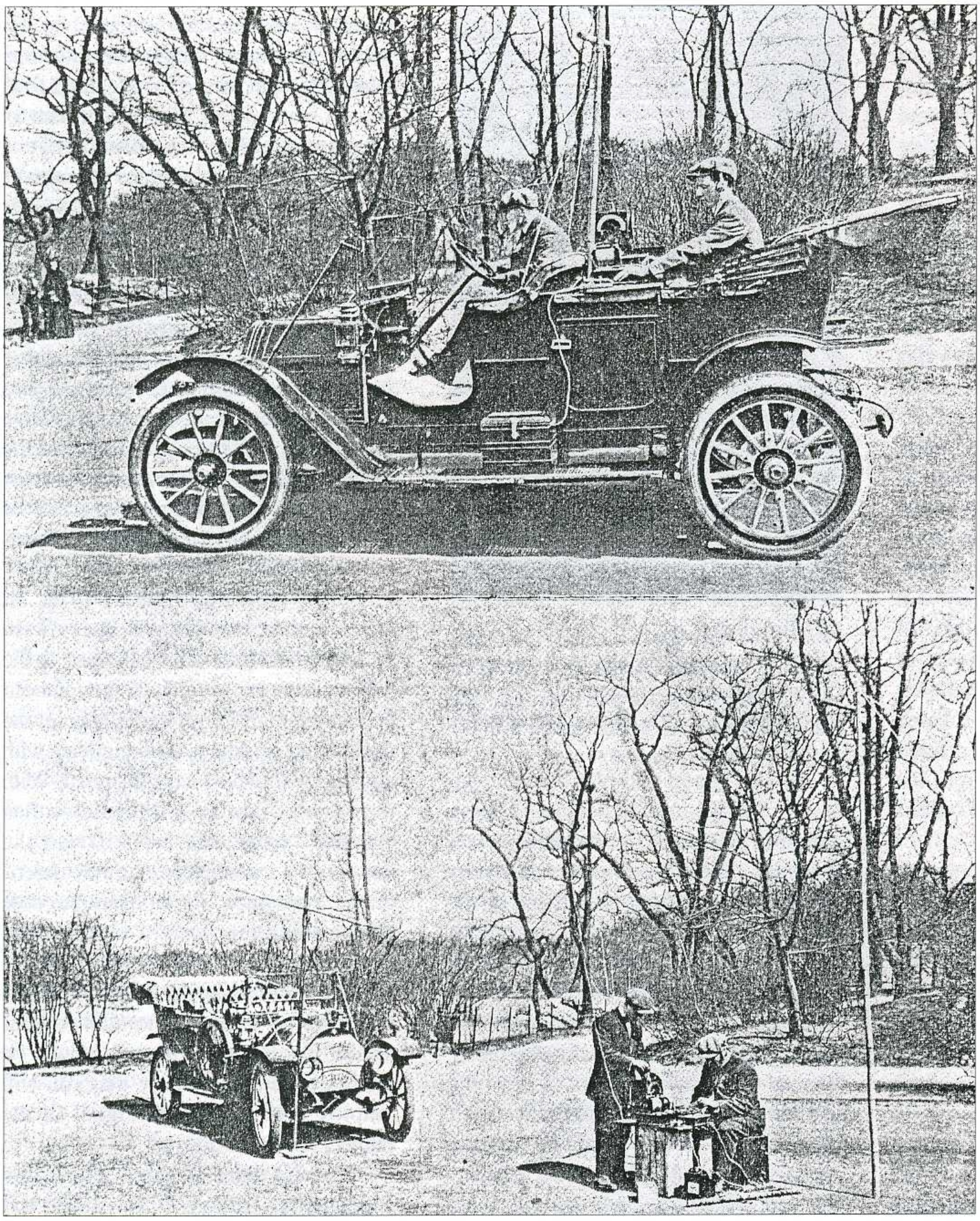


Fig. 4 - An American motor-car fitted with wireless telegraph apparatus

In the May 12 edition of the *Model Engineer*, author Ernest P. Farrow described briefly his 12in Spark Coil with Variable Primary and Condenser. The coil unit was mounted on a base of polished pitch pine (**Fig. 3**). After diligent construction, adequate 'drying and waxing' and the use of 'Ford's medium blotting (paper) between adjacent sections' of the windings the apparatus was tested. Although a 'full and continuous 12" spark' was obtained some of the sections ran very hot, melting the outer wax layer.

This was eventually traced to sparking along their inner turns. Bad sections were rewound and the apparatus was later found to be able to handle 15in sparks without running warm.

The coil was worked off a private 25 volt lighting circuit in conjunction with a home made direct coupled turbine interrupter which gave an 'extremely rapid sequence of interruption.'

At this time our American cousins, unrestricted by legislation, were expanding wireless applications in different directions. One of these was illustrated in the May 19 edition of the *Model Engineer* and showed the advantages of having a portable wireless telegraphy set added to a motor car. It would, it was claimed, enable the owner to keep in constant communication either with his home or with any other wireless station.

It reported that many prominent American car owners were now having their cars suitably fitted up. From the photographs (**Fig. 4**) it is not clear whether the car is chauffeur driven with the owner operating the wireless or the owner is at the steering controls and enjoying the benefit of his personal wireless operator!

RB

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The closing date for adverts to appear in our next issue, due out on 26 March 1991, is March 7.

WANTED

Chart or good copy of WWII 'McElroy Chart of Codes and Signals' as used by radiomen of the armed forces. Reference *ARRL Handbook* 1944. Information please to F. B. Greenall G7CBX, 24 Trelissick Road, Hayle, Cornwall TR27 4HY.

Instruction card or copy for BTH Type C Form A; other early wireless equipment; Fleming or other valves; Marconi Yearbook; penpals. Marc Gottlieb, Box 1112, South San Francisco, California CA 94083-1112, USA.

Regularly attending jumble sales/car boot sales looking for early radios, equipment, books. Perhaps I could seek your wants; send a list! Gordon Holme, 4 Nares Street, Scarborough, N. Yorks YO12 7RR.

Details of coils for National One-Ten receiver. Also early crystal set and 1920/30s receiver and parts. W. H. J. Yeo G2CVY, Ebberly House, Landwey Road, Newport, Barnstaple EX32 9BW, telephone 0272 43355.

Frequency chart, large white one used to note spot frequencies, etc., for front of TCS12 RX. Photocopy of original would be useful, WHY. Phone Ben on Kidderminster (0562) 743253.

Horn only to fit BTH base, threaded diameter 1¼in. Phone Atherstone, Warks (0827) 712348.

3 Mk II Set (B2) Suitcase; H_2S Set; AI Mark IV Radar Set. D. G. Ford Museum, 'Stone Croft', London Road, Dorking, Surrey RH4 1TA, or phone after 1900 hours 0306 882757.

Circuits: MN62A, R1392D, R107. Bits: R107 RF Gain and AF Gain knobs, watch holder, PSU section. R1155 slow motion drive. 6 & 8-pin Jones plugs. MN62A plugs and accessories. Phone R. Walkington 0275 462885 evenings.

Pre-war TV set, also slides with TV test cards, idents and captions, as used in TV slide scanners. Buy or swap. Andrew Emmerson, 71 Falcutt Way, Northampton NN2 8PH, telephone 0604 844130.

Circuit for Pilot U535 receiver, fitted octal valves. Back for Philips 617A receiver. Good 8in energised speaker. D. E. Hewlett, 14 Kenilworth Drive, Willsbridge, Bristol BS15 6UP.

405-line television receivers, test equipment, advertising material, etc. Anything considered. Bill Journeaux, 7 Blair Avenue, Poole, Dorset BH14 0DA, telephone 0202 748072.

Old B126 and AD35 batteries required to complete restorations. Good prices paid for examples in good external condition. C. Hindle – weekday evenings 0943 609707, weekends 0254 248475.

WS No. 18 set Mk 3 or Mk 2 or part of. Any condition considered, any price paid. Please telephone Aylesbury (0296) 87057 ask for Steve weekdays after 6.30pm or weekends any time.

FOR SALE

Marconiphone pickup and BTH 78rpm motor unit, as new in boxes. Garrard RC120/4H auto-changer. Leak Varislope 3 and TL10 power amp. Quad AM2 tuner. Russell Hedges, Leeds (0532) 505024.

Eddystone bug key Model S689. Grey crackle 'tear-drop' case, manual dash, auto dot production. £20. Phone Ben on Kidderminster (0562) 743253.

Line Cord, new, 48 yards still on roll and labelled 0.3 amps, 100 ohms per foot. Offers for the roll or multiples of 3 feet. Phone Atherstone, Warks (0827) 712348.

Murphy Model A262 as featured page 16 *Radio Bygones* Christmas edition, nice condition but only works on VHF, £35.00. Also Classic Murphy AD94 (page 17 Fig. 11) open to offers – working order. Telephone Neil on Hornchurch (04024) 72109.

Osram 'Music Magnet' receiver in oak cabinet 19 x 9 x 9in, also Loewe Type 3NF valve with base and original box. Offers please to Wragg G3WEX, 29 Eastern Road, Sutton Coldfield B73 5PA or phone 021-354 4265.

RB No. 9 READERS ADVERT

Yesterday's Circuits - No. 6

by Gordon J. King, IEng, G4VFV

Circuits for Battery Economy

A primary expense of running early radio sets was the relatively high cost of the 120V HT (high-tension) battery. This gave a spur to the evolution of curious circuit arrangements which were claimed to reduce significantly the quiescent (no-signal) current of the output valve. Radio magazines of the 1930s told how such devices could be made using a component called a 'Westector', which effectively was a signal rectifier.

A battery power pentode of the era (such as a Pen220A or the equivalent Mullard PM22C) could well consume over 20mA of steady anode current when biased and powered to yield its full audio power. As one can well guess this soon made the HT battery feel uncomfortable! By the use of an economiser circuit or, indeed, a then commercially available 'economiser unit', the quiescent current could be cut to around 1.3mA – a good saving but at the expense of audio quality, especially at low modulation levels.

One economising circuit is given in **Fig. 6.1**, connected into the anode circuit of the output valve. Negative grid-bias was applied to the grid of the output valve through R1 and R2, and the magnitude of the bias was set to reduce the quiescent current to around 1.3mA. Hence under no-signal conditions the HT consumption was low. Now, when audio output was present at the loud-speaker, a signal was fed to the Westector cathode via C1 and R3. The signal was thus rectified, and the resulting direct voltage across C2 was fed in opposition to the grid bias polarity to the grid of the valve, this then reducing the magnitude of the bias and hence increasing the anode current of the output valve in accordance with the amplitude of the audio signal.

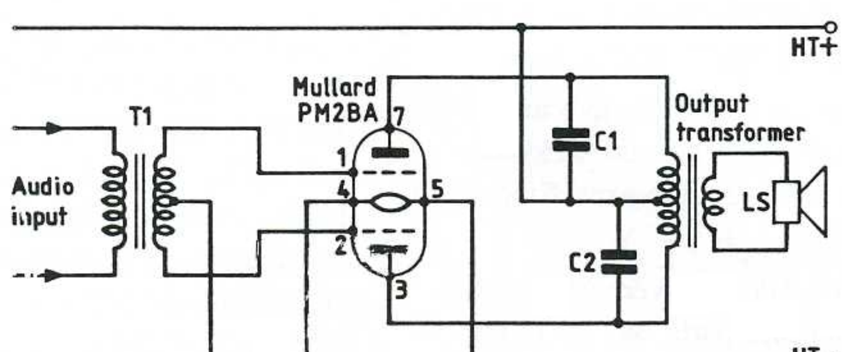


Fig. 6.2 - A Class B battery output stage using a double-triode valve. This sort of circuit called for a small audio driver stage in front of the transformer T1. The Mullard PM2BA was capable of 1.45W of audio from a 120V battery

Early Class B Output

The louder the audio, the greater the anode current is a characteristic of Class B and QPP (quiescent push-pull) operation, so, in effect, a single-ended output stage was provided with a similar characteristic by the so-called battery economiser. However, a real push-pull stage had several advantages over a single-ended stage. For one thing, even-

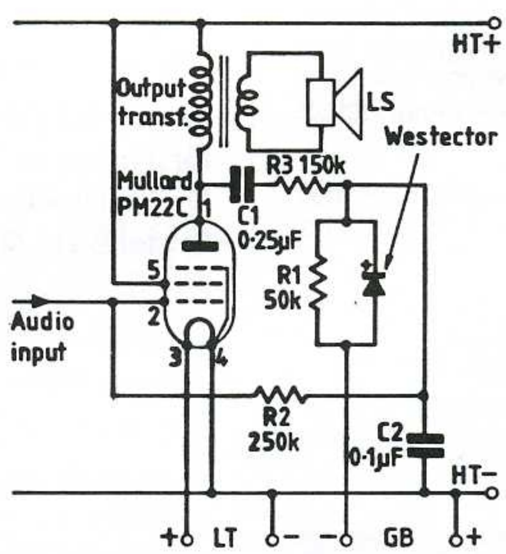


Fig. 6.1 - Circuit diagram of a so-called HT battery economiser which was used to prolong battery life by reducing the quiescent current of more than 20mA to less than 2mA. See text for a full description

order harmonic (and intermodulation) distortion was reduced, and for another available output power (not to mention quality) was increased. Also the amount of HT battery consumption was dependent on the loudness of the sound. Thus battery saving was possible merely by turning down the volume (less reaction?).

An early Class B output stage is given in **Fig. 6.2**. Here grid-bias was applied to the centre-tap of the secondary winding of the input transformer T1 relative to the HT negative line. Best results were obtained by using a small power valve in front of T1. Biasing of the Class B (double-triode) valve was often optimised by first applying a higher-than-normal bias, and then reducing the bias step-by-step until a bias just below the noticeable mid-volume distortion level was obtained, having remembered to switch the set off each time a bias change had been made! Capacitors C1 and C2 were used for tone correction – and were removed if a 'higher tone' was required.

The Mullard PM2BA was capable of 1.45W audio output at 120V HT, 2V and 200mA LT, and –4.5V bias with an output load of 14 000 ohms. Thus, with a 3 ohm loudspeaker, an output transformer of 63:1 ratio was needed. Indeed, during the era under discussion it was possible to obtain tapped output (speaker) transformers to optimise the loudspeaker used to the output load requirement of the valve. Some moving-coil loudspeakers also had tapped transformers fitted to them.

Early QPP

Quiescent push-pull staged had much in common with their Class B counterparts, but instead of the valve being a double-triode it was a double pentode, as shown in the circuit in **Fig. 6.3**. A number of QPP valves became available, including the Marconi-Osram QP21, Mazda QP240 and Mullard QP22A, having audio yields of 1.2, 2.25 and 2 watts respectively.

A popular valve of the day was the Mazda QP240 with an output load requirement of 15 000 ohms (requiring a

70:1 ratio speaker transformer to match a 3 ohm speaker). This would take up to 150V of HT and required –11.5V grid-bias. The filament was 2V at 450mA.

QPP became popular with battery receivers because it required no specific driver valve as for Class B. Indeed, the stage could easily be driven direct from the anode circuit of a triode detector stage, for example (see Part 5 of this series). Before WWII, dedicated QPP units were available, which in many cases could be fitted inside the receiver cabinet after the original low-frequency valves and components had been removed. While some of the QPP valves had 7-pin bases, the Mazda valve possessed nine pins, each Grid-2 being brought out to its own pin. With most of the other QPP valves, the two Grid-2s as well as the two Grid-3s were joined internally.

The grid-bias, usually double the value required for ordinary low-frequency valves, needed to be adjusted carefully and readjusted as the HT battery ran down and its voltage fell. The bias was commonly applied via a resistor (R1 in the circuit). This helped to hold back any instability, the value being increased to around 150 kilohms (from about 100kΩ) or higher should instability become apparent (perhaps with an ageing battery). The tone-correcting capacitors are, again, C1 and C2, while the combination of R2 and C3 acted as a sort of top-cut tone control.

Although the average HT current of a Class B or QPP stage was less than the standing current of a single power pentode in Class A, the current was raised to three or four times the average during strong audio signal peaks. In other words, although the average was in the order of 6mA or less, the peak current could well rise to 24mA or so. This, then, called for an HT battery of largish capacity which was able to accommodate the peak current demands without the voltage falling and hence the distortion rising.

In summary, a QPP valve cost about 50 per cent more than a comparable Class B valve, but this was outweighed by a driver stage not being necessary for QPP. Moreover, the audio quality of QPP was often regarded as superior to Class B by the pundits of the day.

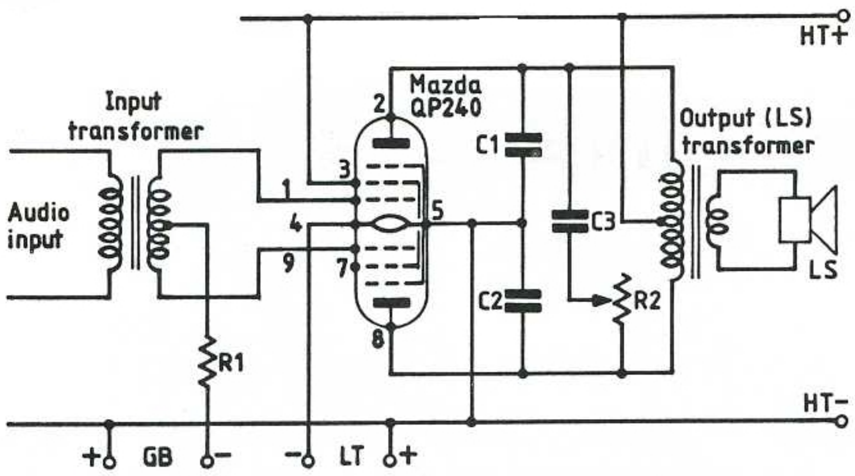


Fig. 6.3 - A QPP battery output stage using a double-pentode valve. This sort of circuit could be driven by low-level audio such as might be obtained from a valve detector for example. The Mazda QP240 QPP valve was capable of 2.25W of audio and would accommodate up to 150V HT. Although not specifically shown in the circuit, the valve had separate pins for the second grids of each section

RAF Receiver R.1084

by E. F. Jones

The R.1084, with a frequency coverage of 120kc/s to 20Mc/s, was a 13-valve supersonic heterodyne ground station receiver in widespread use in the RAF during the late 1930s and the early years of the last war. My own experience with this equipment was primarily at RAF Habbaniyah, Air Headquarters, Persia and Iraq Forces, during 1942 and 1943 when virtually all inter-command communication was by hand-sent CW, as was contact with the Middle East, India and East Africa. From recollection this set was also used by a small unit within the station manned jointly by civilian operators and RAF personnel for communication with the civilian flying boat service which used the nearby Lake Habbaniyah during flights from the Middle East through to Basrah and on down the Persian Gulf.

Clearly the set had been designed primarily for point-to-point CW working and was capable of providing a very high degree of selectivity. Setting up on a particular frequency was quite a complex procedure entailing the use of a frequency chart and the adjustment of some twelve controls to obtain optimum output. However, once it was set up the receiver was rock steady and easy to use for continuous communication purposes. Normally it was used as a superhet but could be used as a 'straight' receiver if desired. When used in conjunction with a transmitter (frequently the T.1087 or the T.1190) side-tone was available. An additional facility was an output limiter.

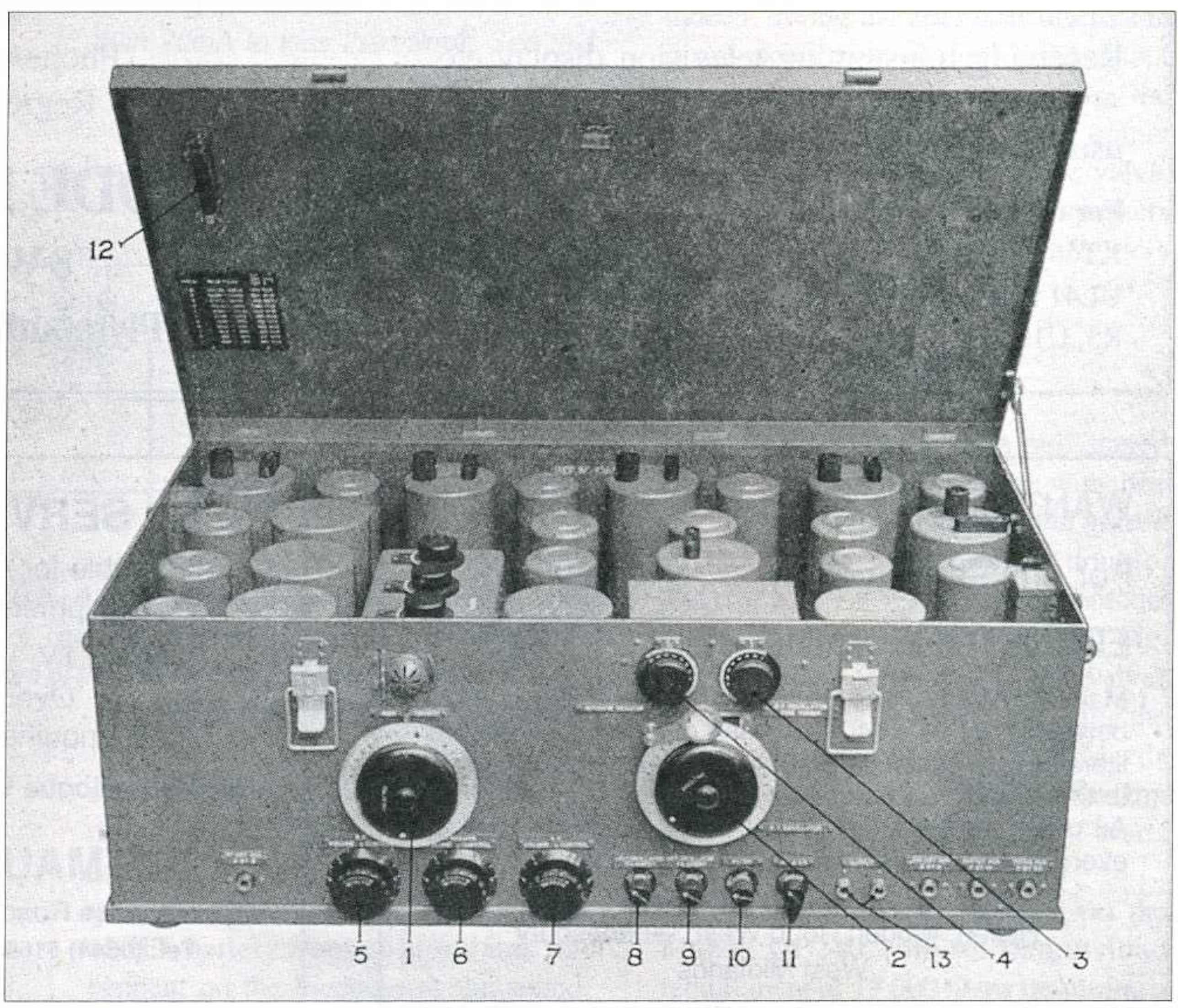
Essentially the receiver provided RF, SF and AF amplification stages plus an output stage. The BFO could be adjusted within narrow limits to alter the beat note. The anode circuit of the first detector and the anode circuits of the four SF amplifiers were each provided with alternative tuned circuits which although adjusted to the same frequency, had different characteristics. Each coil unit had a switch to enable one or other of those circuits to be switched in or out as required. As there were five circuits, selectivity of the RF amplifier stages could be varied within wide limits. Characteristics were so arranged that there was little change in the gain when switching from high to low selectivity.

Coupling between the second detector and the AF stage could be switched through either a resistance-capacitance circuit or a 1000c/s AF filter. Output was suitable for a high resistance load such as the standard telephone headset.

A separate set of RF, Detector 1 and RF Oscillator coils was used for each of the eleven ranges which covered from 120kc/s to 20Mc/s. The four SF circuits, second detector and heterodyne oscillator also had interchangeable coils providing alternatives of 40kc/s or 167kc/s so that each range required a total of eleven plug-in coils. For some reason all the 167kc/s coils were marked 180kc/s! The whole set of coils, 57 in all, were contained in 14 carrying boxes, which took up a great deal of space, bearing

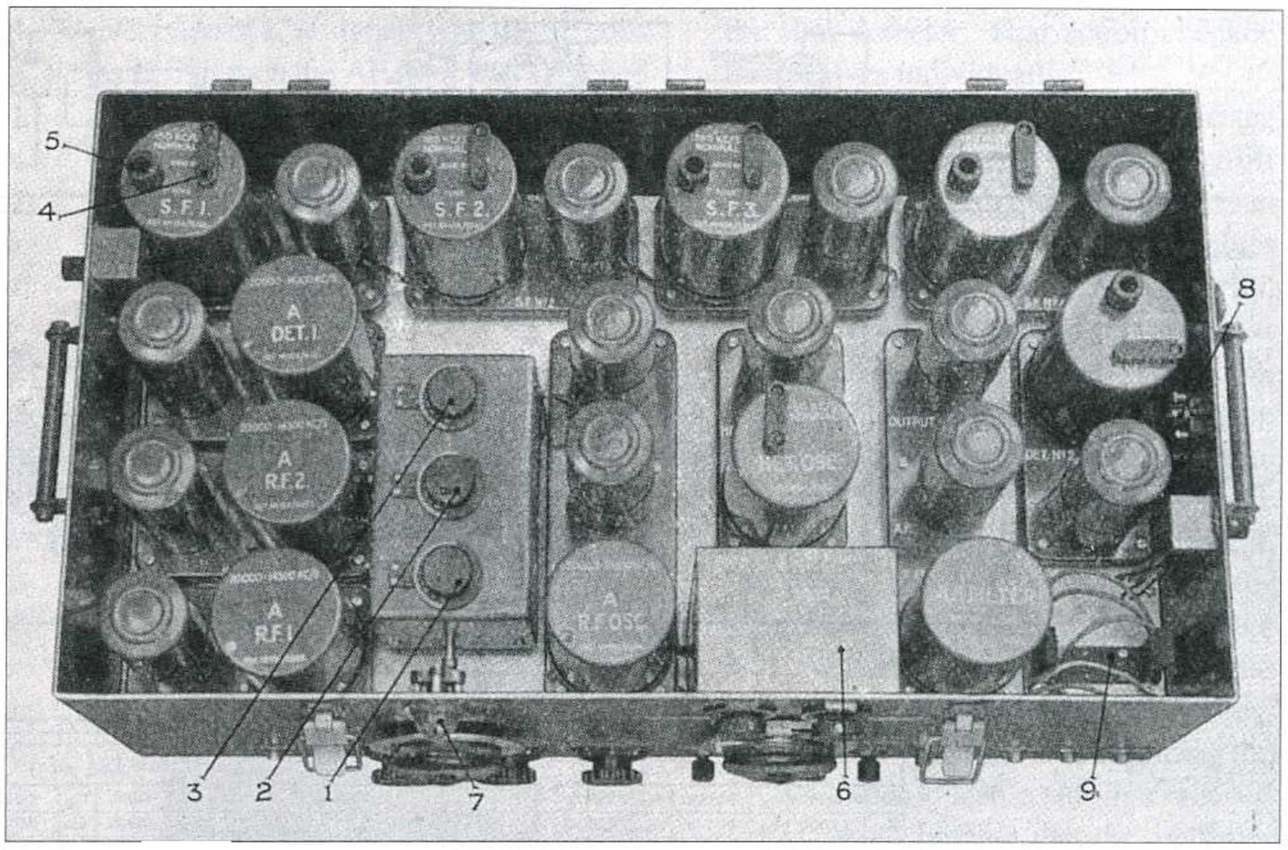
R.1084 Front Panel Controls

1. A single control, 3-gang condenser for the 3 RF circuits. (These had 3 separate trimmers inside the set)
2. RF oscillator control
3. RF oscillator fine tuning
4. Heterodyne oscillator
5. RF volume control
6. RF oscillator control
7. SF volume control
8. RF oscillator filament
9. Het. osc. filament
10. AF filter switch
11. HT/LT on-off switch
12. First detector bias adjuster key
13. Output jacks



R.1084 Internal Plan view

1, 2, 3. RF trimmers
4. Pre-set trimmer
5. Tune/Stand-by switch
6. RF oscillator tuning condenser
7. 2 volt pilot lamp
8. 6 volt lamp in HT– lead as a fuse
9. Grid bias battery holder



in mind that each can measured about 3½ inches in diameter.

LT power was obtained from a 2 volt 90 ampere-hour accumulator; grid bias from three 6 volt batteries with five connections. The HT of 120 volts could be obtained from three sources: a Milnes unit where there was a DC mains supply; an AC power pack, or in a real emergency a 120 volt dry battery. The latter was not recommended as HT consumption was in the order of 25mA.

Layout

The R.1084 was housed in an aluminium-alloy case measuring about 28½ x 15¾ x 10in and weighing some 60lb. At the front of the receiver the following controls were provided. A single control operated the three-gang main tuning condensers for tuning the RF circuits to the signal frequency. (Three trimming condensers were placed inside the receiver: whilst normally pre-set they nevertheless required adjustment whenever the coil units were changed from one range to another.)

To the right of that control was the RF oscillator control which also had a fine tuning adjustment, together with a variable tuning condenser for the heterodyne oscillator to alter the audio frequency note. Three volume control potentiometers were also provided; one for the RF valves, one for the SF amplifying valves and finally one on the control grid of the isolator or buffer valve giving control of the RF oscillator.

In order to allow for possible variation in the characteristics of detector valves a pre-set bias adjustment was provided so that the particular valve could be made to give the best rectification for weak signals, its greatest use being when the set was being operated as a 'straight' receiver. As a superhet the grid bias on the detector valve was not critical. The change-over from superhet to the 'straight' circuit was effected through two switches which cut out the SF amplifier so that the receiver then consisted of two RF stages, detector, audio frequency and output stages and a separate heterodyne oscillator. The separate heterodyne function was performed by the valve circuit which previously acted as the RF oscillator.

When the R.1084 was used in conjunction with a ground station transmitter a modification was introduced to provide side-tone. It consisted essentially of re-wiring the three potentiometers so as to introduce an external potentiometer. A 6-pin plug was wired in, providing HT and LT connections, a connection to the junction point of the three potentiometers and another to the receiver chassis. The necessary side-tone unit consisted of a potentiometer and a send/receive switch. In the 'receive' position the potentiometer was short-circuited and the normal RF and SF bias was applied. In the 'send' position the switch removed the short circuit, introduced the single potentiometer and in addition switched on the transmitter HT supply and closed the circuit for the microphone and the pilot lamp. An output limiter unit (four metal rectifiers, switch and phone jack) was available for use only with CW signals.

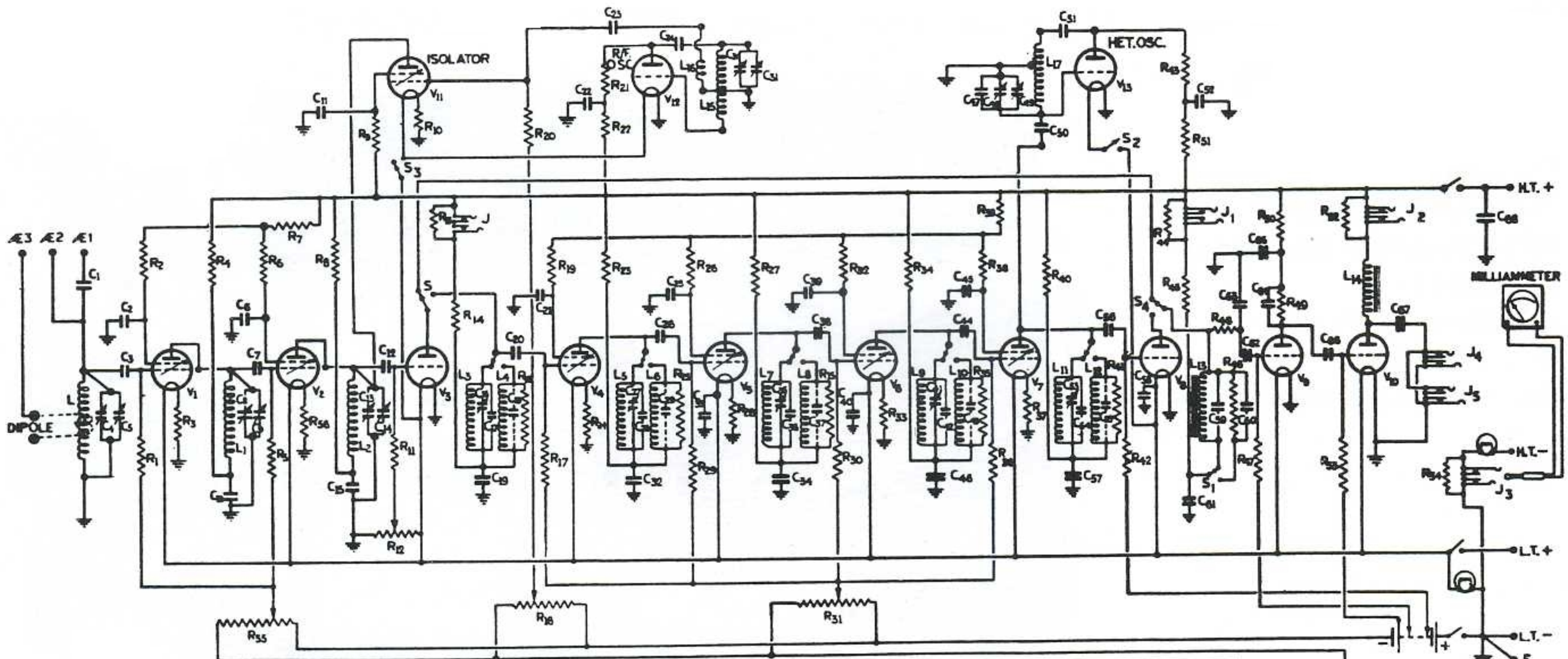
Receiver Function

Essentially the R.1084 functioned as a superhet. The circuit diagram is shown in **Fig. 1**. V1 and V2 are the RF valves, V3 the first detector, V4, V5, V6 and V7 the SF valves, V8 the second detector, V9 and V10 the AF and output valves respectively. The isolator or buffer valve V11 couples the RF oscillator V12 to the last stage of the SF amplifier.

Three aerial terminals were provided: direct input; via a condenser, or a coupling for a dipole. The input inductance was tuned by a variable condenser across which was a trimmer. The control grid of the variable-mu screen grid valve V1 was coupled to the aerial inductance through a condenser and connected to a potentiometer. Similar circuits applied to the second RF amplifier.

Following the first detector stage the next four SF amplifying stages operated in a similar manner with the additional facility of alternative anode circuits, one or other of which could be selected by means of a switch mounted on the coil unit. Grid bias for valves V8, V9 and V10 was provided by a separate battery. The anode load of the output valve V10 was an iron-cored choke. Two telephone jacks were available for output.

In the anode circuit of valve V3 there was a 2-position switch which enabled the anode circuit to be coupled to the succeeding valve or diverted via a screened connection to a similar switch



RESISTANCES (OHMS)								CAPACITANCES (μF)									
R_{1}	250,000	R_{15}	20,000	R_{29}	250,000	R_{43}	10,000	C_{1}	·00005	C_{15}	·02	C_{29}	·0002	C_{43}	·0002	C_{57}	·25
R_{2}	40,000	R_{16}	20,000	R_{30}	250,000	R_{44}	12·5	C_{2}	·25	C_{16}	·0005	C_{30}	·0005	C_{44}	·0002	C_{58}	4·0
R_{3}	1·5	R_{17}	250,000	R_{31}	50,000	R_{45}	2,000	C_{3}	·0005	C_{17}	·01	C_{31}	·00001	C_{45}	·25	C_{59}	·2
R_{4}	1,000	R_{18}	50,000	R_{32}	40,000	R_{46}	20,000	C_{4}	·0005	C_{18}	·0002	C_{32}	·25	C_{46}	·25	C_{60}	·0002
R_{5}	250,000	R_{19}	40,000	R_{33}	1·5	R_{47}	250,000	C_{5}	·0002	C_{19}	·25	C_{33}	4·0	C_{47}	·004	C_{61}	·5
R_{6}	40,000	R_{20}	250,000	R_{34}	1,000	R_{48}	100,000	C_{6}	·25	C_{20}	·0002	C_{34}	·25	C_{48}	·00025	C_{62}	·001
R_{7}	60,000	R_{21}	10,000	R_{35}	20,000	R_{49}	100,000	C_{7}	·00005	C_{21}	·25	C_{35}	·0005	C_{49}	·0005	C_{63}	·0002
R_{8}	1,000	R_{22}	5,000	R_{36}	250,000	R_{50}	20,000	C_{8}	·0005	C_{22}	·5	C_{36}	·01	C_{50}	·0001	C_{64}	·0003
R_{9}	250,000	R_{23}	1,000	R_{37}	1·5	R_{51}	20,000	C_{9}	·0002	C_{23}	·0002	C_{37}	·0002	C_{51}	·001	C_{65}	·5
R_{10}	1·5	R_{24}	1·5	R_{38}	40,000	R_{52}	10	C_{10}	·02	C_{24}	·001	C_{38}	·0002	C_{52}	·5	C_{66}	·001
R_{11}	250,000	R_{25}	20,000	R_{39}	100,000	R_{53}	250,000	C_{11}	·5	C_{25}	·25	C_{39}	·25	C_{53}	·0005	C_{67}	2·0
R_{12}	135	R_{26}	40,000	R_{40}	1000	R_{54}	2·0	C_{12}	·00005	C_{26}	·0002	C_{40}	4·0	C_{54}	·01	C_{68}	2·0
R_{13}	12·5	R_{27}	1,000	R_{41}	20,000	R_{55}	50,000	C_{13}	·0005	C_{27}	·0005	C_{41}	·0005	C_{55}	·0002		
R_{14}	101,000	R_{28}	1·5	R_{42}	250,000	R_{56}	1·5	C_{14}	·0002	C_{28}	·01	C_{42}	·01	C_{56}	·0002		

Note:- Condensers C_{18}, C_{29}, C_{37}, C_{43} and C_{55} are used only for S/F coils on 40 kc/s.

Fig. 1 - Theoretical circuit diagram, Receiver R.1084

in the grid circuit of V9. Thus it was possible to cut out the supersonic amplifier to enable the receiver to function in the 'straight' mode.

Four jacks were provided in the anode circuits of V3, V8, V10 and also in the main HT line. A milliammeter could be plugged in and the reading obtained was multiplied by a figure shown by the appropriate jack to give the appropriate figure. The meter had a full scale deflection of 1mA.

Operation

Setting up the receiver had to be done methodically, in a definite sequence and it was recommended that the following procedure be followed.

1. Check HT and LT voltages.
2. Plug in aerial and earth. There were three aerial input connections: AE1 for a normal aerial and earth system; AE2 for a low capacitance aerial such as a short vertical rod, or a dipole could be connected to AE3 and the adjoining connector but such use was limited to ranges A, B, C and D (20Mc/s to 4.29Mc/s). However AE3 had to be used on its own for ranges J and L (350–600kc/s and 120–200kc/s). An added complication was that there was no direct connection between AE3 and the aerial coil for five of the ranges so that a careful selection of an aerial system to match to the receiver was required.
3. Check the grid bias battery voltages and that the plugs were in the correct sockets.
4. Check that all valves were in their correct position.
5. For frequencies 600kc/s to 20Mc/s use the 167kc/s SF coils.
For frequencies 120kc/s to 600kc/s use the 40kc/s SF coils.
6. Set switches on all SF coils to TUNE.
7. From the tuning chart (fixed in the lid) ascertain which set of tuning coils is required.

To gain experience in the use of the set it was recommended that the receiver

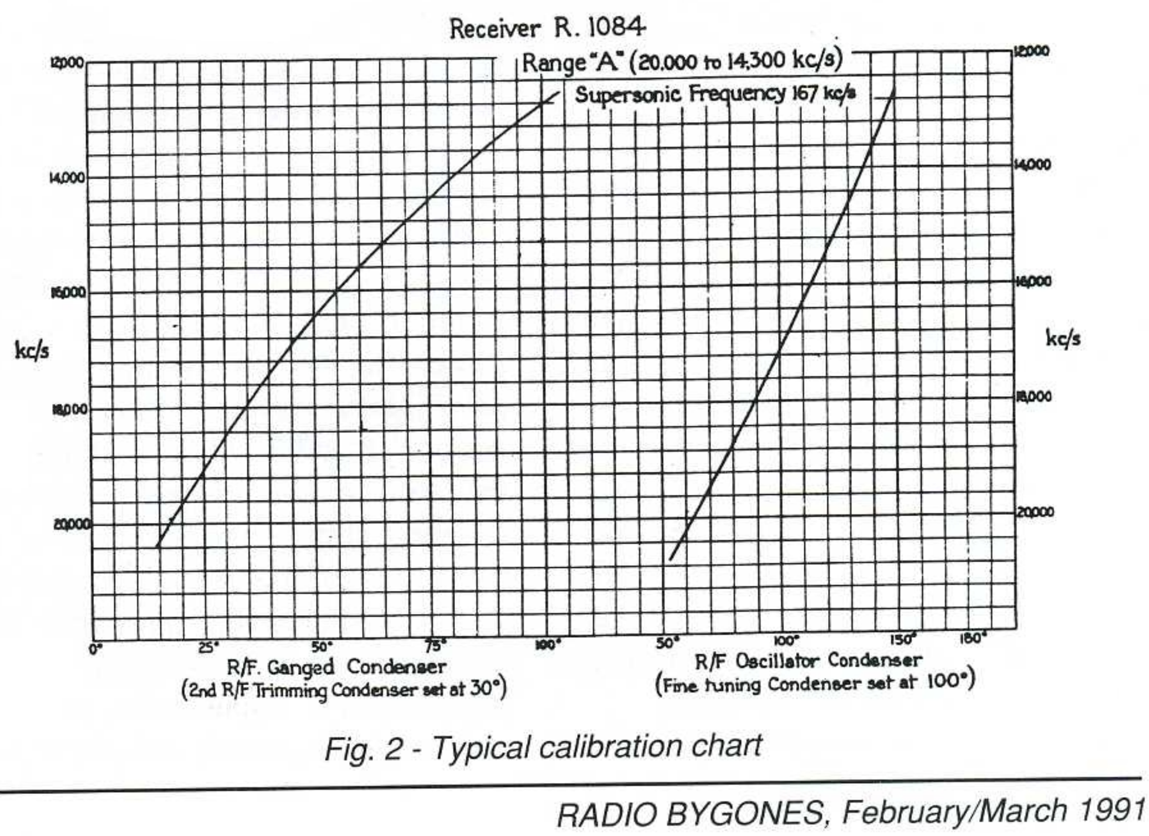


Fig. 2 - Typical calibration chart

be operated in the 'straight' mode, and as an example the following action was necessary:

To receive an R/T or MCW signal on 16Mc/s insert the 'A' range of coils, connect an aerial to AE1, set the two superhet switches to OUT, RF oscillator filament switch to OUT, heterodyne oscillator filament switch to OFF and AF filter to OUT. Switch on HT and LT. Refer to the RF curve on the left hand side of the chart (see **Fig. 2**), set the second and third RF trimmers to 30° and the main ganged condenser control to the point on the curve which corresponds to 16Mc/s – approximately 65°. A search could now be made if the RF volume control was set at maximum and the RF control varied on either side of the pre-determined setting. When the required signal was received all the trimmers were adjusted to give maximum signal strength.

If a CW signal was required the RF oscillator filament was switched on and without any other adjustment the RF oscillator was set to about 114°. Fine tuning could be carried out by using the RF oscillator fine tuning control.

To change to superhet, the two superhet switches were set to IN, the 167kc/s SF coils set to TUNE, AF filter OUT, RF oscillator filament to ON, RF volume control to maximum, SF volume control to about setting 7. Using 16Mc/s again as an example the RF oscillator control would be set to about 114°, the three RF trimmers to 100°. The heterodyne oscillator filament was switched on and a search made for the signal using the RF oscilllator fine tuning control. When heard, the heterodyne oscillator was adjusted to give the desired note. When using the set as a 'straight' receiver, the RF oscillator behaved as a heterodyne oscillator, whereas on superhet it was a frequency changer oscillator.

It was essential that all three RF trimmers were accurately tuned. On occasions, such as with the use of a particularly large aerial, the first trimmer might fail to tune; that necessitated a reduction of capacitance in the main RF condenser. The heterodyne note could also be adjusted and to do so accurately the signal was tuned in to signal 'mush', the heterodyne oscillator filament switched on and whilst listening to a CW signal the heterodyne oscillator was adjusted to give a 1000c/s note. If interference was experienced during reception of CW signals with the SF coils at TUNE then the AF filter was switched on. That filter was tuned to 1000c/s and had a bandwidth of 200c/s.

The reception of R/T transmissions from crystal controlled transmitters was satisfactory with the SF 167kc/s coils switched to TUNE. If reception was unsatisfactory due to transmitter drift then some or all of the SF coils could be switched to STAND-BY except for SF1 and DET2 which had to be left at TUNE.

Milliammeter, 0–1, 2½in Dial, desk type, Ref. No. 10A/8398

Servicing

A simple and comprehensive check of all the valves in the receiver under working conditions could be carried out with the aid of plug-in milliammeter supplied with each set. To do so HT and LT was switched on, the two superhet switches on the sides of the receiver to IN, AF filter, heterodyne oscillator and RF oscillator switched to IN and the three volume controls set to maximum.

Plugging the meter into the right-hand jack gave total HT current. Full scale reading was 1 milliamp and the meter reading had to be multiplied by a specified figure shown by each of the jack points. Total HT current was the meter reading x50 which would have resulted in an actual consumption of about 25mA. Plugging into the output jack should show a reading of beteen 0.4 and 0.6 which, multiplied by the figure 10 indicated an anode current of 4 to 6mA. The third jack checked the second detector, whilst a further one on the left hand side of the set was used to check the first detector. That action checked three valves individually.

The meter was then plugged into the TOTAL mA plug and by switching off the RF oscillator filament a reduction in the meter reading indicated that valves V11 and V12 were working correctly. Switching off the heterodyne oscillator should also show a further reduction, indicating that V13 was normal.Varying the RF volume control should vary the output reading thus indicating that the two RF valves were taking anode current. Similarly, varying the RF oscillator volume control checked the isolator valve V11, whilst varying the SF volume control checked the four SF valves. Finally removing the valve adjoining the AF filter should also result in a reduced reading thus showing that the amplifier valve was normal.

By that method it was possible to check seven valves individually, the remaining six in groups of two and four. Nevertheless it was possible to check those valves individually by removing in turn the pig-tail connection to the top-cap of the valve which would also be marked by a meter deflection. It had to be borne in mind that the valves had a comparatively short life of about 1000 hours and under wartime conditions many sets were in continuous use 24 hours a day. Only four valve types were used: VR21 – RF oscillator, SF oscillator and AF1; VR22 – Output; VR27 – DET1 and DET2; VR28 – RF1 and 2, Buffer and SF1, 2, 3 and 4. Some interchangeability was possible. A VR27 could be used in place of the VR21 and in an emergency either a VR21 or a VR27 could substitute for the VR22.

Difficulties were experienced with the coil cans due to broken springs on the coil contacts. A quick check was to shake the can and if there was a rattle then there was a broken spring. Other simple tests could be carried out to check that the RF side of the receiver was functioning normally by utilising the input circuit noise. With the aerial removed the set was tuned to a frequency between 4 and 6Mc/s. By removing the RF2 coil, set noise would be reduced showing that the RF side was normal. When the set was tuned with the RF oscillator and isolator valves functioning normally, there would be a decrease in background noise when the RF oscillator filament switch was opened; no decrease in noise indicated a faulty valve in either of those positions. The SF stages could be checked for continuity by switching from TUNE to STAND-BY when a firm 'click' would be heard. If not well-defined then there was the possibility of a defective valve, dirty switch, broken pig-tail connection or a broken switch spindle.

Another source of trouble was caused by a variation of capacitance due to ageing of the fixed and pre-set condensers in the 167kc/s SF and DET2 coils. Variations were irregular and in addition to an alteration of the nominal frequency of each individual can, the gain of the complete SF amplifier could be affected. It was necessary for the setting of the pre-set condensers to be checked at regular intervals and ideally that service should be carried out at least once a year. Once any particular set of SF coils had been realigned in a particular receiver then those coils could only be used for that specific set. No realignment of the 40kc/s range was necessary.

Coil coverage

Range	Band		
A	20 000	to	14 300kc/s
B	14 300	to	10 700kc/s
C	10 700	to	6 000kc/s
D	6 000	to	4 290kc/s
E	4 290	to	2 500kc/s
F	2 500	to	1 600kc/s
G	1 600	to	1 000kc/s
H	1 000	to	600kc/s
J	600	to	350kc/s
K	350	to	200kc/s
L	200	to	120kc/s

Rarity Value

I bought one of these sets soon after the War for £4 complete with all the coils in their wooden cases and a spare chassis. Eventually on moving house I had to make room and advertised it for sale in the RSGB Bulletin, there was only one reply – from the Ministry of Defence which had been unable to trace one in any of the UK or Overseas Commands stores. I understand it was their intention to place it in the RAF Museum at Hendon. It is possible that this receiver remained in service use longer than one would have expected, bearing in mind the rapid introduction of more modern equipment such as the R.1155, HRO and AR88. I left Iraq in 1943 and do not recall seeing the set elsewhere in the Middle East. However a friend of mine who also served in Paiforce recalls that an R.1084 was in regular use at RAF Shaibah well into 1944 when he, too, was posted. I have one of the milliammeters issued with the receiver dated 1945 which could indicate that the set was still in production after the end of the war! ***RB***

The Start of Wireless Broadcasting in the UK

Entertainment in the Home

by F. C. Judd G2BCX

Much has already been written about developments in the use of wireless since its discovery by Heinrich Hertz in 1888... About the pioneers who put the discovery to practical use for communication over great distances to other countries and ships at sea... Of the first of the few 'licensed to transmit' radio amateurs who contributed technical innovations and ideas, one of which was ultimately to benefit Britons living overseas.

However, in addition to communication by wireless telegraphy, which was on a commercial footing by the early 1900s, it was the 'wireless industry' who with far greater technical and financial facilities than the radio amateurs, were to provide an entirely new and profitable wireless service for the UK population as a whole.

The Beginning

The Marconi Company of Chelmsford in Essex was licensed by the Postmaster General to set up a transmitting station close to the nearby village of Writtle. With the help of a team of experts, the then Marconi chief engineer, Captain P. P. Eckersley, a pioneer of earlier developments in wireless communication, initiated the first entertainment broadcasts which were made from this station in 1921. Part of the fairly high powered transmitter is shown in **Fig. 1**. The station was allocated the callsign 2MT, better known to listeners as 'Two Emma Toc' and was also equipped with a studio as shown in **Fig. 2**.

A newspaper of the time reported:

'It is estimated that over 5000 wireless enthusiasts in this country were listening to the Marconi wireless concert given last night on a 700 metre wavelength from Writtle near Chelmsford.' It was Station 2MT of course – but this was only the beginning.

The Wireless Craze

Continued publicity about entertainment in the home via the wireless created the need for information. Not many people knew how to make or acquire a receiving set. This need was soon fulfilled by a proliferation of weekly and monthly magazines devoted entirely to the new craze. They described how to make wireless components; how to construct wireless receivers; how to put up an aerial. Their front covers carried blandishments such as 'New Receiver – Circuit Blueprint Free With This Issue', and so on. For those unable to grasp the technicalities, these and other publications also carried adverts for complete receivers as well as kits 'for easy construction without technical knowledge'. There were soon plenty of wireless shops to meet the demand.

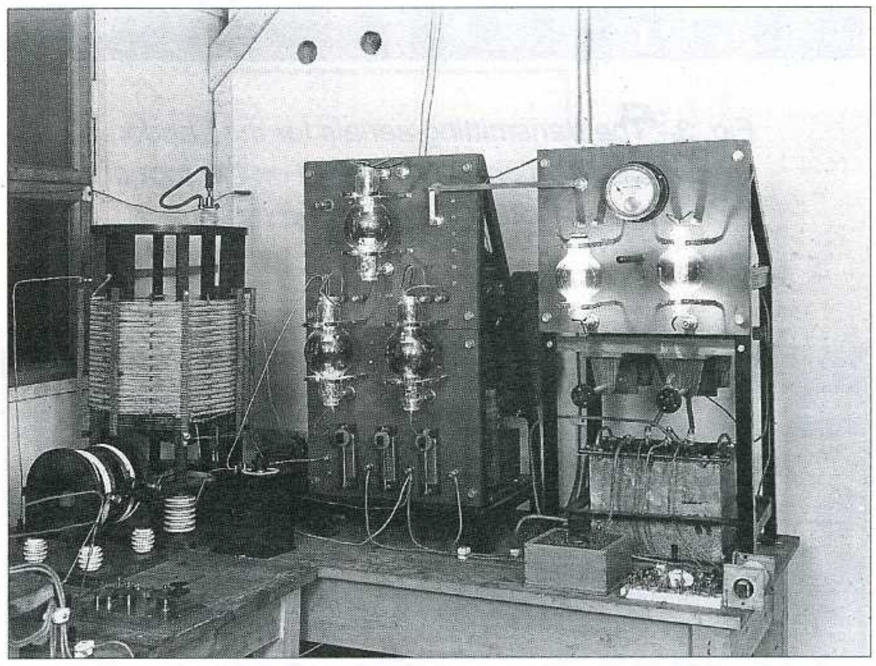


Fig. 1 - Main section of the transmitter at the Marconi wireless station 2MT, at Writtle in Essex (1922)

Fig. 2 - Broadcast taking place from the :studio at 2MT, Writtle (1922)

The London Wireless Station

Using the callsign 2LO this station was set up in 1922 by the Marconi Company at Marconi House in the Strand. Aerials were erected on the roof of the building (**Fig. 3**) which together with the fairly high powered transmitter (**Fig. 4**) provided good reception over an area much larger than Greater London itself. The studio(s) provided for the broadcasters were a little more

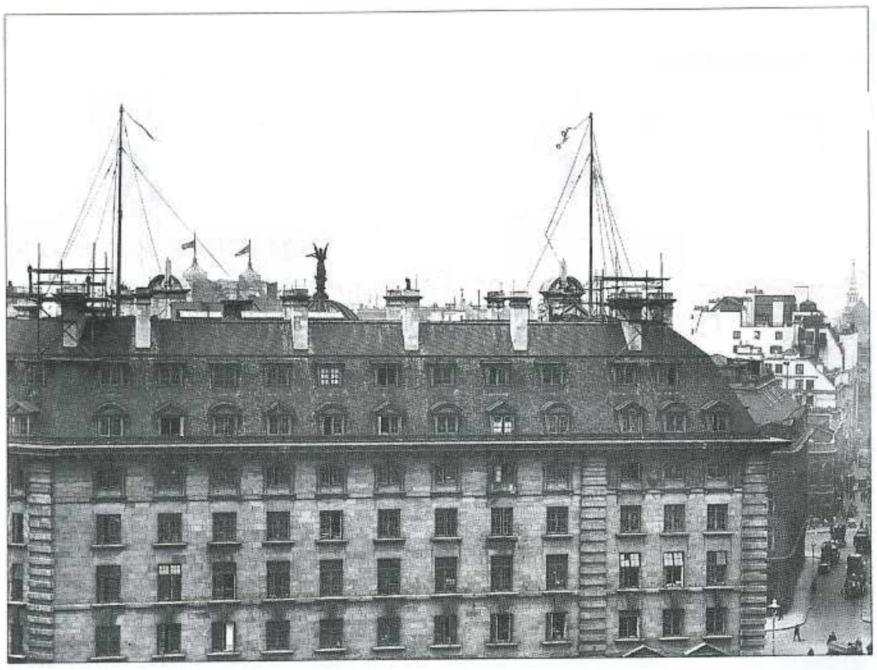


Fig. 3 - The transmitting aerials for the London transmitting station 2LO, located on the roof of Marconi House in the Strand (1922)

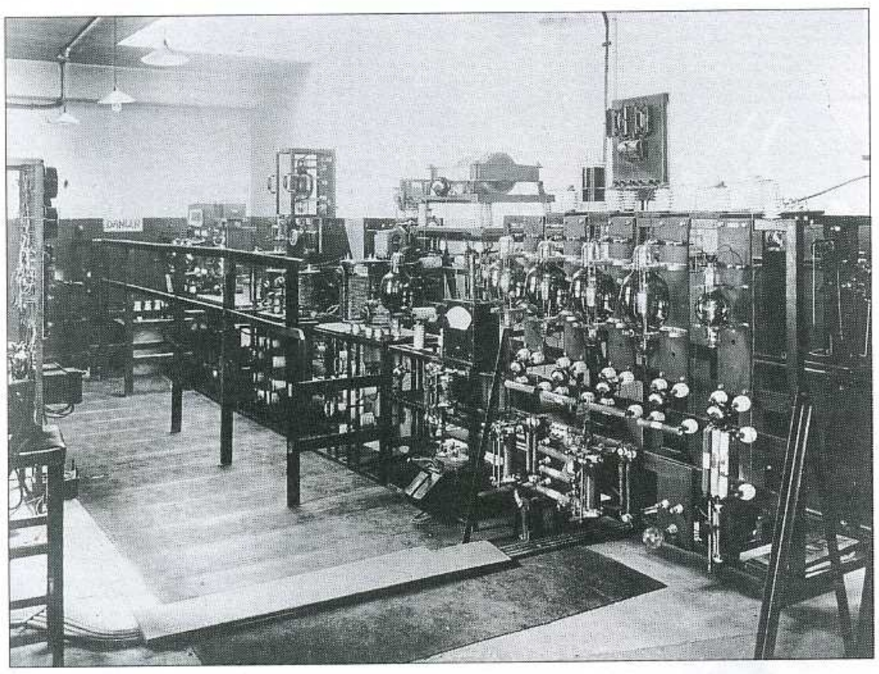


Fig. 4 - The 2LO transmitter (1922). Later taken over by the BBC

Fig. 5 - Broadcast in progress from a studio at the London wireless station 2LO (1922)

pretentious, soundproofed and acoustically decorated like the one shown in **Fig. 5**. In November of that year the station was taken over by the newly formed British Broadcasting Company.

British Broadcasting

'2LO calling, this is 2LO, the London station of the British Broadcasting Company.' The first of many opening announcements by the now established British Broadcasting Company made in the evening of 14 November 1922, followed

THE
BRITISH BROADCASTING STATIONS
AND THEIR CALL SIGNS

	Call letters.	Wave lengths.
London ..	2 L.O. ..	369
Birmingham ..	5 I.T. ..	425
Manchester ..	2 Z.Y. ..	385
Newcastle ..	5 N.O. ..	400
Cardiff ..	5 W.A ..	353
Glasgow ..	5 S.C. ..	415

Fig. 6 - Shortly after the British Broadcasting Company began operation from Marconi House (2LO) in November 1922, other stations were set up around the country

by the news bulletin, a weather forecast and music heard by an estimated 30 000 listeners living in the Greater London area. This was fine but the rest of the UK wanted the same service. Two days later the BBC began regional broadcasting from Birmingham and Manchester. It wasn't long before the total number of stations in operation were as in **Fig. 6**.

The Origin of Empire Broadcasting

In the very early days of wireless, 'wavelength' allocations for amateur radio experimenters were within what we now call the medium and long-wave bands. Then it was discovered they could maintain quite reliable transmission and reception over considerable distances. As a result, these bands were taken over for government sanctioned broadcasting stations. The radio amateurs, still regarded as experimenters only, were allowed to continue operating on a selection of wave bands below 200 metres, known as the short-waves where it was thought they would cause no interference to other services.

'Won't get signals outside their own back yards' was one official observation. It was not long before the radio amateurs were making contacts with each other in almost every part of the globe. One in particular is well remembered for his initiative and pioneering venture on what the authorities considered the useless 'short waves'.

In 1927, Gerald Marcuse, using his own callsign G2NM and operating from his home in Caterham, Surrey, began a series of wireless broadcasts using a high frequency within the short wave spectrum. These transmissions were for the benefit of people living in various parts of the then British Empire. It was a service that proved both successful and popular, and it came as no surprise when the 2NM venture was terminated and the BBC started its own Empire Broadcasting Service in 1932.

'A footnote to Broadcasting History' by Pat Hawker, published in *Radio Bygones* October/November 1989 issue, gives a very interesting and detailed account of the work of Gerald Marcuse.

Wireless Broadcasts from Europe

Various European countries had also set up broadcasting stations. The French for instance had begun transmitting from the Eiffel Tower. For the first time, citizens of the UK were able to hear well known artistes, as well as concerts by famous orchestras, of other countries. This entailed the use of more powerful receivers and ownership of one that would receive broadcasts from anywhere in Europe was something of a status symbol. Wireless had by now become an invisible technological web in which the people of more than one country were becoming entangled.

Wireless – a Hobby and Profession

At the age of eight I can remember helping Dad put up an aerial and even more exciting, being allowed to tune the wireless set, which employed three bright-emitter valves. Then I constructed my first crystal set. The 'wireless bug', as it was called, had bitten and years later I embarked upon a lifetime professional career in radio, later to be combined with electronics. But radio also remained a hobby for which, in due course, an amateur radio transmitting licence was obtained.

Forgive the digression but this is what happened to me and, in much the same way, to many others. For most people wireless was simply a new media for the conveyance of entertainment in the home. Others made the construction of wireless sets, combined with extensive listening, a hobby-cum-pastime of its own and became the 'short wave listeners' or SWLs. Those with more serious experimentation in mind became the licensed radio amateurs of then and today, but many turned to professional practice as engineers and scientists in one of the numerous fields of technology that stemmed from the research and development that continued over the years.

Learning About Wireless

Those who desired to adopt wireless as a new and interesting DIY hobby or who simply wanted to know a bit more about the apparatus required for listening to broadcasts, turned to one or other of the various wireless publications that appeared during the 1920s. However, some were not as informative as they might have been. For example, to quote from an article for the absolute beginners; 'There is nothing really baffling about wireless. Two things alone are needed; imagination and a little common sense'. What, no components?

Technical terminology also became a little mixed at times: 'The waves sent out from any broadcasting station are only a fraction of a mile in length'. Well, why not; we're British!

'The object of tuning an aerial is to prepare it to vibrate at a certain frequency'. Twang!

'Sound waves differ from light, heat and wireless waves, in that their medium is air, whereas the latter waves are regarded as acting through a mysterious substance called "ether"' Available from most chemists! But it was all good clean fun once you got started.

Receivers and Circuits

The crystal set was the cheapest and easiest receiver to construct and a circuit similar to that shown in **Fig. 7** could drive at least two pairs of high resistance headphones. 'More sound can be obtained for the benefit of several listeners by placing the headphones in a large basin'. With two 'spaced' basins and headphones in each, one presumably got stereo!

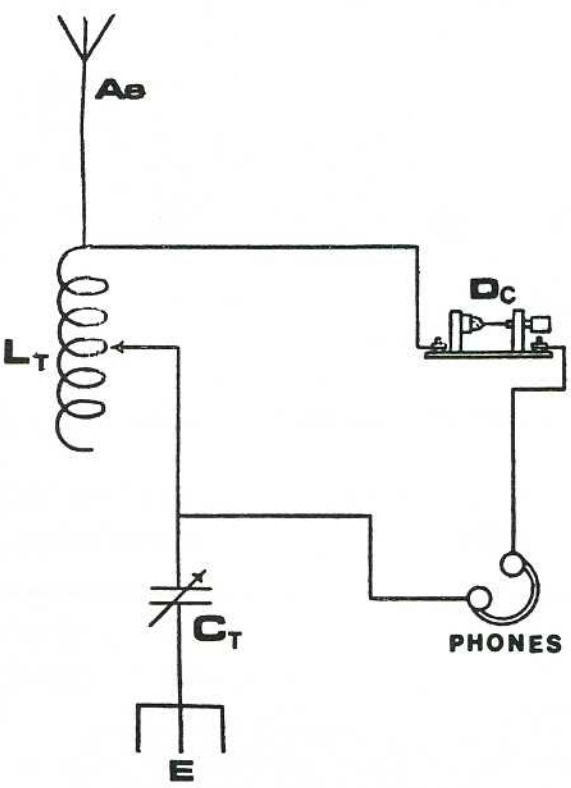


Fig. 7 - Typical crystal detector receiver of 1920s. Lt, tuning coil. Ct, tuning capacitor. Dc, crystal and 'cat's whisker'

The Valve Arrives

With the advent of the valve, the weak signals from crystal detectors could be amplified to deliver enough power (at least half a watt) to drive a magnetic diaphragm 'horn' loudspeaker. But, quoted one wireless magazine;

'The feeble currents set up in a receiving aerial a great distance from a transmitter, can be amplified into signals which can be heard by hundreds of people in a large hall' What big valves you have grandma!

The crystal detector was soon discarded in favour of the triode valve which served as both detector and LF amplifier. At first, triodes did duty as HF amplifiers, detectors and LF amplifiers.

An advertisement of the day offered: 'Best quality dull-emitter triode all purpose valves. Made in Austria. Special price, only 2/- each.'

Screened grid and pentode valves for use as HF and LF amplifiers came later.

Receiving Aerials

There wasn't really much to choose from. The most common arrangement was a long single length of stranded copper wire, or a twin wire system as in **Fig. 8**. The receiving licence actually allowed a maximum height for the aerial of 100 feet,

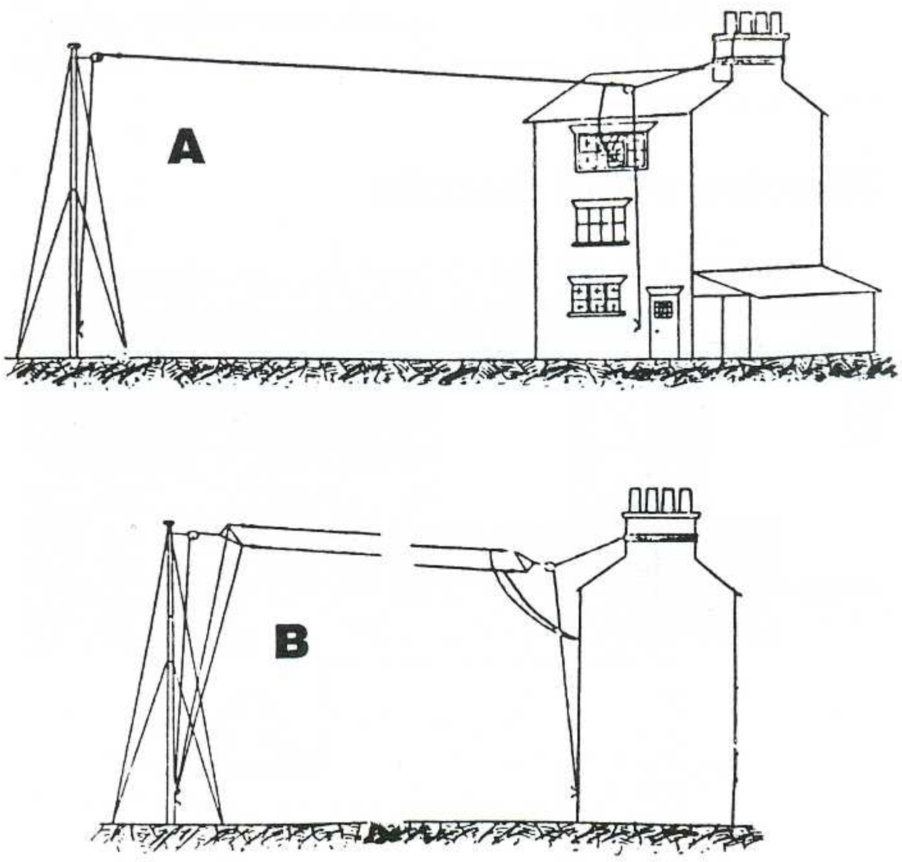


Fig. 8 - Typical receiving aerials of the 1920s. (a) Single wire. (b) Twin spread wires

although few exceeded 30 or 40 feet for reasons of safety, or to remain friendly with the neighbours. With the more sensitive receivers an 'indoor frame aerial', averagely 2 feet square could be used thus obviating the use of an 'unsightly' outside aerial. The frame aerial later became incorporated in the famous (?) five-valve-entirely-self-contained-battery-suitcase-portables. Most owners suffered from 'slipped discs'!

A Few Notable Events

1910 – London Police use wireless to effect arrest of the notorious Dr. Crippen for murder.
1912 – The letters SOS used in Morse code for the first time as a distress call during the *Titanic* disaster.
1921 – Wireless communication between air and ground. Transmissions from the Airship *R33* to report on traffic and relay results from the Derby.
1927 – The BBC were granted a Royal charter to provide a radio (and television) service to include information, education and entertainment without political or religious bias.

By the 1930s the 'listening public' were being well catered for. Wireless had become almost a 'domestic necessity', like tap water, to be turned on when required. ***RB***

RADIO BYGONES

IN OUR NEXT ISSUE – Due out March 26

Radio Valves & Tubes, Part 2 – Military Equivalents: RN, Army, RAF, USA
Famous Names, No. 1 – Radiospares Ltd
Restoring a Wartime Civilian Receiver

Contents subject to last-minute revision

Classic Book Review – No. 4

by Richard Q. Marris G2BZQ

The ARRL Handbook

The ARRL *Radio Amateur's Handbook* has been compiled and published on an annual basis since 1926 by the American Radio Relay League.

The Handbook is targeted at the listener as well as the transmitting amateur, and is always good value for money, irrespective of the year of publication. It is essentially a handbook for the practical enthusiast, with many equipment designs ranging from simple to quite complex, all very well illustrated with photographs, circuits, data, and easy-to-understand text.

Copies of earlier Handbooks are not too difficult to find. Many public libraries have copies dating back a few years, and sell off redundant stock from time to time. They can be found in small advertisements in various magazines, and at junk stalls and shops.

For this review I shall look at the 1943 20th Edition (published September 1942), which was the first to appear after the entry of the USA into World War II, and is therefore of particular interest. The Japanese attacked Pearl Harbour in December 1941, just one month after the 1942 19th Edition was published, although several reprints appeared in 1942. Britain had entered WWII two years earlier in 1939.

The 1943 Edition was conveniently divided into the introductory sections 'Amateur Radio' and 'Electrical and Radio Fundamentals'; Principles and Design (8 chapters); Construction and Data (10 chapters); and Operating and Regulatory (2 chapters). Being the first US wartime edition, the 'Catalog Section' at the back of the Handbook makes interesting reading, with patriotic and propaganda exhortations from various well-known manufacturers. For example, Hallicrafters tell us that they 'have important assignments defeating America's enemies' and 'our efforts have justified the award of the famous Army and Navy "E" flag'. They illustrate the Hallicrafters Complete Army Signal Corps Short Wave Communications Unit. All good stirring stuff!

The famous National HRO and 1-10 receivers are advertised among others. The E. F. Johnson Company heads its advert 'The Viking Family Fights for Freedom', and so it goes on, page after page, with a catalogue of famous US communications manufacturers, most of which are still in business.

Chapter 16 tells us all about the amateur-operated VHF/UHF Emergency Radio Service, formed as a communications service to aid in the protection of civilian life and property in the event of enemy air attack, which, fortunately for the USA mainland, never materialised.

The practical side of the Handbook is divided into receivers, transmitters and antennas, subdivided into chapters covering HF and VHF/UHF. As it would be quite impossible within the space of this article to review the large number of designs in these chapters, it is proposed to highlight just the simplest HF receiver and the simplest HF transmitter. It must be remembered that in the 1930s and 40s, many enthusiasts (SWL or TX) used such home-brew equipment to receive and transmit world-wide signals.

First, a one-tube Regenerative Receiver which uses just one double-triode valve as a regenerative detector and audio amplifier. Data is given for plug-in coils providing continuous coverage from 1700 to 18 000kc/s. Bandspread tuning made the RX equally suitable for general coverage broadcast reception or use on the amateur bands. Such a receiver could easily be reproduced today, at low cost, though an audio output transformer should be inserted in the position marked 'PHONES' on the circuit '**A**', to isolate the phones from the HT voltage, and also to enable the use of modern low impedance headphones. With this minor safety addition, the sensitivity could then be improved by using up to 100 volts HT. With a good antenna you could hear the world of AM and CW.

Second, a Simple Tetrode Oscillator Transmitter. The 6L6 transmitter circuit in '**B**' will bring back memories to older G's. Most of us used similar transmitters giving 15 to 20 watts output on the HF bands. Possibly we substituted a 6V6 valve with an HT of 250/300 volts, giving a power of under 10 watts.

This one-valve TX could be used on Top Band, 80 and 40 using plug-in coils and quartz crystals for each band. A 3.5Mc/s crystal could be doubled up to 7Mc/s to economise on crystals. The antenna was either an end-fed, half-wave wire tapped onto the tank coil (bad practice in these days of TVI!), or a feedline could be taken from the tank link coupling coil to an ATU. Page 27>

A

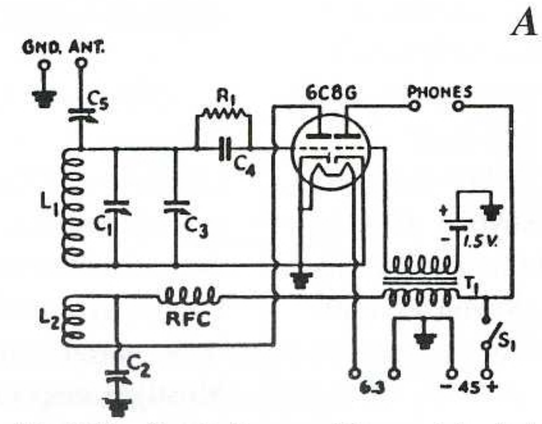


Fig. 1103 — Circuit diagram of the one-tube dual-triode regenerative receiver.

C_1, C_2 — 100-μμfd. variable (Hammarlund SM-100).
C_3 — 15-μμfd. variable (Hammarlund SM-15).
C_4 — 100-μμfd. mica.
C_5 — 3–30-μμfd. mica trimmer (National M-30).
R_1 — 1 megohm, ½ watt.
L_1, L_2 — See coil table.
T_1 — Audio transformer, interstage type, 3:1 ratio (Thordarson T13A34).
S_1 — S.p.s.t. toggle switch.
RFC — 2.5-mh. r.f. choke.

B

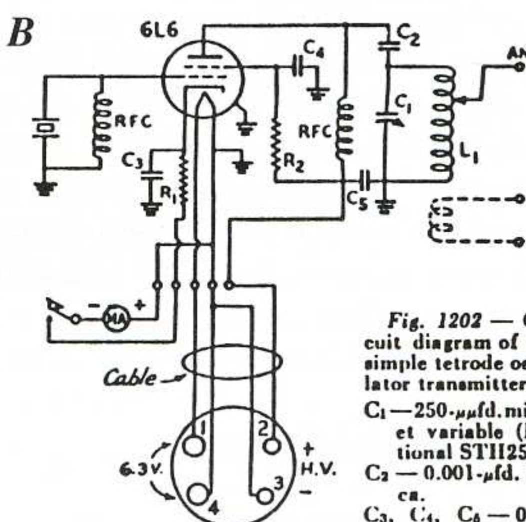


Fig. 1202 — Circuit diagram of the simple tetrode oscillator transmitter.

C_1 — 250-μμfd. midget variable (National STH250).
C_2 — 0.001-μfd. mica.
C_3, C_4, C_5 — 0.01-μfd. paper.
R_1 — 200 ohms, 2-watt.
R_2 — 15,000 ohms, 2-watt.
RFC — 2.5-mh. r.f. choke.
L_1 — 1.75 Mc. — 42 turns No. 22 enam., 2 in. long.
3.5 Mc. — 21 turns No. 18 enam., 2 in. long.
7 Mc. — 15 turns No. 18 enam., 2 in. long.
All coils wound on 4-prong, 1½-in. dia. forms.

Why *Q*?

by Charles H. Langton MSc C.Eng MIEE G3DOM

Correspondence in the technical press recently has revealed an interest in the origin of the symbol Q in relation to the circuit magnification factor of a tuned circuit. The reader may feel that an equal measure of curiosity should be generated about the origin of Z (impedance), G (conductance), B (susceptance), etc. So why pick on Q?

I do not know what the motives of the other Q-seekers are, neither can I satisfy the question of the origin of Q. I can only convey my personal thoughts about Q, which are entirely different from those I have about Z and the rest.

In those exciting, early days of 'wireless' there were no engineering courses in the subject. The nearest formal routes involved a study of power electrical engineering, or physics. Some transferred from the career of telegraph operator at sea or on shore. Although the early leaders in the field of wireless were often from one or other of these camps, the vast majority of entrants into the wireless domain comprised amateurs whose enthusiasm generated the self-discipline required to study the subject beyond the point of set construction.

This was a different experience. The concept of machines (even the horseless carriage) could in general be understood, however vaguely. But wireless was magic. The whole concept was magic. Invisible waves travelling through an indefinable aether (let's not start that all over again), launched from awe-inspiring towers bedecked with festoons of wires. To be picked up on a receiving aerial slung across the back yard between the chimney stack and an extended washing pole. The porcelain egg-insulators at each end of the wire were vital (or so we thought. Useless, in fact). They started off white, and became soot coloured after three months, thereby changing into egg shaped carbon resistors.

Then there was the lead-in tube. Undoubtedly the cause of more premature rot in window frames than any other single factor. Everyone had one, though. But whilst in this area, the biggest prize of all must go to the inevitable aerial-earthing knife switch (available from any 'NOTHING OVER SIXPENCE' shop). At bedtime every night, countless listeners would conscientiously earth the aerial by means of this puny agent. They then, presumably, slept content in the belief that their installation was protected against lightning. Anyone who has witnessed the result of an aerial 'struck' by lightning will verify that there remains no trace of the aerial wire, downlead, knife switch, or receiver front end. All have evaporated.

To the Sideboard

The magic continues to flow. Having religiously insulated the aerial wires and lead-in as already mentioned, the wire as often as not was bundled out of sight under the carpet to emerge behind the sideboard upon which THE SET was assembled. Sometimes the wireless set was in a cabinet, mostly it sprawled across the sideboard in full glory. This was necessary in order to facilitate frequent servicing.

But what a breathtaking sight, guaranteed to leave a small (or large) boy spellbound. With or without a cabinet, the shiny black ebonite panel bristling with knobs informatively engraved 0–180 degrees. There were no capacitors in those days, only condensers. The centimetre was still with us as a unit of capacitance, but the jar had become obsolete.

$$1 \text{ jar} = 1000\text{cm} = 900\text{pF}$$

The skill of the operator in tuning-in to a station was matched by the mystique radiated by the interleaving of the plates of the tuning condenser. He would refer to a chart on the wall, muttering 'aerial series condenser 115°, RF coupling 20°, aerial tuning 95°.' Eventually he would succeed in short-lived triumph just as the filament accumulator faded off. There is no doubt, however, that the half-hour watching this performance was vastly more entertaining than any broadcast programme could be.

The sight of a row of highly polished silvery valves reduced strong men to silence. The most knowledgeable pointed out that the valves were deliberately silvered so that the likes of us could not see inside. In that way the manufacturer seeks to prevent anyone from learning his trade secrets. Magic.

A set employing three or more valves certainly warranted a loudspeaker. Nothing more elegant than the old horn loudspeaker has ever appeared on the sideboard since the days when this exponential question mark looked down from its lofty position above the HT battery. In those days, the words emanating from such loudspeakers reflected a dignity and respect totally unknown to many present day broadcasters.

Modern loudspeakers may sound better to some people, but what has happened to the character, the personality?

Wind Your Own

Most fascinating of all, however, were the coils. Call them inductors if you like. You see, we silently acknowledged that valves were above our head. Too much for ordinary schoolboys to comprehend. Leave all that to Fleming and de Forest. But the coils. We could wind our own coils, and wind them we did. Long wave, medium wave, short wave (100 metres), reaction coils, aerial coupling coils, honeycomb coils, pancake coils. Mostly, I suspect, the coil finished up pile-wound upon a toilet-roll insert. Plug-in, of course. Nothing quite so satisfying as adjusting the coupling between a pair of swinging plug-in coils. Optimisation at its best.

They were all there. Igranic ('What are the wild waves saying?'), Colvern, Varley, Telsen, Lissen, etc. Everything depended upon the coil. One set worked better than another because its coils were better. How or why was another mystery.

Oliver Lodge was one of the first to appreciate the need for tuning aerials and receivers in sympathy with the incoming waves (it wasn't always obvious). He also talked about damping, so the idea grew that a good coil should have low losses (low resistance).

But a coil must have a minimum inductance in order to resonate at the desired frequency. It materialised, therefore, that an effective measure of a good coil was the ratio of its inductance to its resistance. It was not long before the self-capacitance of a coil was seen to reduce the tuning range. Techniques were then applied to wind coils so as to have a low capacitance.

A conductor has a higher resistance when used at radio frequencies than it does at DC or low frequency, due to **skin effect**. This is because high frequency currents tend to flow only on the surface of the wire. Litz wire was introduced to combat this problem in receiver coils, whilst silver plated copper tube was used to wind transmitter coils. After World War II, ex-RAF continuously variable silver plated coils (roller-coasters) were popular amongst radio amateurs. Variometers came and went. They suffered from the disadvantage that although the inductance could be varied, the resistance remained the same, and so the *L/R* ratio varied widely as you tuned over the range.

Enter *Q*

It seems to me that in the earliest days the electrical tuned circuit was (rightly) treated as a resonator having losses. Such damping was measured by a factor known as logarithmic decrement. This approach follows from studies in acoustics, electrical energy distribution, and telegraph lines. Later, when the tuned circuit was considered as a resonant magnifier (owing to the development of the tuned amplifier) the advantages of employing a measure which described the magnification of the circuit at its resonant frequency rather than its losses soon became apparent. Thus the idea of circuit magnification factor was born, and in due course this acquired the well-known symbol *Q*.

A tuned circuit requires two components, *L* and *C*. In practice, both contain losses which are usually represented by resistance *R*. A 'good' tuned circuit is one which possesses a high *Q* factor, that is small losses. However, in practice the losses in a capacitor are usually negligible compared with those of a coil, and so the *Q* of the circuit is dictated almost entirely by the coil losses. Because of this, it is almost universal practice to talk about the *Q* factor of the coil only. This is almost always the same value as that of the complete circuit.

Which reminds me that this is what these notes are all about. Exactly who decided to use the symbol *Q* I do not know. The earliest reference to this symbol amongst my archives is given in an article by W. T. Cocking in *The Wireless World*, 10 July 1936. Earlier journals include a good deal about circuit magnification factor but do not mention *Q*.

The *Admiralty Handbook* for 1925 mentions decrement but not *Q*. The 1938 version adequately repairs this earlier deficiency. The first City and Guilds examination paper to include a question referring to ' ... the *Q* value of a tuned circuit ...', as far as I know, appeared in Grade II, 1939.

After its surreptitious arrival, *Q* rapidly made its mark. A *Q* value was assigned to everything which resonated; aerials, crystals, tuning forks, tuned feeders (*Q*-bars), wave-guides, etc. Because *Q* was easy to measure we rapidly acquired a good insight into good and bad design of coils. The out-dated *L/R* ratio did not tell you how a coil would perform at any given frequency. On the other hand the *Q* factor was defined at the desired working frequency.

Today, *Q* is merely a symbol on a syllabus, alongside *R*, *Z*, *B*, etc. The definition will be something like '... ratio between energy stored and energy dissipated ...' Ah, well. Today's students do have satellites, robots, laser systems, micro-processors, and opto-electronics to get on with.

Let me see now, aerial tuning 17°, reaction 85°, filament rheostat half on, with luck I may still be in time for the nine o'clock news... !

Further Reading

An excellent account of the historical background to *Q* is given by Professor P. B. Fellgett in the *Journal of the IERE*, February 1986.

RB

CLASSIC BOOK REVIEW

continued from page 25

The separate AC Power Supply circuit 'C' delivered 450 volts at 130mA. If a 6V6 valve was substituted for the 6L6, it required only 250 to 300 volts. Both the 6L6 and 6V6 were (and still are) very robust, and capable of being abused, unlike modern transistors. Such transmitters worked the world!

The 1943 ARRL Handbook contained about 480 pages, plus a Catalog section of 103 pages. In all there were 6 HF receiver designs (including a 7-valve single-signal superhet), and 14 HF transmitter designs including a mighty kilowatt job. In addition there were many constructional descriptions for VHF/UHF receivers and transmitters, antennas, measuring equipment and instruments, and 7 introductory chapters on principles and design. In all, 1902 circuits and photographs, excluding the data tables and illustrated advertisements.

C

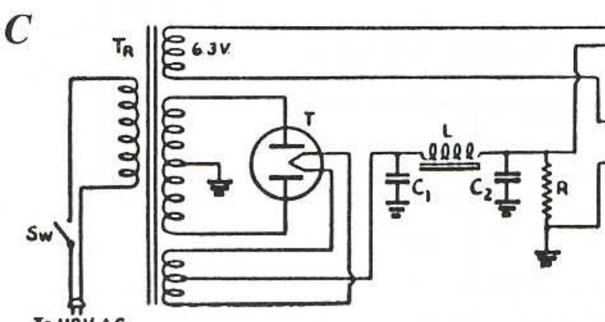


Fig. 1204 — Circuit diagram of the 450-volt, 130-ma. power supply pictured in Fig. 1203.
C_1 — 4 μfd., 600 volts, electrolytic (Mallory HS691).
C_2 — 8 μfd., 600 volts, electrolytic (Mallory HS693).
L — Filter choke, 10 hy., 175 ma., 100 ohms (Utah 4667).
R — 15,000 ohms, 25 watts.
T — Type-80 rectifier.
Tr — Combination transformer: High-voltage winding delivering 400 volts, r.m.s. each side of center, rectifier filament winding, 5 volts, 3 amp., r.f. filament winding, 6.3 volts, 6 amp. (Utah Y616).

Alas space does not permit me to describe all these 'goodies', but suffice it to say that any ARRL *Radio Amateur's Handbook*, old or modern, at a sensible price, should be snapped up by the enthusiast. The several old copies which I have were bought at prices ranging from 10 pence to £4 each.

The 1943 ARRL Handbook had a cover price of just $1. The prevailing rate of exchange at that time was four US Dollars to one Pound Sterling, giving a present-day equivalent price of just 'Five Bob' or 25 pence!

RB

The Coming of the Superhet

Part 2 – The Flood

by Lorin Knight MIEE G2DXK

The year 1930 arrived and there were still no superhets being manufactured in Britain.

In March that year the second of the BBC's two transmitters at Brookmans Park came on the air. For the first time, the Home Counties were being served by two high-powered medium-wave stations (London Regional and London National) and, much to their dismay, the owners of many of the older valved receivers found they could not separate the two stations. This highlighted a growing awareness that, as more and more stations came on the air, selectivity requirements were going to become more and more exacting. In the *Wireless World* issue of October 1, A. L. M. Sowerby expressed the view that high selectivity, combined with good audio quality, would never be achieved by the TRF receiver, but that it ought to be achievable by a suitably designed superhet. He consequently foresaw that the superhet, in some improved form, might eventually become popular again at the top end of the market. A few days later, as if in answer, an improved form of superhet appeared at the Manchester Radio Show. It was Majestic Radio's Model 50, which they were importing from the USA (where development of the superhet had never ceased).

It was a self-contained model for AC mains operation and made good use of the screen-grid valve, which had first become available around 1927. It Had an RF stage, a two-valve frequency changer, one IF stage, an anode-bend detector and a push-pull triode output stage driving a moving-coil speaker. Image rejection was very much better than the earlier superhets because it had the relatively high IF of 175kHz and it had two signal-frequency tuned circuits. Its reproduction of the higher audio frequencies was better than that of the earlier superhets because of its use of band-pass circuits in the IF amplifier. Moreover it had the simplicity of a single tuning dial which was calibrated in kc/s.

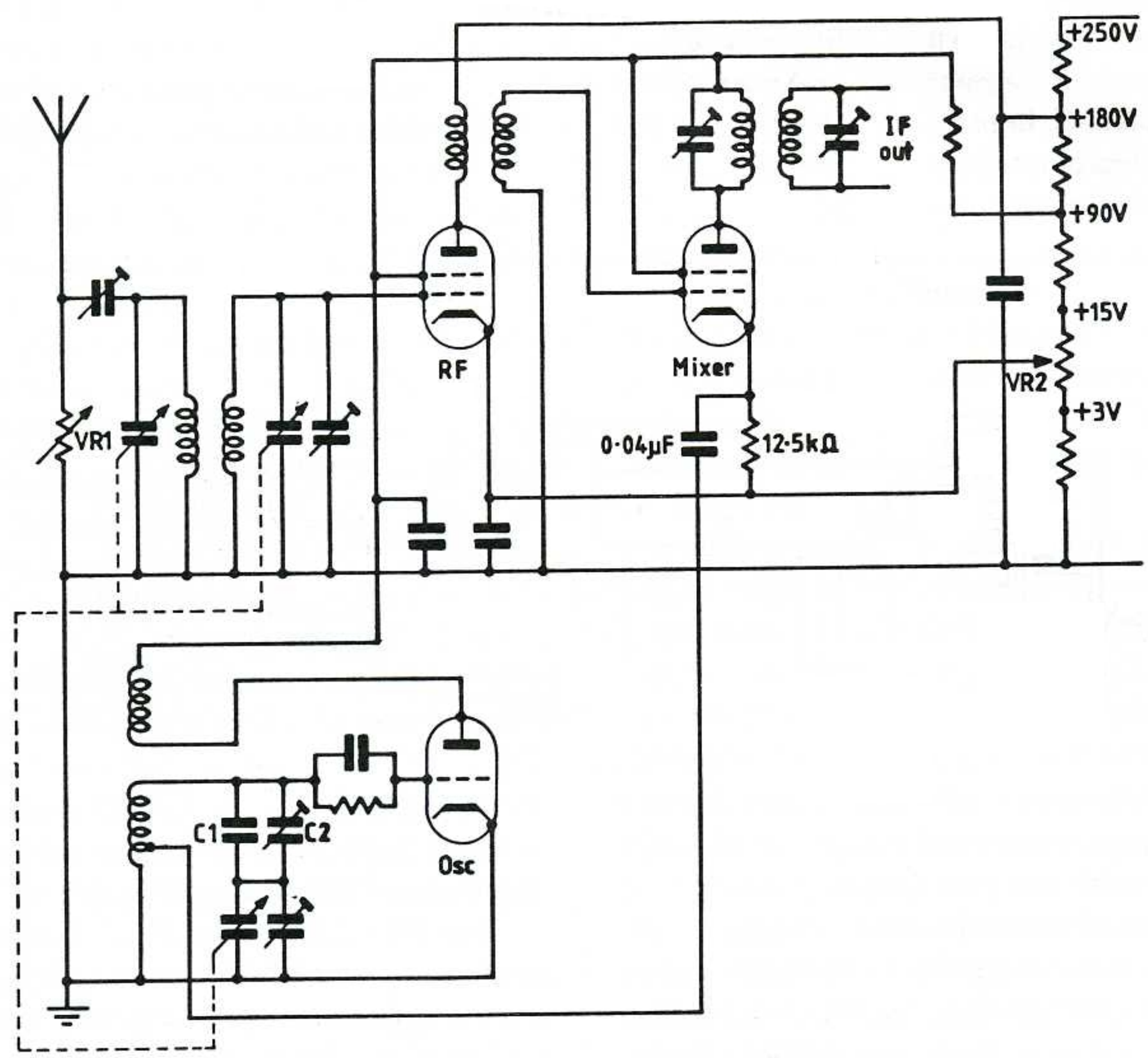


Fig. 2.1 - Front end of the Majestic Model 50 (1931). Note that VR1 and VR2 were ganged

At 28 guineas (£29.40), it was somewhat more expensive than a self-contained AC mains TRF and, originating in America, it had no long-wave band. Nevertheless, it was a very attractive receiver. *Wireless World* considered its performance 'something of a revelation' and hailed it as the forerunner of a new class of receiver.

There had, in fact, been two British-made battery superhets put on the market earlier in 1930 but these were not in the same class and seem to have attracted very little attention. The Rialton 'Melva' receiver used screen-grid valves but had no RF stage. It had two tuning dials and its volume control varied the filament voltage of some of the valves. The Rees Mace 'Tourist Seven' did have a screen-grid RF stage but had three tuning dials. Both were considerably more expensive than the Majestic receiver.

During the following year, 1931, several British-made AC mains superhets with single-dial tuning appeared on the market, including table models from Kolster-Brandes and Radio Instruments, and a radio-gramophone from RGD. The flood gates then opened and during 1932 and 1933, 30 or more British manufacturers brought out superhets. The simpler sets usually had five valves – a single-valve frequency changer, one IF valve, a triode detector, a pentode output valve and a full-wave rectifier. The more expensive ones had up to ten valves.

Although the main emphasis was firmly on AC models, a few manufacturers had battery models – and one or two had DC models. The fashion for frame aerials had gone and the only ones seen were inside battery portables. In America, where there were no LW broadcasting stations, 175kHz had become the standard intermediate frequency. British manufacturers had to use a frequency outside the LW band and almost all of them chose a frequency between 110 and 125kHz. This unfortunately made it a little more difficult to obtain good image rejection.

Front-end Design

The circuit of the front end of the Majestic Model 50, the set that led the revival, is shown in **Fig. 2.1**. It had a screen-grid mixer valve, with the oscillator signal injected into the cathode circuit. There was a double-tuned band-pass circuit between the aerial and the RF amplifier, and an aperiodic coupling between that stage and the mixer. The tuning capacitor had three identical sections and used a padder, consisting of C1 and C2, in the oscillator circuit to obtain correct tracking with the two signal-frequency circuits. Similar frequency changers were used in many of the British receivers, with a variety of different oscillator circuits and with various ways of injecting the oscillator signal into the cathode of the mixer valve: some injected the oscillator signal into the grid circuit instead. The British sets, of course, had to cover the long-wave band as well: this required a wavechange switch and the added complications that entailed. Most manufacturers used ganged capacitors which had all sections identical but there were some who had specially shaped vanes for the oscillator section, thus eliminating the need for a padding capacitor.

The cheaper sets economised by using a single-valve frequency changer. This usually employed a screen-grid valve in a circuit such as in **Fig. 2.2(a)**. The Murphy Model A4 (1933) had a quite different circuit (**Fig. 2.2(b)**) using an output pentode, which had a much higher slope than any RF pentode of the day and consequently gave a much better conversion gain. This circuit provided quite good isolation because the oscillator signal reaching the grid via the grid/screen capacitance was neutralised by an out-of-phase signal via the grid/anode capacitance. The capacitance Cb was added to give a very close balance.

One disadvantage of these single-valve frequency changers was that the gain could not be successfully controlled by varying the bias voltage. This disadvantage, however, did not apply to the pentagrid valve, which arrived from America in 1933 and was the first valve to be designed specifically as a frequency changer. One of the first British manu-

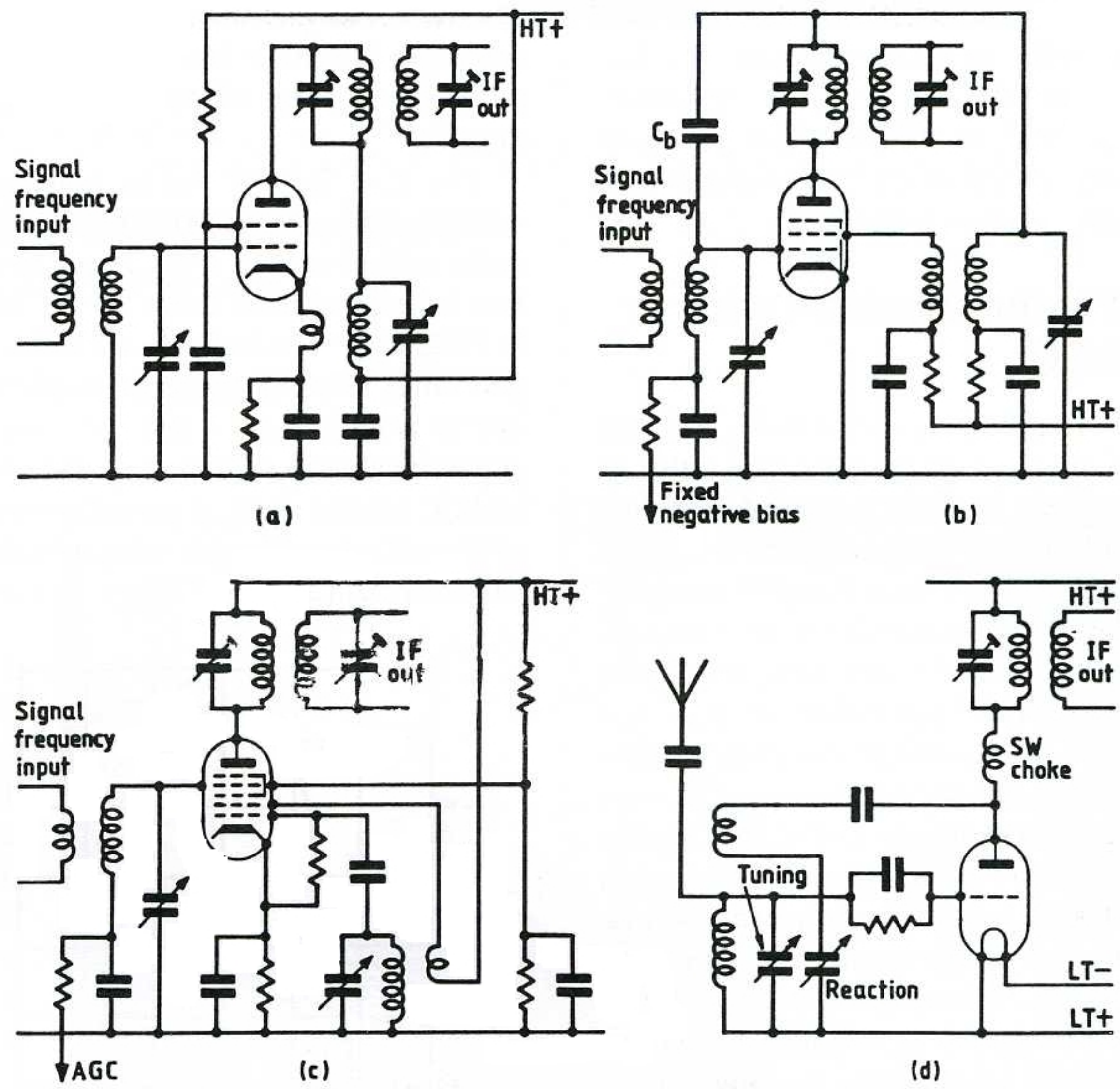


Fig. 2.2 - Typical single-valve frequency changers (1931–33). (a) Using screen grid valve. (b) Using output pentode. (c) Using heptode. (d) Autodyne circuit, as used for short-wave receivers (note use of reaction control for adjusting oscillator for optimum performance). The circuits in (a), (b) and (c) have been simplified for clarity, by the omission of band-switching and of trimming and padding capacitors

facturers to use it was the City Accumulator Co. In their 1933 'Lancastria' receiver, Ferranti used a similar valve of their own manufacture, which they called a heptode (**Fig. 2.2(c)**).

In sets having no RF stage it was standard practice to have a double-tuned band-pass circuit between the aerial and the frequency changer. It was difficult, however, to obtain really good image rejection with only two tuned circuits at the signal frequency and, in their 1933 models, several companies, including Ferranti, Majestic and GEC, used a circuit arrangement which gave an enhanced image rejection. The basis of this circuitry was a small coupling winding on the aerial coil which was connected in the cathode circuit of the RF amplifier (or the mixer if there was no RF stage). I don't profess to know exactly how this worked. The only explanation I have seen was rather enigmatic and said, 'the circuit constants are adjusted so that the feed-back tends to neutralise all incoming signals, other than those to which the set is tuned.'

The autodyne frequency changer was not yet completely dead. It still found use in some home-constructed SW receivers and in 1931 was used by McMichael in their 'Colonial Receiver' – a battery superhet designed primarily for overseas listeners to receive the SW broadcasts from Britain. With the low intermediate frequencies then in use it was impossible to get any significant image rejection on the SW bands. It was an easy way out, therefore, to accept image interference as a fact of life and use a simple autodyne circuit such as in **Fig. 2.2(d)**.

Because the signal frequency and the oscillator frequency were only of the order of 1 per cent apart, there was no need to have a separate signal-frequency circuit and the aerial could be connected directly into the oscillator circuit. Thus one had the simplicity of a single tuning capacitor, and band changing could be accomplished very simply by plugging in a different oscillator coil. There must have been considerable radiation from the aerial, but nobody seemed to worry about that!

As they became available, pentode versions of the screen-grid valve started to be used instead of the earlier tetrodes. Variable-mu valves started to come into use in 1932 and, by 1933, were almost universal for RF amplifiers and fairly widely used for the mixer stage in two-valve frequency changers.

IF Amplification and AGC

The simpler sets usually had one IF stage, using a screen-grid valve or pentode and two screened IF transformers. Each transformer contained two tuned circuits, complete with trimming capacitors, the coupling between the coils being arranged to give fairly flat-topped IF response. Some of the more expensive sets had a second IF stage. One of these was the Murphy Model A8, which came out in 1932. It had a total of three double-tuned IF transformers operating at 120kHz, and is an early example of a receiver in which considerable care was taken to obtain a response which was fairly flat out to around ±4½kHz and then fell away steeply. (See **Fig. 2.3**).

As with the RF stage, the use of variable-mu valves had become general practice by 1933.

The Alba Model 56 (1933) was unique at that time in having an IF of 473kHz. This meant that it was able to obtain adequate image rejection with just one tuned circuit ahead of the frequency changer. There was, however, a price to pay. The inherent selectivity of the IF circuits was distinctly inferior at this frequency. Alba therefore used a regenerative IF stage in order to sharpen up the selectivity, making the 'reaction' control accessible from the back of the cabinet.

The Varley Model AP43 also had an unusual IF stage. This receiver had the luxury of an RF stage but made up for it by having no IF amplifier. There was just a band-pass circuit between the frequency changer and the detector stage, the latter being made regenerative to enhance the selectivity and gain.

Several manufacturers, including Radio Industries in 1931, Alba in 1932 and Eldeco in 1933, brought out 'Stenode' models. These had extremely sharply tuned IF circuits and compensated for the resultant sideband clipping by having an AF stage with a greatly enhanced high-frequency response. The inventor of the 'Stenode' concept, a Dr Robinson, maintained that it represented a major breakthrough, but this view was not universally shared. One thing is certain: when a 'Stenode' receiver was a little off tune it sounded horrible!

The first British set to employ automatic gain control (AGC), or automatic volume control (AVC) as it was then called, was the Murphy Model A8 in 1932. This set had variable-mu screen-grid valves for its RF amplifier, its mixer and its two IF stages – and AGC was applied to all four. Within a year the use of AGC became standard practice, some of the more expensive sets using an extra valve to obtain amplified AGC.

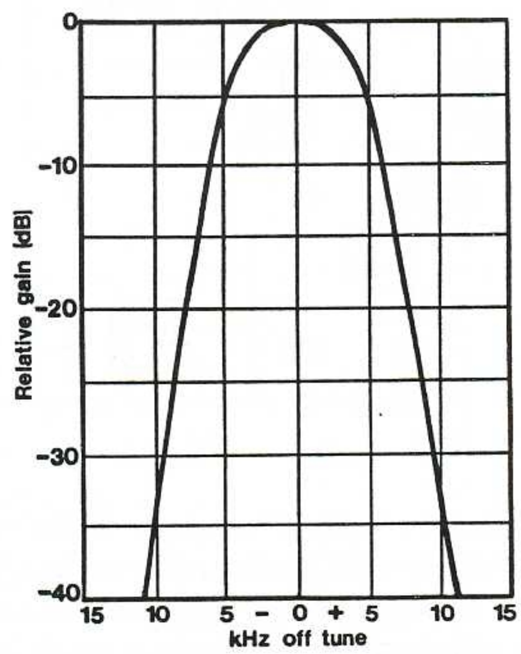


Fig. 2.3 - The IF response of the Murphy Model A8

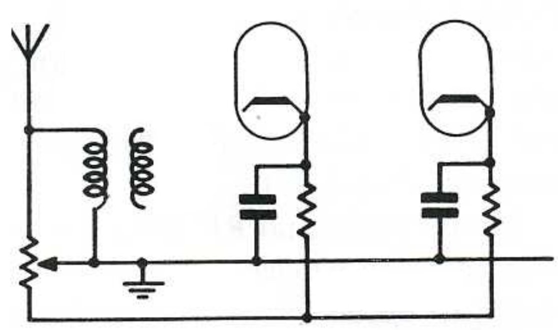


Fig. 2.4 - A volume control circuit often used on sets having no AGC

AGC confronted listeners with two new phenomena. Firstly they could no longer judge the correct tuning point by the amplitude of the sound output and had instead to judge it by the quality of the output, a process some of them found a little strange. In a few receivers they were given some assistance in the form of a tuning indicator, consisting of a meter which monitored the anode current of one of the controlled valves.

The other phenomenon was a rise in noise level in between stations,which some listeners found a little alarming. In some of the more expensive sets the manufacturers added quiet AGC, which muted the receiver when the input signal dropped below some predetermined threshold. Some other sets had a noise suppression switch which, by modifying the AGC circuits, limited the maximum achievable sensitivity.This would be switched in for tuning and then switched out again.

Before the arrival of AGC, it was standard practice to use a triode or screen-grid detector, often in the anode-bend mode, the output of such a detector being adequate to drive the output stage directly. With the introduction of AGC, the use of diodes became standard practice for detection and AGC. It became normal then to have a double-diode-triode, the triode being used for AF amplification. A few sets, however, used the miniature 'Westector' copper-oxide rectifier for the AGC.

Sets with AGC had an AF volume control between the detector and the first AF stage. On sets without AGC, the volume control was, in effect, an RF/IF gain control, varying the bias on some or all of the valves ahead of the detector stage. Sometimes, there was additionally a variable resistance between aerial and earth. The Majestic Model 50 used a two-gang potentiometer to do this (see Fig. 2.1) but later sets economised by using a single potentiometer as in **Fig. 2.4**.

The output stage was usually a single pentode but some of the larger receivers, particularly those in radiograms, had two triodes or two pentodes in push-pull. By now loudspeakers were almost always of the moving-coil type, most AC sets using so-called 'mains-energised' types and employing the field coil of the loudspeaker as a smoothing choke in the HT supply.

Market Domination

By 1934 the superhet completely dominated the market and practically every manufacturer had, as his bread and butter model, a '4V + Rect' superhet. The last major company to turn to the superhet was Philips. During the early 1930s they had continued to develop and improve their 'Superinductance' sets, a range of superior TRF receivers which, in performance and ease of handling, were quite similar to a superhet. Eventually, however, Philips had to acknowledge that the TRF was losing out to the superhet, both in performance and price. They brought out their first superhet in 1934 and their last 'Superinductance' model in 1935. ***RB***

Feedback...

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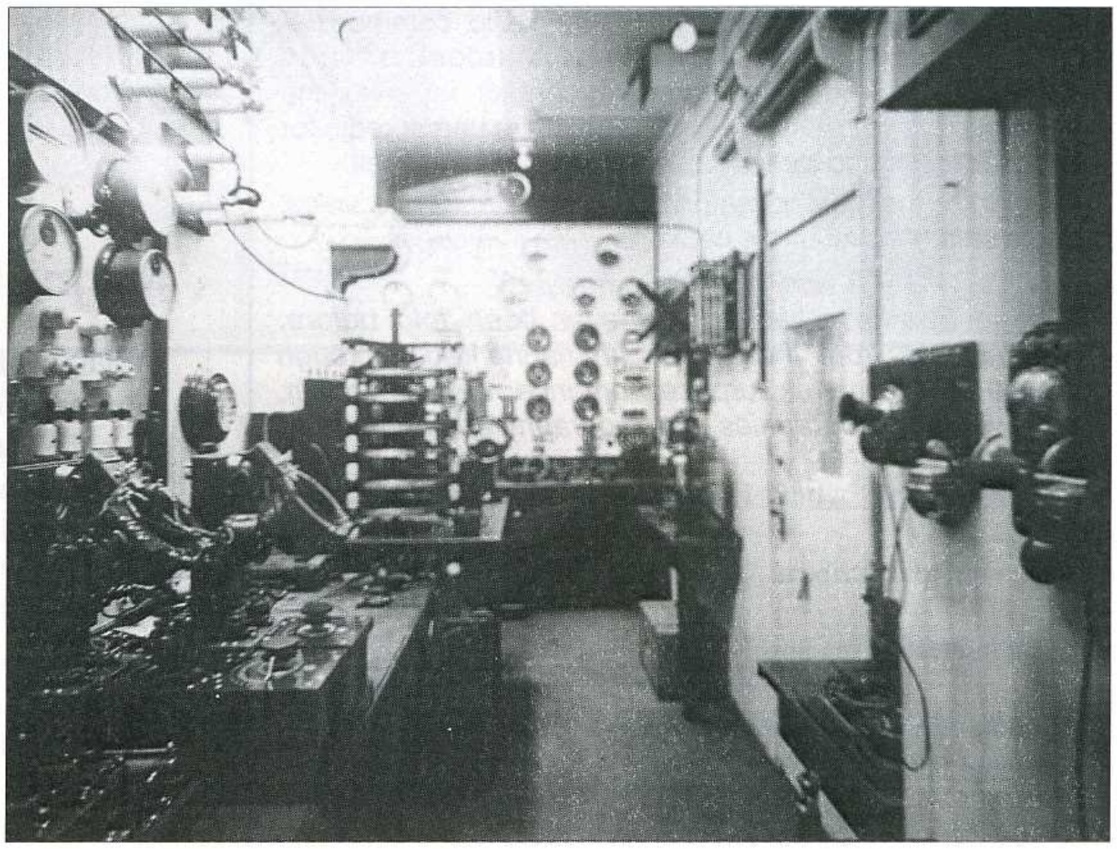
Marine Radio 1912



The photograph shows the wireless room of the German luxury liner *Imperator*, as it was in 1912. Beginning at the lower left-hand corner of the picture, the equipment is as follows.

The first item is control gear, and next to it are two Telefunken receivers Type Et5a Mk.2. These have two tuning condensers against one of the Mk.1 model and the coils can be changed. The thing with circles round it further into the room is a 'tragbar', i.e. portable transmitter of 250 watts. Portable is a relative term, meaning in this case that it can be moved from Point A to Point B by two hefty bods without them developing a hernia, so long as A and B aren't more than 6 feet apart!.

On the far wall in the fancy cabinet is a long-wave alternator frequency-multiplier radiotelephone transmitter. The signal starts at 10kc/s and is quadrupled to 40kc/s, then quadrupled again to the working frequency of 160kc/s. The actual power radiated from the 10kW input was about 6kW. The multiple microphone so necessary is on the end of the bench at the right-hand side. This transmitter on *Imperator* when used on CW could contact either shore of the Atlantic at will – a similar transmitter was used ashore for speech communications from Berlin to Vienna.

The spider coils on the wall with Leyden jars are the normal Telefunken transmitter Type TK1.2 with about a kilowatt output. Under the telephones on the wall are a couple of pieces of gear that 'fell off the back of a truck', two Marconi solid dielectric variable condensers – I wonder where they came from!

Imperator was taken as reparations at the end of World War I. I knew an operator who served in her after handing over, when she was renamed and in passenger service. The 10kW transmitter was still in the wireless room, though apparently not used.

Norman Burton
Revesby, NSW, Australia

The 1913 edition of the Yearbook of Wireless Telegraphy and Telephony *lists the* Imperator *as operating with callsign DIR, with a normal range of 150km on 300, 450 and 600 metres and offering a 24-hour general service. – Ed.*

E52 Köln Receiver

In the February 1990 *Bulletin* of the New Zealand Vintage Radio Society there is an article on the German E52 military receiver. One of the NZVRS members has pointed out an error in the manufacturer's circuit diagram of the E52 which was used to illustrate that article, and also the one by Neil Clyne published in *Radio Bygones* No. 7.

The mistake is in the area of valve Rö5, whose grid and anode circuits are shown connected together, with the +140V HT supply via point 9 on the circuit going to the junction of two capacitors, C148 and C163.

In fact, the lower end of tuned circuit L38/C148 goes to +140V, decoupled by C163. The lower end of the CR combination C164/W19 goes to chassis via L37.

Considering the rarity of these sets, it seems quite a coincidence that two such articles should have appeared in such widely separated parts of the world at much the same time.

John W. Stokes
Auckland 4, NZ

R-390A Heater Ballast

I have recently become the proud owner of an R-390A receiver (courtesy of *RB*'s Readers' ADs), and would like to pass on the following tip, for what it's worth.

During a brief internal inspection of my receiver after purchase, I noticed that the position formerly occupied by the RTS-10 barretter tube on the IF Amplifier chassis was actually filled by a PCL83. This valve has the same heater rating, (12.6V at 0.3A) as the 12BY7A recommended for use in this position in Peter Hopwood's article on the 390A in *RB* No. 4; however, in my experience, the PCL83 works just as well and is both more widely available and much cheaper than the 12BY7A.

A rummage through a job lot of mixed valves at a junk sale or radio rally will often produce one or two PCL83s in good enough condition for use as a heater ballast at maybe 10p or 20p each, compared to £8 or more apiece for the 12BY7A.

Neil Clyne
Uxbridge, Middx.

Southdown

Can anyone remember a radio works in the Newhaven, Sussex, area producing 5-valve superhets bearing the name 'Southdown' during the mid 1940s? Any information regarding the company and/or its location would be much appreciated and all postal expenses will be paid.

Anode Electronics, 8 Wilderness Road, Plymouth PL3 4RN

Marine Emergency

I found Jeff Harris' account of the East Goodwin lightship happening (*Radio Bygones* No. 8) an interesting expansion of the rather bald accounts given elsewhere, not least being the manner in which Lloyds played down the whole affair. Could this be to discourage any large insurance claim? However, in taking the transmitter circuit as typical of those actually in use by Marconi in 1900, both Jeff Harris and W. J. Baker before him have assumed that the adjustable loading coil in the aerial circuit was introduced by Marconi in 1900. Reference to the 7777 British Patent associates that particular circuit not with the Provisional Application of April 1900, but with the Final Application of February 1901. The 1900 application does however describe a tapped transmitting 'jigger' or aerial transformer.

There is further evidence in photographs of the period, such as have been reproduced in the 1984 Marconi Company booklet *Guglielmo Marconi* and elsewhere, and in a surviving 1900 jigger in the Science Museum, to suggest that an **untapped** jigger was used at that time. And the inductance of that jigger secondary was about right to resonate some ninety-odd feet of vertical wire, as seen in the engraving of the lightship, to the Marconi 'Tune A' wavelength of 60 metres or thereabouts, under end-fed half-wavelength conditions, **without any loading coil**.

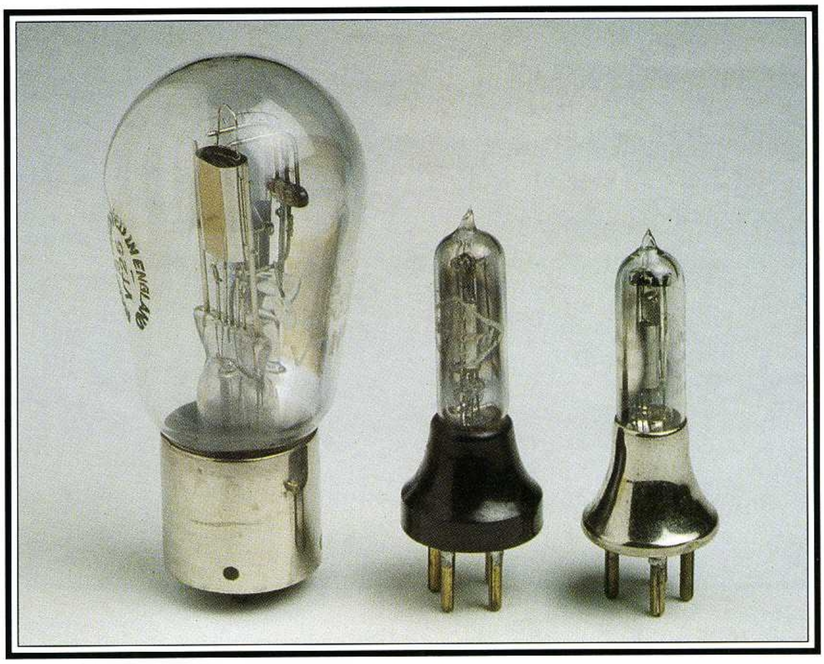
If one turns to the slightly later picture of the wireless equipment on the *Philadelphia* in 1902, the extra terminals on the front of the wall-mounted jigger suggest to me that we are seeing a tapped jigger in use. However, working at a distance with Poldhu would have required much longer wavelengths than 60 metres. There are various ways in which this could have been achieved. But it looks to me as though, in that photograph, there may be a loose coil or hank of wire on the net above the jigger, acting as aerial loading coil, without however any obvious means of adjustment.

So I conclude that any factory-built aerial loading coil of an adjustable kind is likely to appear in use **after** the 1902 *Philadelphia* tests, in ships at sea. But just when I cannot say. It would certainly be of interest to see any further evidence on the dating of the Marconi advances in aerial tuning.

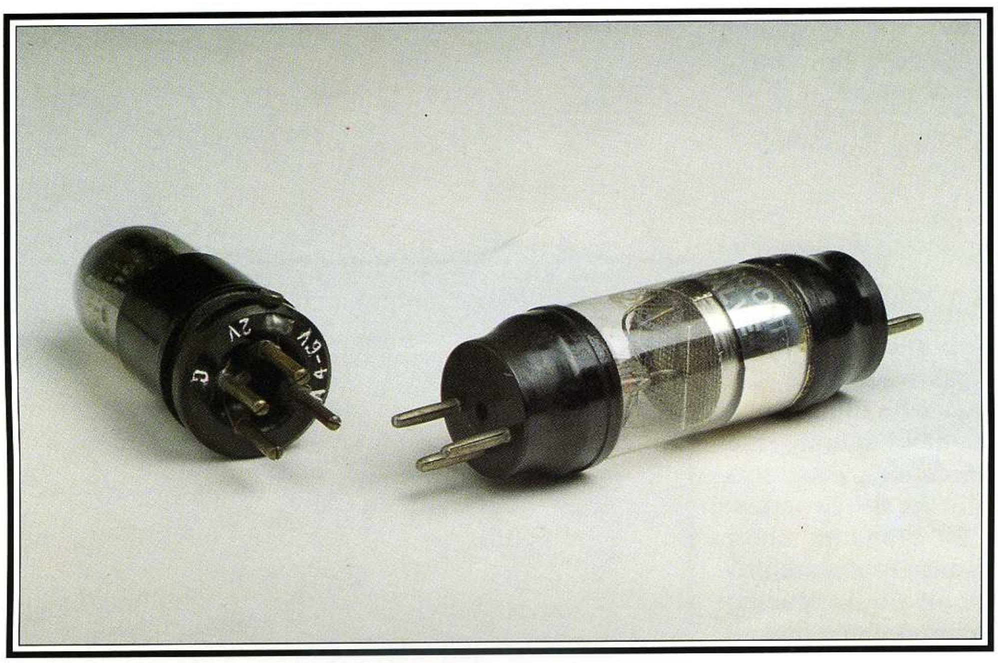
I am much obliged to the staffs of the Science Museum, London, and the Marconi Museum, for their considerable help.

Desmond Thackeray
Byfleet, Surrey

Three valves from the early 1920s. On the left, a VT25 (Valve, Thermionic, No. 25) manufactured for use in GPO telephone repeaters by the MO Valve Company. The VT25 was developed from the R valve.
In the centre, a BSA Standard 4001A, which is internally identical to the Wecovalve 4215AA on its right. The 4215AA was a development of the US Western Electric 215A, fitted with a British 4-pin base, and was manufactured in the UK by both British Thomson-Houston Co. Ltd (BTH) and Mullard



MUSEUM PIECES



The Cossor WR2 (left), launched in 1925, was designed to work from filament supplies of 2 to 6 volts. When the thumbscrew on the side of the valve-base was inserted in the '4-6V' hole, a resistor in the base was connected in series with the filament. The resistor was short circuited when the thumbscrew was in the '2V' hole.
The Marconi-Osram S625 double-ended tetrode valve (right) was designed by H. J. Round, and first sold in 1927. The filament and control grid connections were at one end, the anode and screen or outer grid connections at the other

Like many other firms whose names are better known in some other branch of engineering, BSA was at one time involved in the radio industry.
These valves were made for BSA Radio Ltd by Standard Telephones & Cables Ltd. The smaller one, the G.125A, is a 'Peanut' valve, similar to the Wecovalve but with a US-pattern base

MUSEUM PIECES

Cosmos was the brand name of the Metropolitan Vickers Electrical Co. Ltd (Metrovick), who produced a range of valves of entirely new design in 1925. Among them was the SP.18 series.
The letters 'SP' stood for 'short path', a design feature which allowed closer electrode spacing and produced a mutual conductance higher than had previously been achieved.
The SP.18 was available selected for mutual conductance figure under suffix letters G, R and B, the valves and their boxes being marked with green, red and blue spots respectively