£2.40
ISSN 0956-974X

RADIO BYGONES

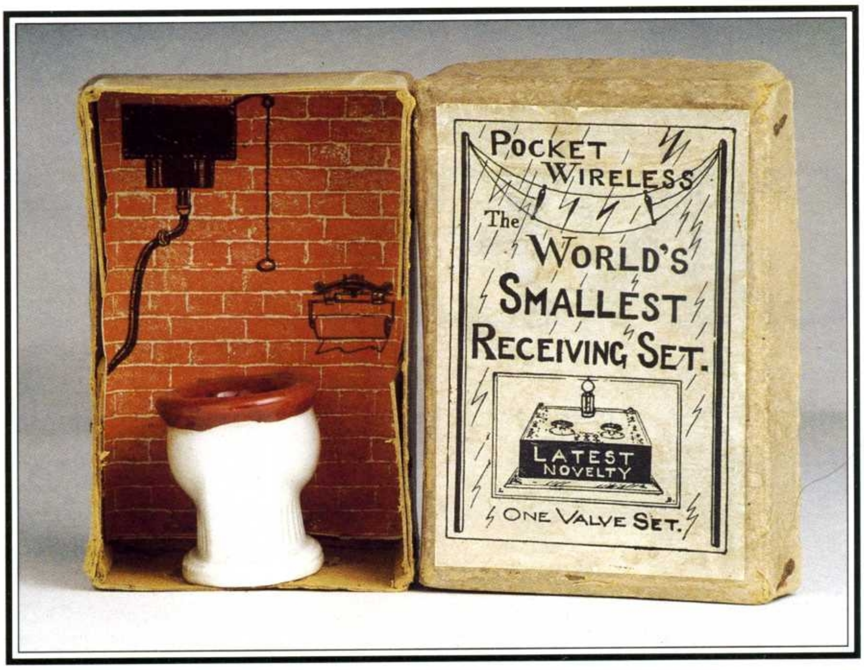
No. 7 – August/September 1990

Wireless Novelties

The E52 'Köln' Communications Receiver □

'Time-Warped' Transmitter □

International Polar Year 1932/33 – Radio Observations in Northern Norway □



JHWC

Proof, if proof were needed, that bad taste is very definitely not an exclusively modern phenomenon!

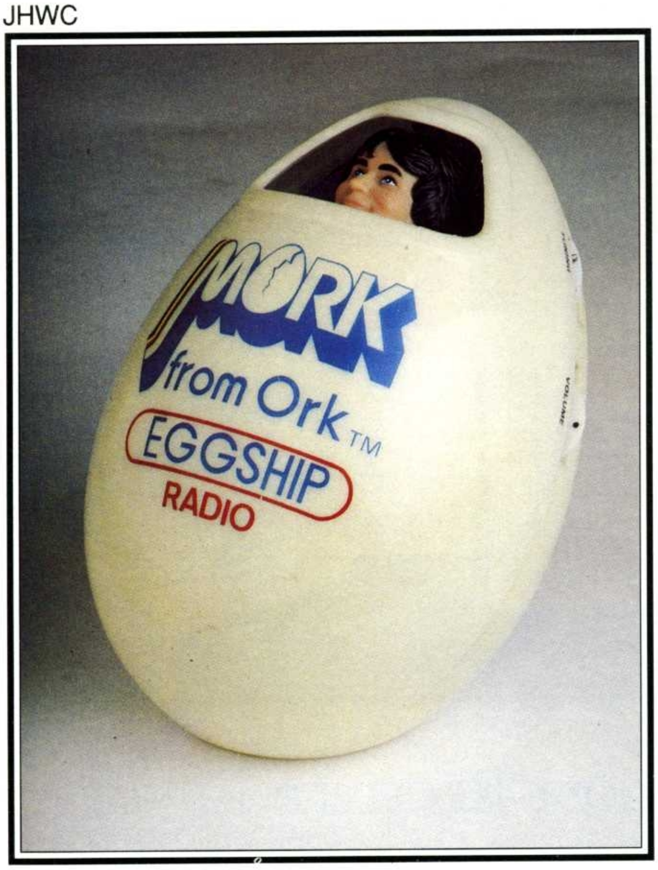
OUR FRONT COVER

Playing cards produced by Chad Valley for a game played like 'Happy Families', with KDKA as the Good Joker and Oscillator as the Bad Joker. Photograph courtesy of Dave Hooper of Dublin

MUSEUM PIECES

'Wireless Novelties'

JHWC



We make wireless sets that look like people – the Mork from Ork™ medium wave radio Model 4461 from 'Concept 2000' ©...

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... and now we design buildings that look like art deco wireless sets – Bournemouth headquarters of property developers McCarthy & Stone, known locally as 'the wireless set'!

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August/September 1990
Issue No. 7

Published 29 August 1990
ISSN 0956-974X

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Printed by
The Friary Press Limited,
Dorchester, Dorset

One of the problems besetting collectors of vintage (and not-so-vintage) valved radio equipment is the excess power, heat or voltage which results from running an item designed for operation on perhaps 220 volts on the present-day UK standard of 240 volts. Unlike modern transistorised sets, many of which incorporate an inexpensive yet efficient voltage stabiliser circuit to protect the 'works' from excesses, it was most unusual to find regulators in valved equipment except in the professional area.

When I was a lad, the mains supply was 250V 50c/s where I lived in Southampton, but there was talk of changing all UK supplies to a national standard of 230V AC. Before that aim was achieved, however, the 'powers-that-be' had decreed instead that the new standard would be 240V, presumably with the advent of the 13 amp plug and socket 'ring-main' system in mind. A few moments with a pocket calculator will show that 13A at 230V yields only 2990 watts, and where does that leave a 3kW electric fire with a 60W 'flicker-flame effect' lamp built in? Incidentally, what was it about those lamps, with the little windmills whirling round in the heat above them, that made them such efficient generators of RF noise in VHF Band II? But I digress!

Reading through the June/July issue of *Elektor Electronics* magazine, I chanced upon a comment in a constructional article on a mains voltage meter, which read as follows: 'The design of this meter is in direct response to the intention of most electricity generating boards in Europe of standardising on a mains voltage of 230V, 50Hz. The change from the current 220V or 240V (mainly UK and Eire) will be made gradually during the present decade.' My enquiries have subsequently revealed that there is indeed a move towards a common 230V supply throughout Europe – obviously it will make the exchange of surplus power between the various countries a lot easier.

Amid this bid for harmonisation, however, it seems that dear old Britain is likely to be accused of dragging its heels yet again. Our powers-that-be (yes, them again) are apparently saying that they don't want to make 230V the declared UK standard, but since the ±6% tolerance allowed by the Electricity Supply Regulations means that our nominal 240V mains can actually be anything between 225V and 254V, we are complying with the spirit if not the letter of the law.

I'm all for standardisation in areas where interchangeability is either convenient or essential. The trouble with standards comes when people change their mind about what they should be! If it stopped all those vintage radios burning out mains transformers or blowing up reservoir capacitors, I suppose a change to 230V would be a good thing for we 'old-timers'. I wouldn't fancy having to change all my 13 amp plugs and sockets for the new European 16 amp design, though. ***Geoff Arnold***

In This Issue

PRINCIPAL FEATURES

OTHER ITEMS

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News & Events

'B2' User Group

The interest from many countries, with rising collectors values, prompted the setting up in October 1989 of a user group for the 'Type B 3MkII' clandestine transmitter/receiver, more commonly known as the B2 suitcase set. The man behind the group is John I. Brown G3EUR, who designed the SOE 'A' and 'B' series sets.

B2UG members receive the quarterly *B2-UG Newsletter*, which features: copies of articles, stories, etc., about the B2 which have appeared since 1947; news and contributions from B2 users; notes on other clandestine sets, SOE/OSS, etc.; a Wanted/Sale section plus notes of locations of B2 in museums and collectors/correspondents in other countries, and recent prices which should assist collectors/restorers in valuation of their collection.

Members will also receive a package of information, comprising a complete copy of the latest original Instruction Book in 38 pages, plus 8 sides A4 advice from G3EUR on first tests and repair.

The subscription for the first year, including the instruction book is £12 Sterling, including postage to UK addresses, but will be less in the second year. To other countries £14 Sterling including airmail postage, or $20 USA (dollar bills) or cheque in dollars on a USA bank. To join the group, or for further information, write to **John I. Brown, 74 Humber Avenue, South Ockendon, Essex RM15 5JN**.

Wireless Collections

It is really quite amazing how many private collections of vintage wireless equipment exist around the UK, and in other parts of the world, too. A number of these are on view to the public, either on a permanent basis or from time to time at local shows, etc. Two collections on permanent show have come to our notice recently.

The first, entitled 'Steam Radio', is an exhibition of over 100 items of early wireless, TV and gramophones dating from 1900 to 1980, at the showrooms of Joseph Urban & Sons, TV & Radio Specialists, 44 High Street, Anstruther, Fife, telephone 0333 310471. It is open on weekdays between 10am and 5pm, and on Sundays from noon to 5pm.

Some 400 miles to the south, you will find another vintage wireless collection on display at the shop of Aerial Services, 203 Tankerton Road, Whitstable, Kent, telephone 0227 262491. Here, in a very limited space, are displayed some 80 valved wirelesses, crystal sets, test instruments, etc., from a collection of about 450 items in store. Opening hours are 9am – 1pm and 2pm – 5.30pm, Tuesday, Thursday, Friday, Saturday; closed all day Monday and Wednesday.

Also available to purchase in the Aerial Services shop are a selection of radio and electrical books, leaflets and collectable items. A repair service for valved radio receivers (not radiograms) is available on a strictly 'by arrangement' basis.

Electric Radio

Copies of a new monthly magazine for vintage radio enthusiasts, launched last year in the United States, have recently arrived in the *RB* office. *Electric Radio* is an A5-size magazine of 40 pages plus card covers, published by Barry R. Wiseman N6CSW/0 'for amateur radio operators and others who appreciate the older tube type equipment'.

The magazine is a staunch supporter of the continued use of amplitude modulation (AM) on the amateur bands, and carries regular features on communications receivers and military radio equipment, with photographs of amateur radio set-ups, some of them of amazing size and complexity – whole walls lined with equipment! There are several pages of mouth-watering classified advertisements in each issue, too!

A year's subscription to addresses outside the United States and Canada will cost you US $55 including airmail postage. At present, surface mail despatch is not available. Write to *Electric Radio* Box 139, Durango, CO 81302, USA.

New Italian Society

The 'Associazione Italiana Radio d'Epoca' (AIRE) was legally founded on 9 June 1990.

The President, Mr Fausto Casi, says its scope and interest are equal to the other vintage radio clubs around the world, i.e., telecommunication with particular interest in radio, telephone, telegraph and other aspects of early electricity.

Italian residents can apply for membership through AIRE – Via Cavour 5, 52100 Arezzo. A subscription which will last until December 1991 will cost Lit. 50,000.00≠.

Overseas membership will cost Lit. 55,000.00≠. The first newsletter is expected out in the autumn. Further information can be obtained by writing to AIRE headquarters, or to R. Kron, Via Machiavelli 12/A, 36061 Bassano, Italy.

Museum News

Special events for the remainder of the 1990 season at the Chalk Pits Museum at Amberley, West Sussex are: **Sept. 9** Model Steam Engine Day; **Sept. 16** Southdown 75th Anniversary Bus Rally; **Sept. 23** Woodworking Day; **Oct. 14** Open Day Anniversary Gathering of vintage vehicles. All of these feature visiting exhibits as well as having many items in the permanent collection in operation.

In the Radio Building, the Lancaster bomber exhibit (see the front cover of *RB* Issue No. 1) has been refurbished and augmented specially for this Battle of Britain 50th Anniversary year. Over the weekend **Sept. 1 and 2** there will be a special Empire Broadcasting display, featuring the pioneering work of Gerald Marcuse (see *RB* No. 2).

Can You Help?

Reader W.G. Scase has a GEC radio Model BC4835R (1947) which has a mottled dark green bakelite cabinet. Does anyone know what other colours were sold? He has so far found reference only to a walnut pattern cabinet. Information, please, to 8 Springfield Road, Taverham, Norfolk NR8 6QT, or telephone Norwich (0603) 868986.

Reviewed by Geoff Arnold

Radios von Gestern

I recently received details of a book entitled *Radios von Gestern* (literally 'Radios from Yesterday') by Ernst Erb. It is, according to the author, the best book on the subject, and it certainly sounds a fantastic publication. Unfortunately, my appreciation of *Radios von Gestern* is somewhat curtailed by the fact that I have not actually seen the book, which, like the descriptive leaflet, is written entirely in German.

The book, intended for 'collectors, radio amateurs and professionals', comprises 456 A4 pages, with 900 illustrations in colour and black and white, covering most aspects of valved radio history and technology, and it weighs a massive 2 kilos (4½lb)!

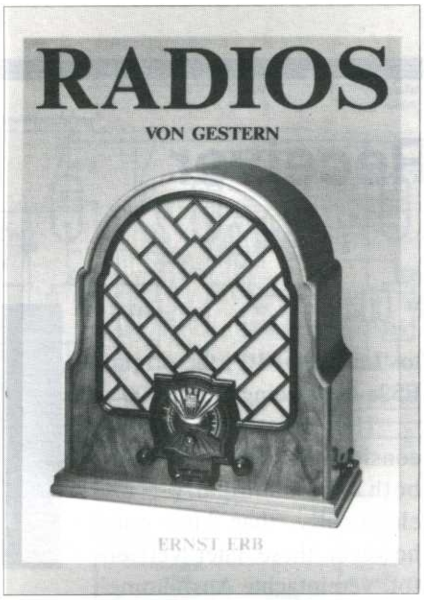
It can be ordered direct from the publishers, **M+K Computer Verlag AG, Postfach 1401, CH-6000 Luzern 15, Switzerland** at a cost of £61.00 Sterling including airfreight. I would suggest that interested readers contact the publishers in the first instance for a copy of the leaflet, so that they may assess it personally.

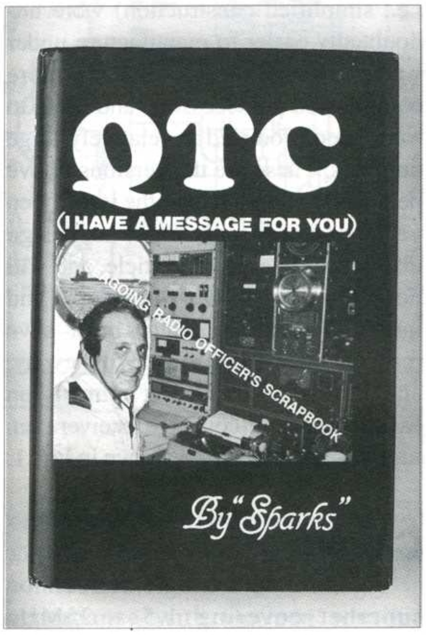
From Rattle to Radio

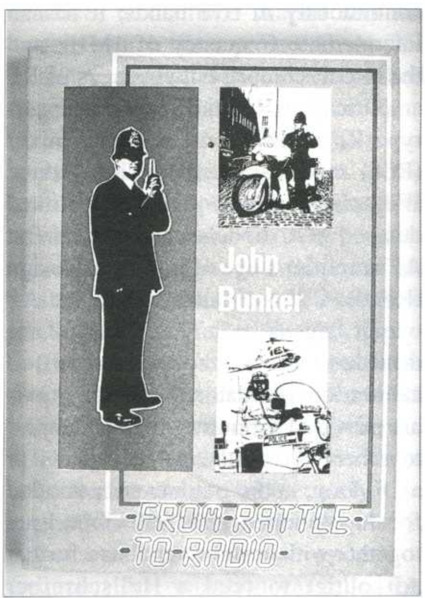
Readers who enjoyed Mr F. C. Judd's article 'Wireless and the Metropolitan Police' in *RB* No. 4, and would like to read more on the topic, may be interested to know that John Bunker's book *From Rattle to Radio* (1988) is still available.

The book gives a detailed history of methods and equipment used for communication by the police from the early watchman's rattle to the introduction of the 999 system in the 1930s, with an overview of the Metropolitan Police during World War II and the development of electronic data processing and transmission in post war years. It contains over 100 photographs of early radio, telephone, police box, motor vehicle and aerial equipment used by London's police over the years, many of them previously unpublished.

From Rattle to Radio is published in paperback, comprising 270 pages 8¼ x 5¾in, under ISBN 0-947731-28-8, and may be ordered direct from the publishers, ***Brewin Books, Doric House, Church Street, Studley, Warwickshire B80 7LG***, price £9.95 plus £1.00 post and packing to UK addresses.







Radios – the Golden Age, reviewed in *RB* No. 6, is now published by Chronicle Books, of San Francisco, California, USA, under ISBN 0-87701-419-1. Other details the same.

QTC

The subject-matter of *QTC (I Have a Message for You)* by 'Sparks' is neatly summed up by its sub-title, *A Seagoing Radio Officer's Scrapbook*, and the lines from the publishers' blurb, which read:

'Seamen were always isolated. Radio gave communication, hope, life. A million lives were saved at sea in 20th Century ... then VIPs decided that radio officers and Morse should be "phased out". This (in the opinion of the author and many others) will be a grievous mistake. Thousands will die for lack of the good old reliable Morse-&-SOS system.

This is Sparks' swan-song. It has never been told before. Without boring technicalities or tedious history, you are led from the origins of marine radio through stories of adventure / surprise / romance / travel / heroism / achievement / biographies / autobiography / humour.'

'Sparks', alias Raymond P. Redwood, was born in England and served as a wireless operator with the RAF in the Second World War. He then joined the merchant navy, travelling the world and eventually taking US citizenship.

He recounts many of his personal experiences and escapades, and looks in depth at two episodes where ships' radio officers played a significant part, the loss of the *Titanic* and of the *Morro Castle*.

Will ships' radio officers *really* be replaced by the satellites and computers of the Future Global Maritime Distress and Safety System (FGMDSS) in 1999? Ray is doubtful, and explains just why.

In recognition of his many years seagoing service, and his portrayal of the human interest aspect of radio communications at sea, Ray Redwood was awarded the 1990 Marconi Memorial Gold Medal of Achievement by the Veteran Wireless Operators Association of America.

QTC (I Have a Message for You), is published in hardback under ISBN 0-945845-00-6, and has 376 pages 9 x 6in with 109 illustrations.

Orders should be sent direct to the publishers, **Sequoia Press TX, 2502 Cockburn Drive, Austin, Texas 78745, USA**, with a remittance for US $15.00 plus $2.00 shipping. UK readers can make their payment in Sterling by sending a cheque for £10.00 to **Barclays Bank, 12 High Street, Great Dunmow, Essex, quoting Capital Advantage Account 0074-2589.**

The E52 'Köln' Receiver

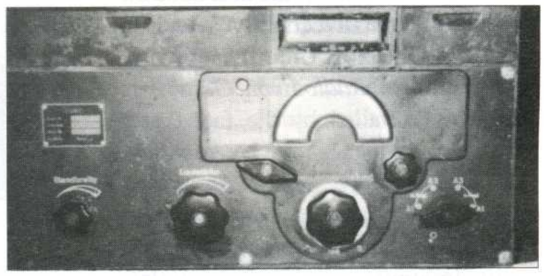
by Neil Clyne G8LIU

'We've found this old wireless set out in the shed', a very pleasant young lady informed me on the phone one evening. 'It's like a dirty old tin box, but ever so heavy, and it's got some funny German writing on it. If you want it, you'd better come over straight away, as we're moving house next week, and if we don't get rid of it beforehand it's going in the Grundon (skip)'.

This was how I acquired a second-world-war German E52b-1 receiver about 18 months ago. Following some remedial treatment with WD40 and replacement of one open-circuit resistor it roared into life, and has worked well ever since. It is one of a series of receivers designated E52, developed by Telefunken initially for the Luftwaffe (the manual describes it as the 'standard ground-station receiver'), it first appeared in 1943. It is described in an authoritative German text as advancing the known limits of receiver performance, selectivity and serviceability – this last feature as a result of the receiver's modular construction. Like many German radio equipments of WWII, the E52s were given a code name, in this case,'Köln' (that is, Cologne, after the city). Besides the Luftwaffe, the E52's superb performance and reputation soon ensured that it found widespread use elsewhere amongst the German services, in army monitoring stations both fixed and mobile, in direction-finding (DF) installations and in shipboard radio stations, for example.

The E52 series appears to have included no less than eleven distinct variants of the basic design, although it is doubtful whether all of these were produced in quantity. Of these eleven, four basic sub-species may be observed, designated E52a, b, c and d, later developments of these being identified by a number suffix, e.g. E52b-1, b-2, etc. Further identification is provided by the various 'Anforderz' (order nos.?) stamped on the receiver nameplates (probably roughly equivalent to the contemporary British Army ZA reference numbers) viz.'Ln 21000-1' to 'Ln 21000-10', the original E52a itself being 'Ln 21000'.

The earlier versions were considerably more complex, both mechanically and electrically, than later ones; however these later versions (of 'vereinfachte Ausführung', i.e., simplified construction) were undoubtedly easier to manufacture under wartime conditions than their more complicated predecessors, and seem to have been produced in relatively large numbers. These are the versions I have personally met with over the last fifteen years or so. I will return to design differences later in this article, and will now describe the various useful and interesting features which must have made the set a delight to use in its heyday, and have ensured that it remains an excellent general-coverage receiver even today. A basic circuit is shown in Fig. 1.



Circuit

The E52 is a single-conversion superhet covering 1.5 – 25MHz continuously in five bands; it has an intermediate frequency of 1MHz and the circuit comprises two stages of RF amplification (Rö2 and 3) with bandpass-type RF transformers, separate mixer (Rö6) and local oscillator (Rö5), three IF amplifiers (Rö7, 8 and 9), a combined delayed AGC diode/second detector/1st AF amplifier stage of ingenious design (Rö10), CW oscillator (Rö11) and AF output stage (Rö12).The CW oscillator doubles as a crystal-controlled calibration oscillator. Separate inputs are provided for mast or wire antennas, together with a further pair of sockets for a DF loop; audio outputs are provided for headphones and 600 ohm line, together with in some versions a further AF outlet to feed a Hellschreiber teleprinter. Early versions of the E52 also contained a neon tube protection device across the antenna coils, but this feature was dropped in later production.

A relay-operated noise limiter is fitted in many versions of the set, connected between the control grid of the output stage and chassis. Several stages of the receiver are constructed in the form of interchangeable plug-in modules to facilitate servicing, viz, IF amplifiers, CW/calibration oscillator and AF amplifier – a style of construction which would seem to have been well ahead of its time in 1943. These modules are instantly accessible upon removal of the front panel. The integral power supply is also a plug-in module mounted across the full width of the rear of the receiver, from which it is detached by unscrewing two large coin-slotted securing bolts; this PSU operates from either 12V DC or 110/230V 40-60Hz AC, and contains two full-wave rectifiers, metallised voltage stabiliser tube and a rare-earth or 'Urdox' current regulator, which in this receiver actually provides a stabilised negative grid-bias voltage for operation of the set on manual gain control.

Apart from the power supply, all valves in the receiver are of the same type, a small indirectly-heated pentode developed by Telefunken for the Wehrmacht in the 1930s, type RV12P2000. This practice of using a single type of valve in a receiver (or transmitter) was widely adopted by the German services in WWII and generally worked well, although occasionally some strange circuitry had to be resorted to, for example I know of one design employing a pentode with anode and all three grids strapped together as a 'diode' detector. However, it undoubtedly eased the spares situation to some extent. It may also be noted that owing to the ingenious mechanical design of the receiver, and of the valves themselves, (described later) all valves may be accessed without having to first remove the receiver from its case; the PSU valves

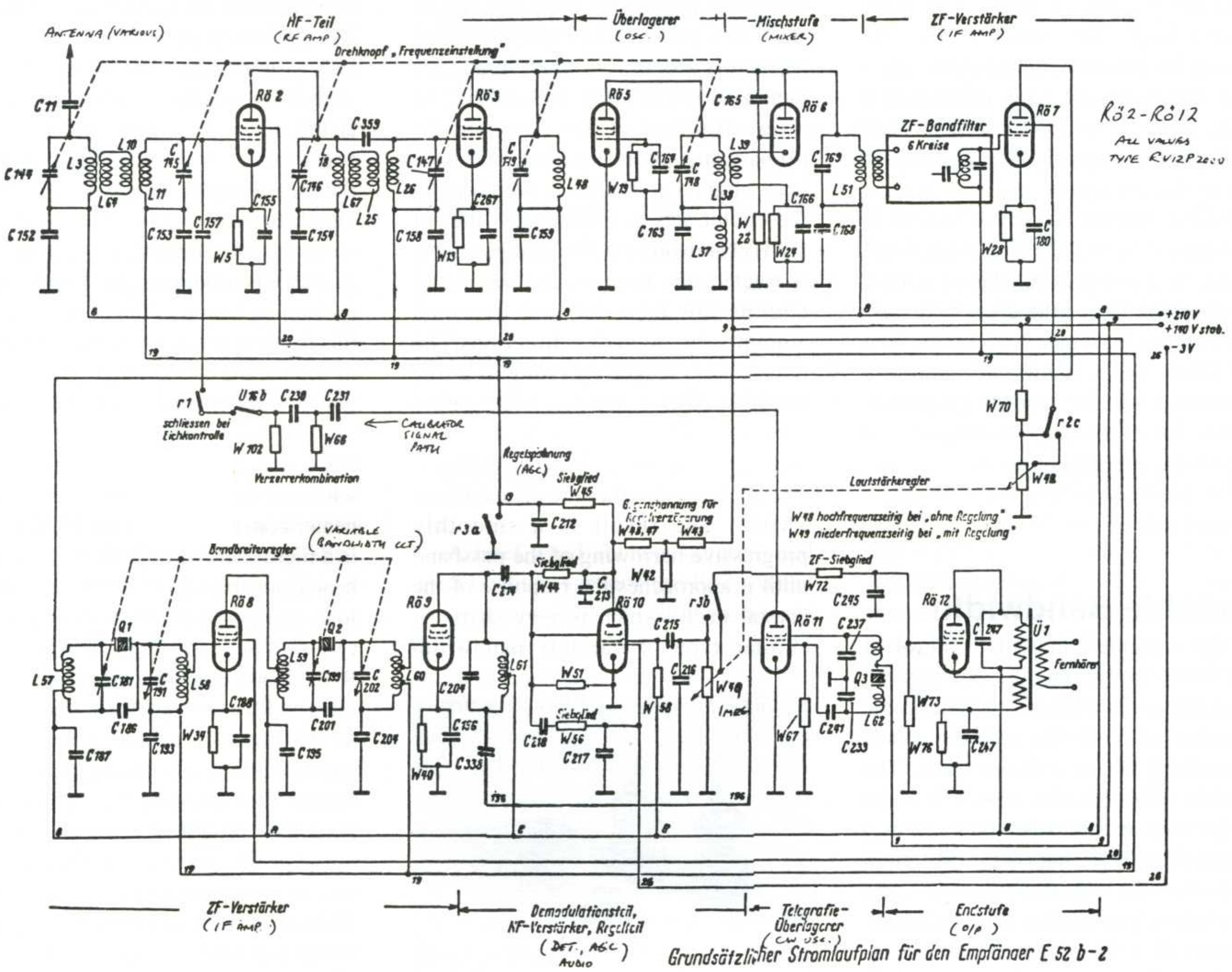


Fig. 1 - Basic circuit of the E52

may be withdrawn directly, whilst those in the receiver itself are reached by lifting one of the two hinged flaps at the top of the front panel. A further servicing aid is provided on some E52s by a printed diagram or plan of the various valve stages and their locations, stencilled on the underside of these lifting flaps.

Controls

All models of the E52 series feature two-speed tuning, via an elaborate gearbox which drives a large multi-gang variable capacitor mounted transversely across the full width of the receiver. Other controls comprise a system switch – power on/off, A1 A3 with AGC, A1 A3 with MGC – a dual volume control, AF gain on AGC, IF gain on MGC, a sturdy bandswitch with a characteristically German positive action, and a variable bandwidth control, one of the most satisfying features of the E52 to which I shall return in a later paragraph. The control knobs are mostly of an unusual heptagonal shape, clamped to their shafts by threaded collets; the bandswitch, however, seemingly in accordance with German wartime practice, is diamond-shaped and the system switch has a pointer knob. The frequency readout is unconventional and quite spectacular; a semi-circular tuning dial is mounted above the large (slow speed) tuning knob, as shown in the heading photograph, and contains five rainbow-hued coarse frequency scales corresponding to the five ranges of the receiver which are set out on a coloured band chart to the left of the dial.

The dial colours again appear to follow a German wartime convention of white = Band 1, red = Band 2, yellow = 3, blue = 4, green = 5. However these coloured scales give only an approximation of receiver frequency, and a much more precise system of frequency determination was called for, which could nevertheless be easily read by the relatively unskilled operators of the equipment. This was achieved by mounting on part of the drive gearing of the tuning capacitor, a large ground-glass disk; this disk, minutely etched with the full frequency coverage of the receiver in its five bands, rotates in sympathy with the tuning capacitor, and in so doing is illuminated by a low-voltage bulb located behind and below the rectangular 'window' visible above the semicircular scale.

The frequency calibration on the glass disk – far too small to be read unaided by the naked eye – is magnified by a strategically placed lens and viewed directly through the window where it appears in the form of a continuous horizontal scale, somewhat reminiscent of the filmstrip on the Racal RA17. Frequency markings are at 10kHz intervals on the 18 – 25MHz band, 5kHz intervals on 6 – 10MHz, and 1kHz on 1.5 – 3.0MHz (band 1). By way of comparison, frequency marks on my AR88LF are at 100kHz intervals from 6MHz upwards. The glass disks were individually calibrated on E52s up to and including 'order no.' Ln 21000-5, later receivers were equipped with a 'standard tuning scale' (Einheitsskala); a spare calibrated disk was included as standard equipment mounted in slots in the back of the case, although nowadays with the passage of time, these have usually long since vanished. The low voltage bulb used to illuminate the glass disk was a special type, containing a horizontally mounted filament instead of the usual vertical type, in order to direct the maximum amount of light sideways onto the glass disk, instead of upwards; these may be identified, if still fitted, by a conspicuous dab of yellow paint on the top of the glass bulb, and were originally made by Osram, type OB120/4. As a matter of interest a somewhat similar type of projection system has also been seen on a post-war RCA HF communications receiver, type R503, believed to have been produced for the United States Navy in the 1950s.

Variable Bandwidth

The variable bandwidth control of the E52 is in my opinion, possibly the most practically useful of many desirable features built into the receiver and is remarkably effective in operation. The audible effect on this device is quite unlike the variable 'selectivity' control found on the National HRO and certain other wartime American receivers, and more closely resembles the variable IF bandwidth type of control found on modern Yaesu and Kenwood HF transceivers, where the effect is achieved only with a much larger component count than the E52; in other words as the bandwidth control is advanced or retarded, a symmetrical narrowing or widening of the IF passband is achieved, which in practice is very useful in eliminating or reducing QRM on adjacent channels in crowded amateur bands, for example. The passband width in the case of the E52 is fully variable from approximately 200Hz to 10kHz at an IF of 1MHz.

The theory of operation of this variable bandwidth circuit is fairly complicated, and I do not propose to cover it in detail here; the basic circuit elements will be apparent from the circuit in Fig. 1, and will be seen to consist of a pair of bandpass-type IFTs in cascade (L57, 58, 59, 60) separated by an IF amplifier stage Rö8, and whose primary and secondary windings are coupled by means of quartz crystals Q1 and Q2, both 1MHz. A special 2-gang variable capacitor tunes the primary and secondary windings of each IFT, such that as one gang increases in capacitance on rotation of the capacitor, the other gang decreases by the same amount; on the E52 a pair of these special 2-gang capacitors are used in cascade and are identified as C181, 191, 199 and 202. At a certain setting of this capacitor, the primary and secondary of the IFT have been aligned at 1MHz, at which point the circuit acts as a bandpass filter of 10kHz bandwidth; as the 2-gang variable is rotated, the primary and secondary circuits are then detuned by equal amounts in opposite directions. The circuit is no longer operating as a true bandpass filter, but is now effectively a series-tuned circuit (the crystal) connected between two impedances, which decrease as they are detuned from 1MHz. The result is a smoothly progressive narrowing of the passband until it approaches the response of the crystal itself, which is very sharp. A similar type of variable bandwidth control is found on some other wartime German receivers, one of which (type Fu.HEd), I hope to cover in a future article.

Valves of similar style and shape to the RV12P2000, with the bakelite-handled extraction tool in the foreground

Photographed at the Chalk Pits Museum, Amberley, West Sussex

A device for checking internal receiver noise is incorporated in the E52, and consists of a press-button switch located below the left-hand panel flap, which shorts the grid and cathode of the first RF amplifier and thereby removes any noise or signals present in the receiver's input circuits. A receiver in good working order should produce a distinct increase in overall 'liveliness' on all bands when the antenna circuitry is reconnected on release of the switch.

Valves

The valves in the receiver – type RV12P2000 – have already been briefly mentioned. To British eyes they look strange (see photo above); an RV12P2000 consists of a short glass bulb of about the same dimensions as a British B9A type such as a 12AT7 or ECC81 with a grid cap at one end, and a special 6-pin bakelite side-contact base at the other. In use the valve is fully encapsulated within its holder, only the flat end-surface of the bakelite base being visible to the outside world. To extract a valve from its holder, a small bakelite grip tool is used, equipped with a short protruding length of threaded brass rod; this rod is screwed into a threaded bush in the centre of the base of the valve, which is then easily pulled out of its holder. The extraction tool is normally left screwed into one of the valve bases when not in use. It may be noted that the heater consumption of the RV12P2000 is a mere 75mA at 12.6V, and radiated heat from the valves is thus relatively low, compared to conventional Allied types. The rectifiers, two of type RG12D60, and other valves in the integral PSU are of similar construction to the receiver valves, and are also equipped with side-contact bases of a similar (but not interchangeable) type. As noted earlier the E52 can be operated on 12V DC battery supplies using a special non-synchronous vibrator type MZ6001 – nowadays often missing – which has a conventional plug-in base albeit a rather strange 9-pin one.

Variants

I will now briefly mention the principal differences between the various models of the E52 receiver starting with the E52a. These featured switchable motorised tuning and band-changing, with provision for four fixed-frequency channels (Rasten), as well as normal manual tuning. Early E52a's also contained comprehensive internal metering facilities for valve testing and voltage checking, but I know of only one surviving example of this type. A neon tube was wired across the antenna coils to limit RF voltage peaks from nearby transmitters. Some E52a's also contained a tuneable BFO.

The E52b lacked the motorised tuning and band-switching and the b-1, b-2, and b-3 models omitted the tuneable BFO. The two-speed manual tuning controls were also relocated. A late version of this series was developed specifically for SSB and diversity reception.

The E52c was essentially an E52a in a special dust-free 'Panzerholzgehäuse'

– literally armoured wooden case – this is basically a stout wooden case reinforced with riveted steel edges and corners.

Finally the E52d was probably a development of the E52b, equipped with a special AF output stage designed to feed into a Hellschreiber teleprinter. The special output stage later became available for fitting in other versions of the receiver.

The details shown in the table are quoted from the official manual. You will see that the E52b, at slightly less than two thirds the size of an AR88, is only 10lb lighter! The E52a models, with their greater mechanical complexity, twin motors and extra gearing, weigh around 45kg (100lb). Most of the metalwork in the E52 is of heavy die-cast construction, using an alloy of unknown composition, but believed to consist largely of magnesium. Stability figures are not quoted in the manual, but from my own and other users' experience, I can confirm that this is of a very high order for a receiver using a conventional free-running local oscillator, as a result of low heat radiation, rigid construction and extensive use of close tolerance NTC capacitors. Provided that the receiver is in good working order, there is no perceptible drift after initial warm-up.

E52 'KÖLN' SPECIFICATION

Sensitivity	CW Narrow: 0.5µV on all bands R/T Narrow: from 5µV at 1.6MHz to 14µV at 24MHz R/T Wide: 3µV at 1.6MHz, 4µV at 24MHz (for an AF output of 5V into 4kΩ with 30% noise voltage).
Image rejection	Better than 86dB @25MHz, better than 94dB @19MHz.
Selectivity	Wide: ±5.25kHz @ –2dB; ±15kHz @ –60dB Narrow: ±200Hz @ –2dB; ±2kHz @ –60dB (bandwidth fully variable between 200Hz and 10kHz).
Dimensions	446 x 245 x 350mm (Width x height x depth).
Weight	40.8kg (90lb) for the E52b-2.

Acquiring an E52

So, what are the chances of acquiring one of these classic examples of German wartime technology today? Like most WWII German radio gear, the E52 is rare and much sought after, but it seems can nonetheless turn up from time to time in unusual or unexpected circumstances. Because of its weight (and the consequent difficulty of heaving into a loft or attic!), I suspect it is more liable to materialise in garden shed clear-outs or garage sales than attic clearances. All I can recommend is vigilance. No doubt a supply of wartime 'swop material' in good condition would help, too.

A brief word about restoration and modification, apropos the E52. At the outset I would say that if any reader is sufficiently fortunate to obtain an E52 and needs advice or assistance in getting it going, I would be pleased to help. As regards restoration/modification, my personal view is that this should be restricted to the barest minimum necessary to keep the set in reasonable working order. As a general rule, capacitors are reliable and unlikely to need replacement; resistors occasionally fail, and should be replaced by 5% types of ½W rating, preferably of similar appearance to the originals. Suitable types can sometimes be cannibalised from defunct postwar German test equipment made by Rohde & Schwarz and others.

As regards valves, there still seem to be some RV12P2000s about and probably some of the advertisers in *RB* will be able to assist here. The original power connector is of a type which I gather is still in use in Germany, and should not be too hard to obtain. Mechanical and switching problems have in my experience yielded to application of WD40 and Super Servisol. The ground-glass disks containing the frequency markings – actually deposited thereon by photographic means – may, if dirty be carefully washed with soap and water, but on no account should Vim or other abrasive cleaning materials be used. The most vulnerable component in the whole receiver, however, appears to be the audio output transformer, which seems underrated for its intended purpose; unfortunately, it is physically very small, and it is unlikely that any commercially available replacement can be accommodated in the limited available space. As may be expected, the usual problem is an open-circuit primary winding – though in practice, application of HT to the output stage often seems to restore some degree of continuity! For the record the turns ratio of primary to secondary (headphone winding), is 6800:710, or approximately 9.5:1. Where the transformer is completely defunct however, I have obtained fair results by rewiring the output stage as a cathode-follower type, substituting a 20kΩ resistor for the open-circuit primary winding.

This concludes my review of the E52 'Köln' receiver which I hope has been interesting and reasonably comprehensive. As mentioned above, I shall be happy to deal with readers' queries, observations or requests for assistance arising from this article – my address is QTHR as per all RSGB callbooks back to 1976! All I ask, please, is an SAE for queries needing a reply. **RB**

Where is it? – No. 4

It seems we foxed most of you yet again with this one, but not everyone! L. E. Newnham and his wife, G6NZ and G4HSV respectively, of Southsea, Hants, recognised the scene instantly because, as they told RB at a recent radio rally, they used to walk past it every day! Mr & Mrs Newnham win the prize of a year's subscription to *RB*.

Their card – incidentally the only entry to correctly identify the location – reads 'This shows the aerial of 2LO when it was at Selfridges in Oxford Street, London (from April 1925). The aerial was 250ft above ground, the masts being 120ft high. The TX had an output of 2kW. It was replaced by Brookmans Park in October 1929.' Another picture puzzle in our next issue.

Classic Book Review – No. 3

by Richard Q. Marris G2BZQ

'Radio Servicing' by G. N. Patchett & B. Fozard

This textbook is a 'must' for anyone wishing to gain a practical technical knowledge of valved and the very earliest transistorised circuits.

Though *Radio Servicing* appeared as one volume in 1960 it was, in fact, an amalgam of four earlier books published in 1956, 1957 and 1958. Parts 1, 2 and 4 were by G. N. Patchett, and Part 3 by B. Fozard, both these gentlemen holding senior positions at Bradford Institute of Technology.

The 287-plus pages were intended to cover the syllabus of the City and Guilds Intermediate and Final Radio Servicing examinations. Part 1 is entitled Basic Electrotechnology; Part 2 – Intermediate Radio Theory; Part 3 – Final Radio Theory; Part 4 – Fault Finding. Many chapters end with a few typical practical worked examples of any formulae involved.

Part One – Basic Electrotechnology (13 chapters): Chapter 1 simply explains the Principle of Radio Communications concluding with an excellent little illustration '**A**'. The next five chapters take us through the basics of Voltage, Current & Resistance; Conductors & Insulators; Electric Charge; Power & Energy; Resistors & Batteries. Chapter 7 is Magnetism and catches the eye with some excellent drawings such as '**B**'; this leads automatically through Chapters 8 to 12 on the subjects of Measuring Instruments; Electrostatics; Electromagnetic Induction; AC Currents & Voltages; AC Current Flow in Electrical Circuits. The concluding Chapter 13 gives the principles and simple design instructions for Transformers.

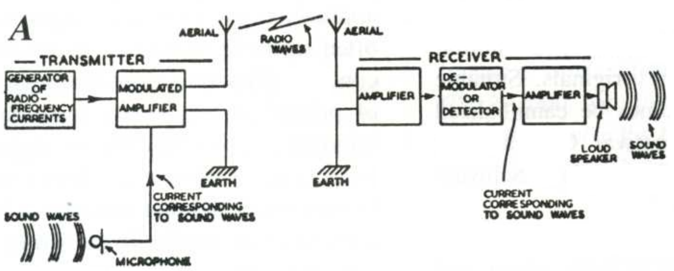
Part Two – Intermediate Radio Theory (12 chapters): We now get down to real radio business with the first two chapters talking about Transmission & Reception of Radio Signals and Valves. We then proceed, in some detail, through chapters giving the theory and circuits of the various receiver stages, culminating in Chapter 8 with a complete Tuned Radio Frequency (TRF) Receiver circuit '**C**', typical of those home-constructed by many of us, or commercially available, in the 1930s to 1950s.

Quite logically, through three chapters, we have a look at the Superhet Receiver, with a simple block diagram '**D**'. A full superhet circuit appears later in the book.

Part Three – Final Radio Theory (11 chapters): Things now get really interesting. For the vintage radio enthusiasts will be found circuits of the Vibrating Convertor '**E**'; the Rotary Transformer & Convertors often found in WWII military equipment; plus the dreaded Line-cord used as a mains voltage dropper with imported American midget valved receivers, and quite lethal!

The remaining chapters are a gold-mine of information

A



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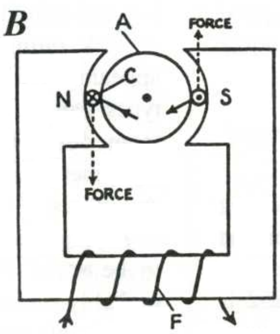
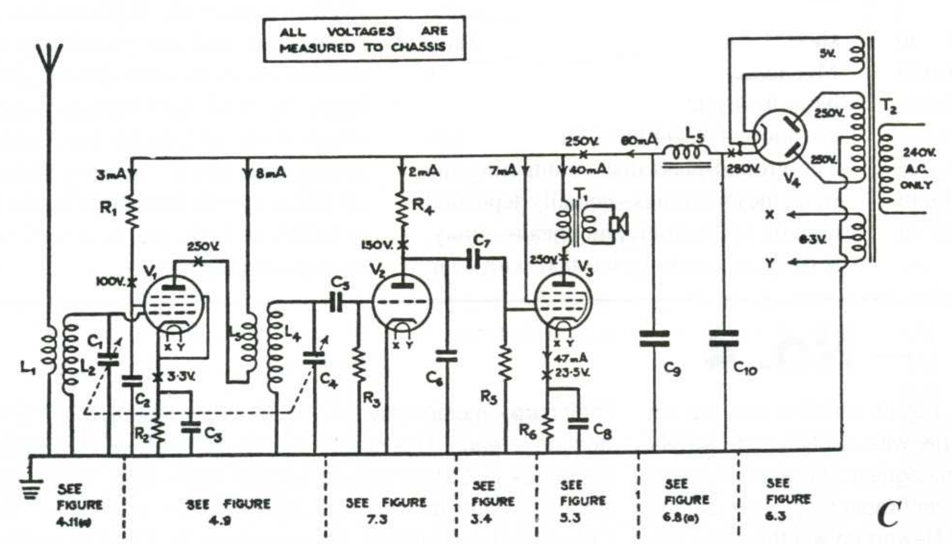
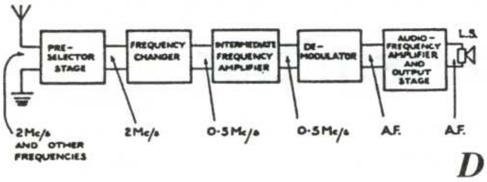


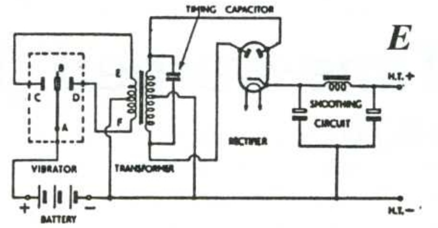


C

and circuitry, dissecting the Superhet Receiver stage by stage with a block diagram '**F**' and a full circuit which is also used in Part Four. Every component required to build this circuit is still obtainable, and it could form the basis of an excellent valved receiver construction project. Chapter 11 goes into Frequency Modulation (FM) in some detail with some very useful information and circuits.



D



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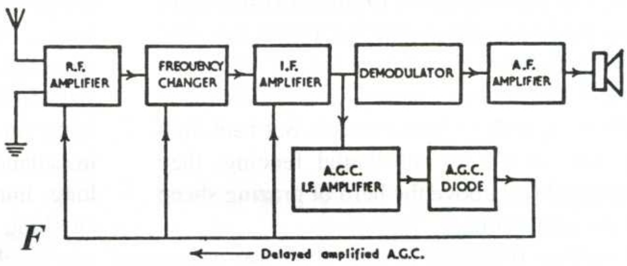


F

Part Four – Fault Finding (13 chapters): The information contained in the first eleven chapters covers detailed Fault Finding in Receivers, and has often proved useful to me when delving into an old valved receiver without a service sheet. After the Introduction we are taken through a range of Static Tests; No Signals; Distortion; Hum; Noise; Instability; Intermediate Frequency Faults plus Incorrect Calibration & Alignment. Most valved radio enthusiasts have met all of these!

Strangely enough Part Four contains few circuits, but many fault-finding tables and charts which tie up with the Superhet Circuit 'F'. Chapter 12 comes as a bit of a shock as we are suddenly launched briefly (four pages) into Transistors with simple basic explanations.

I would suggest that any valved radio enthusiast should try to obtain a copy of this book. Over the years, I have come across several copies in junk shops. Other possible sources of supply are the redundant stock in the local public library, or from a retired radio repairman. ***RB***

'Time-warped' Transmitter

by WJM

Only a couple of decades ago, as a fairly recently joined engineer to the BBC, I found myself suddenly transported from state-of-the-art, short-wave senders to one of the Corporation's former creations, dating from the start of Empire Broadcasting! The purpose of the magnificent building, of a style synoptic and in sympathy with Broadcasting House but set in its own immaculately tended gardens in a country setting, was made obvious by the adjoining pair of lattice masts. Set back in a well-mown field, surrounded by substantial fencing, they towered several hundred feet above the herd of grazing sheep which completed the rural scene.

There was no parking problem. A wide driveway swept up to the glazed bronzed doors, with the armorial bearings and motto masoned into the Portland stone fascia. All most impressive, and needing only the appearance of liveried footman in the doorway to complete the country manor-house effect.

Once inside, having followed suitable directives, I entered an office manned by a gentleman of the old school, best described as 'Edwardian', complete with wing collar and boots. He was the Station Clerk/Paymaster and general source of historical knowledge about the place, having been lured there from his mundane solicitors' clerk situation by the prospect of 'being on the wireless'. In fact, a better job description would have been 'under the wires', for 'wireless' the place certainly was not! Stretched taut across a very large room, and visible through glass doors from the spacious entrance vestibule, were a dozen thick wires, four in a central cluster, the remaining eight forming a cage around them. It was in fact a skeleton coaxial cable, capable of carrying 200 kilowatts of fully modulated medium-wave transmission.

Aerial Tuning House

It passed through the substantial wall of the hall out into the field, where it was held aloft by a series of pairs of telegraph poles as it made its way to a green-painted 'house' situated between the masts, fully a furlong (660 feet) away and looking quite diminutive. The masts, rearing to a height of 490 feet above their concrete plinths and about the same distance apart, were held upright by taut yet curved sets of stay cables terminating in concrete weights. Between the tops of the masts stretched four substantial wires, held several feet apart, and supporting four down-leads which descended in a slow twist to anchorages near the green-painted house.

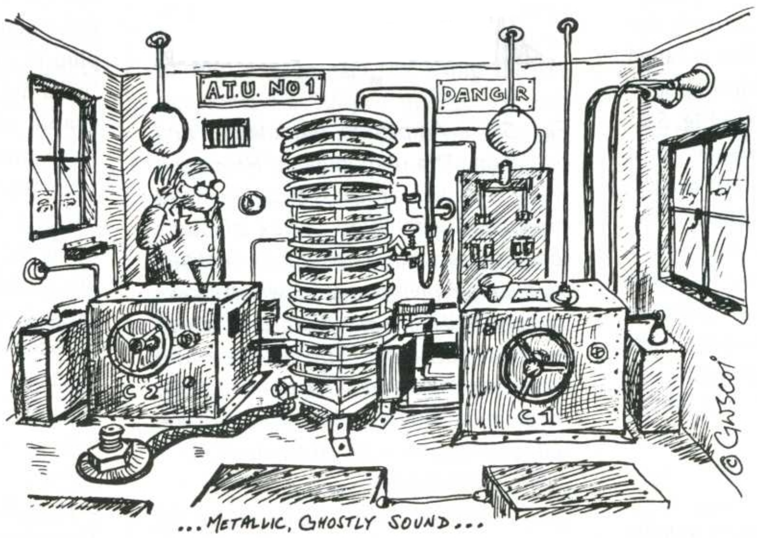
Within the house was the aerial tuning unit – one-inch copper tubing wound into solenoids thirty inches in diameter, supported by plane wood frames, tuned by variable condensers whose plates were immersed in evil-smelling oil in a tank the size of a 50-gallon oil-drum, with suitcase-size mica condensers lying on the earthed floor to attain the required matching impedances. Static leaks, made up of paralleled resistors a foot long, hung below chokes – all eager to hiss RF energy at anything within a foot or so. The programme being radiated was audible as a metallic, ghostly sound. Mast-head warning lights were fed with DC via bifilar isolating chokes. Rejector circuits, mounted on the wall where the feeder entered, reduced induction from the other programmes being generated at the station – even these coils were about a foot in diameter and of similar length. Current into the actual aerial was readable on a well-insulated instrument, with a telephone back to the control room.

The equipment, still available for full specification service at 50kW carrier power, was as old as I was. It was powered from a set of four great diesel engines, each having six cylinders with a 12in bore and 30in stroke. They were compressed air started, foot-pump primed and governed to trundle around at 350rpm with a four-ton flywheel to maintain smooth torque to the huge dynamo. This was six feet in diameter, capable of delivering a thousand amperes via the four sets of brushes spaced along its two-foot long commutator, to a switchboard of eight-foot high slabs of polished Welsh slate, each having an open-construction air circuit breaker capable of rupturing and arc-quenching 2000 amps in the desired direction and 50 amps in the reverse direction. Each negative connection found 'earth' via a hefty (open) current shunt, the ammeter having 1500–0–100 scales, with a trip contact operated by the foot-long 'needle' pointer. The positive connection, another arm-sized cable, went via a porcelain 1500A fuse (with enough room for two hands in its 'handle') to a knife switch, the blade of which was hand-sized, operated by a two-handed ebonite handle.

Distilled Water by the Gallon

The output of one engine was enough to start up the transmitter, with voltage stabilisation being provided by a battery-room of 115 lead-acid cells, each of 400 ampere-hour capacity, needing gallons of distilled water in warm weather. A hundred feet separated the engine room from the machine room, where more Welsh slate gleamed ominously in the light reflected from more knife switches and copper 'bus-bars'.

Running up this equipment called for practised choreography. The water pumps, each electric motor to be gently started by a quadrant handle, the bias machine in similar manner, then the filament machine, whose dynamo delivered a couple of dozen volts at 1200 amps, by which time the glow from the pure tungsten filaments could be seen from next door. At this stage each valve needed visual checking through the plate-glass doors, the oscillator, buffer, modulator and 'mod. amp.' all being Rugby-football sized and perched precariously on asbestos rope collars in the first of five brass 'chicken coops' – ten-foot cubes ranged in a row along the transmitter hall.



The second coop held a pair of cylindrical triodes, anode-down in insulated water jackets with 'fingers' for filament connections on the top. Another, poking out of the side of the hard-glass cylinder, had an anti-corona cap connector leading to each valve's grid-current meter, perched amid the 'man-sized' components around the valves. The third and fifth coops were similar, each having a row of seven valves of which six were in normal use with a filament switch for the 'spare'. Each coop had a woven asbestos mat resistor of 500 ohms and a sloping 'chimney' up which, in theory, would blow the carbon tetrachloride and spring of a fuse to give rapid rupturing should any valve go 'soft' and glow pale blue, with red-hot anode for the few seconds that elapsed before a spectacular 'blow'. Again, meters for grid current and anode current reposed safely within the glass-housed upper half of each coop. Inside the lower metal-doored cupboards were carefully wooden-framed coils of rubber hose – for the cooling water to have a long path up to the anode jackets – and the necessary coupling and isolating mica condensers, bias resistors, etc.

The fourth coop sprouted a pair of motor-car steering wheels, used to tune the tank-coil lying horizontally behind the upper panel. A coil large enough for a man to climb inside to adjust the 'croc-clip' inductance-selecting 'tap' on the inch thick tubing, with a 'rope' of about the same diameter of Litz wire!

Lurking at the back were two more 'Rugby football' diodes to monitor and display peak RF volts at either end of the tank coil. It took quite some ambidextrous skill to resonate and balance the devices.

Hopefully, while all this was being looked over, someone at the other end of the long building would have started up a second engine and 'got it on the bars', a state displayed by some long-suffering lamps high up in the ceiling, which would put up with 270V while the second engine's dynamo 'thrash-charged' the batteries for a few minutes until an engineer could get back to the machine room to run up the EHT set.

15kV at 15 Amps

The EHT set was in a safety cage and consisted of a mean-looking DC motor coupled to the first (and earthy) of a pair of 10ft diameter dynamos, each rated at 7½kV 15A and connected in series. The commutator 'whine' was filtered by a smoothing choke (about eight feet high) and a wall-high stack of $2\mu F$ paper condensers situated on the other side of the wall to the transmitter hall, where more Welsh slate bristled with huge meters that could be read from the console in the centre of the hall, and polished switch handles.

The high 'mains' voltage was a temporary necessity, as the large motor would not budge against the appreciable inertia of the twin dynamos unless a thousand amps was 'poured' into its armature. With squeaking brushes the three armatures would slowly begin to turn, the glow from the starter resistance bars behind the switchboard reflecting off the ceiling until the sections were short-circuited by a row of knife switches as the speed increased to a reassuring whine.

Then back to the hall and the console. Buttons for the 3kV for the oscillator (originally self-excited but crystal controlled by then) and buffer. Getting over the initial scare of a red-hot molybdenum anode of the modulator valve. Similarly the intermediate amplifier pair, passing the already-modulated carrier to the dozen-valved PA stage, whose EHT was brought up by a hand-wheel controlling the battery-excited shunt fields of the two series-connected dynamos. A second control set the excitation of the engine dynamos, whose distant roar under load, combined with the inevitable throb or beat between the sets of revolving machinery, could be physically felt.

When all readings had been checked, etc., programme would be key-switched in from the GPO racks in the screened front rooms, with a continual walking around the whole station called for – checking engine cylinder-head temperatures, their cooling water, fuel header tanks, air bottle pressures, cooling pond sprays, valve currents, etc., etc. One really felt like an engineer on such time honoured gear! **RB**

Propriety at All Times!

Browsing recently for possible radio titles at a local church second-hand book sale, my eye was caught by a volume entitled *The Sensuous Female*. A few minutes later, discreetly segregated on another trestle table in the far corner of the hall, I espied its companion *The Sensuous Male*.

Geoff Arnold

Yesterday's Circuits - No. 5

by Gordon J. King, IEng, G4VFV

AM Detectors

With amplitude modulation (AM) the audio information is applied to the carrier wave in such a way that the amplitude of the carrier is caused to vary in direct sympathy with the audio information. To extract the audio information it is merely necessary to rectify the information-bearing carrier wave, then to attenuate the remaining radio-frequency (RF) signal, so that only the audio information remains. This is called AM detection, and a graphic illustration of the process involved is given in **Fig. 5.1**.

An early AM detector consisted of a semiconducting material, such as the crystal galena, plus a 'cat's-whisker'. The craft was to get the 'cat's-whisker', which was a thin, spring-wound wire, to make contact with a 'sensitive' spot on the surface of the crystal. When this was achieved the combination made a remarkably efficient rectifier (detector) of RF signal. It represented the heart of the crystal set. The receiver was completed by a suitable tuned circuit, probably an RF by-pass capacitor and a pair of high-impedance (2000Ω) headphones. A typical circuit of a simple crystal set is given in **Fig. 5.2**. Disadvantages were poor sensitivity and selectivity along with low audio output.

During the crystal set era, various artifices were evolved as a means of improving the selectivity – notably by endeavouring to enhance the Q-factor of the tuned circuit – but usually at the expense of audio output! Nevertheless, with a lofty 100ft aerial and an efficient earth, the 'local' stations were received at adequate entertainment value volume! This is rather amazing when it is realised that the actual urge to operate the 'phones emanated from the 'power' contained in the modulated signal itself.

To avoid the Q-factor of the tuned circuit being unduly damped by the aerial, the aerial was sometimes tapped down the tuning coil, as shown in **Fig. 5.2**. Other schemes included mutually-coupled coils, one being the tuned circuit itself and the other connected to the aerial, the spacing and hence the coupling between them being adjustable. However, if the coupling was too loose, the aerial signal arriving at the crystal detector was less than with tighter coupling, despite the enhancement in the selectivity, and so the signal was less loud in the 'phones. For this reason, the aerial was often connected right at the top of the tuning coil, the resulting impaired selectivity meaning that the local station could be heard over half the rotation of the 0.0005µF (500pF) tuning capacitor – not that this mattered much since to tune any other station might well mean a change in the tuning coil, which was invariably a plug-in component bearing the legend 'what are the wild waves saying', and a graph showing the frequency or wavelength range of the particular coil when tuned by a 0.0005µF capacitor. Oh dear, what nostalgia – I can almost smell the copper and Bakelite and feel the quality of the polished mahogany cabinets of my early crystal sets.

What a great history the simple AM detector has. In those bygone days one experimented with full-wave detection, with biasing the crystal, by adding an AF stage to work a horn loudspeaker and even an RF stage to bring in Radio Paris! The crystal detector was the fore-runner of the semiconductor diode, In fact, early point-contact diodes constituted commercially produced crystal detectors with the 'cat's-whisker' fixed at the most sensitive position on the semiconductor crystal at the factory. It was soon found that these devices made excellent detectors of VHF and UHF signals.

Anyway, let's get back to the main story. The capacitor across the 'phones in **Fig. 5.2** is essentially to eliminate the residual RF signal and to improve the efficiency of detection. However, with the crystal set the capacitance of the 'phones and leads was usually sufficient for this without the need for an extra capacitance in many cases.

At this point it is interesting to look at an early full-wave detector. **Fig. 5.3** shows an experimental circuit of this kind which I used way back in the early 1930s. The tuning coil was centre-tapped to provide a balanced drive to the two crystal detectors, while the aerial signal was coupled in via a separate winding. This circuit rectified both halves of the modulated wave and would thus produce an audio output as at (d) in Fig. 5.1, but

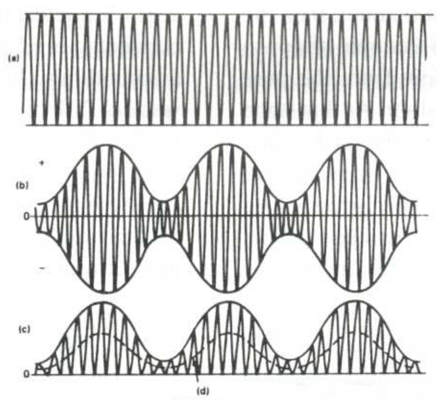


Fig. 5.1 - Amplitude modulation and detection. The unmodulated RF carrier wave is shown at (a); the carrier wave modulated with three cycles of audio tone at (b); the detected or rectified modulation waveform at (c), which shows that one half of the waveform is removed by the detector. The broken-line waveform (d) is that of the original audio modulation which appears across the detector load resistor. The residual RF is removed by filtering

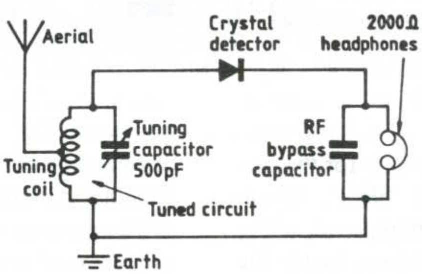


Fig. 5.2 - The crystal set, using one of the earliest of semiconductor detectors, the crystal and cat's-whisker

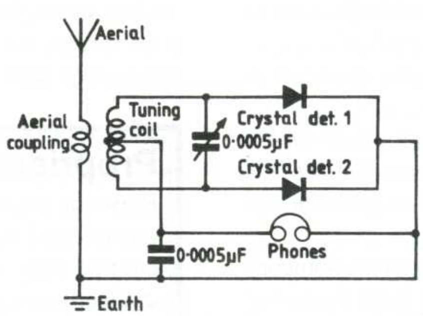


Fig. 5.3 - An experimental circuit used by the author in a full-wave crystal set

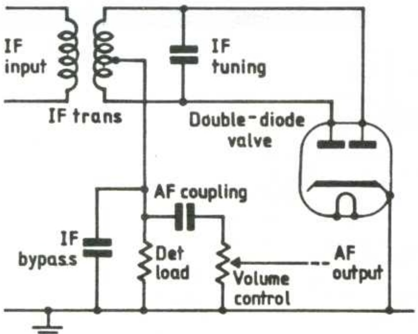


Fig. 5.4 - Full-wave detector circuit

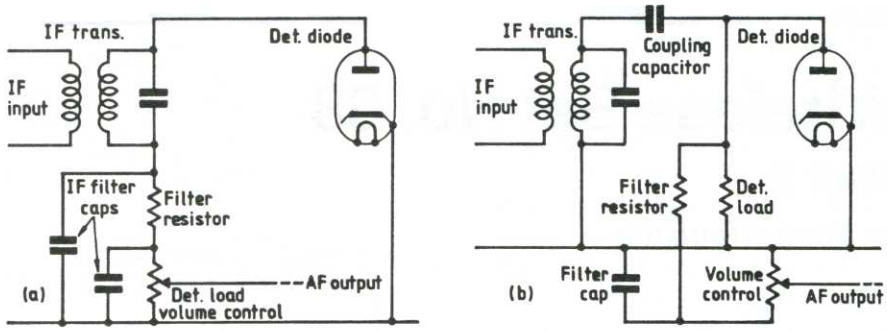


Fig. 5.5 - Simple AM detector circuits: (a) series-fed and (b) capacitively-coupled

owing to the balanced nature of the circuit there was little or no RF signal at the centre-tap and hence across the 'phones. A small RF by-pass capacitor was still used however to eliminate any residual RF signal (now at twice the original RF frequency) and to optimise the detection process.

Some pre-war receivers used full-wave detection, a double-diode valve (such as the 6H6) taking the place of the two crystal detectors. In this case, the by-pass capacitor reduces the amplitude of the harmonics of the carrier (or IF signal) which would otherwise appear across the detector load. Such a circuit, along with the functions of the various components, is given in **Fig. 5.4**. With valve diode detectors it is interesting to note that the electrons produced by the cathode within the vacuum are of sufficiently high velocity to reach the anodes, even in the absence of signal, and owing to this a potential (albeit a small one) is produced across the load resistor. This is called the 'contact potential' which tends to 'bias' the anode negative with respect to the cathode.

Two more early valve diode detectors are given in **Fig. 5.5**. At (a) the diode is effectively in 'series' with the IF signal, which is the most common form of AM detector, while at (b) the diode lies in parallel with the signal across the IF transformer secondary winding, and the signal is coupled via a capacitor, for which reason the circuit is known as a capacitively-coupled diode detector. Also note that the load resistor is connected directly across the diode. This, of course, means that there can be no filter capacitor here (as in circuit(a)). Instead, the detected audio signal at the top of the load is connected to the volume control through a filter resistor, and a filter capacitor used at the far end of this.

The classic 'leaky grid' or cumulative detector circuit is given in **Fig. 5.6**. This was a popular basis for many very early valve receivers. In fact, if the AF transformer is replaced by a pair of headphones, then one has a very simple one-valve receiver. Because of the amplification at AF provided by the triode, the signal is significantly louder in the 'phones than from the crystal set of Fig. 5.2. In fact, by using the AF transformer as shown in Fig. 5.6, and coupling to a simple AF amplifier stage, one can achieve sufficient audio power to drive a loudspeaker.

The way the circuit works is quite simple, because the grid of the valve acts as a diode in conjunction with the cathode, so the first part of the circuit is almost identical to that of the diode detector at (a) in Fig. 5.5. Thus, superimposed between the grid and the cathode is the audio signal, which is amplified by the triode proper, the resulting audio then appearing across the anode load – either the transformer shown or a headphone set. Early receivers using cumulative detection invariably used regeneration (or Q multiplication) as a means of improving both sensitivity and selectivity; but care had to be taken to avoid excessive regeneration otherwise the triode would turn into an oscillator and interfere with other receivers nearby. In early days this was known as 'reaction'.

Finally, mention must be made of plate (or anode bend) detection. This, again, is an early circuit which can use either a triode or, preferably, a pentode valve. When a pentode valve is used the anode is best loaded by a very high inductance choke, shunted by a resistor to 'flatten' the frequency response, as shown in the circuit at **Fig. 5.7**. The cathode resistor is best by-passed by a capacitor of smallish value for the RF signal rather than for the RF and AF signals.

Detection occurs since the valve is operated towards the point of anode current cut-off, where there is severe non-linearity of the operating (transfer) characteristic – this, of course, resulting in rectification. With a triode or pentode valve either bottom or top bend rectification was adopted; but with a pentode the valve was

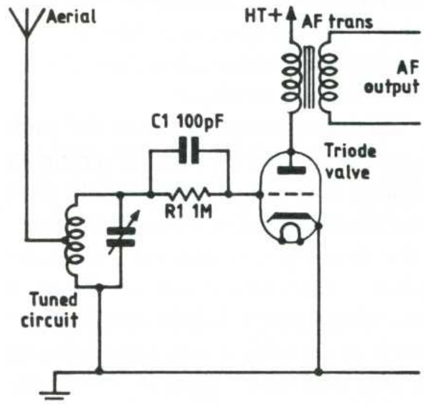


Fig. 5.6 - Leaky grid detector

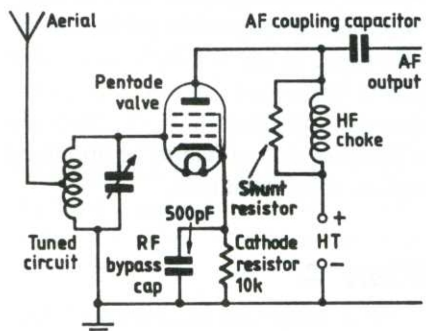


Fig. 5.7 - Anode bend detector

generally set for top bend working. The circuit was optimised in terms of anode voltage and grid bias, the latter being particularly critical. In Fig. 5.7 the valve is biased by the volts drop across the cathode resistor; but for the least audio distortion a form of fixed bias was preferred.

There were variations of the circuit, including 'reflex' detection, which was similar to plate detection but with negative feedback to reduce the audio distortion. An advantage of plate detection was the relatively small degree of damping applied to the tuned circuit owing to the high grid impedance, which was further increased by negative feedback. Plate detection in one form or another was favoured by the radio amateur and short-wave enthusiast because of the relatively improved selectivity and sensitivity obtainable as a result of the reduced grid loading effect.

Wireless Set No. 38

Part 2

by Louis Meulstee

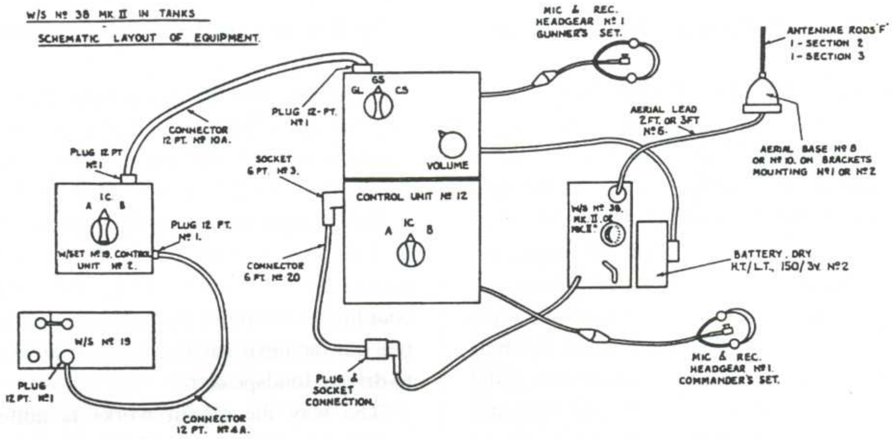
Communication between tanks and infantry is of major importance. It allows the infantry to warn the tanks, who have only a limited view, when running into troubles such as concealed anti-tank guns or difficulties of terrain.

Communication between the tank commander and the infantry during an assault was virtually impossible until the introduction of radio communication. The first solution was the 'tank telephone', a telephone handset mounted in an armoured box on the outside at the back of the tank. It was provided with a long lead which allowed an infantry officer to get hold of the telephone and find cover whilst holding conference with the tank commander. An automatic 'wind-up' arrangement proved to be necessary, as the handsets were often left on the ground and were torn off the moment the tank moved. Also the telephone handset had to be armoured against rough treatment.

Plan 'A'

As a temporary measure to obtain direct liaison between the tanks and infantry, No. 38 sets were put into infantry tanks. Usually the set was operated by the gunner. This improvised construction served quite satisfactorily until an improved type of set, specially designed for this purpose, became available. Two types of installations, with the WS No. 38 suitably adapted, were developed and were known as plan 'A' and plan 'B'. Under plan 'A', normal man-pack 38 sets with dry batteries were permanently fitted in the tanks within easy reach of the main gunner, who was responsible for operating and switching the set and control unit. The set, which was mounted in the turret, was connected to the tank No. 19 set communication system by means of Control Unit No. 12, replacing the existing No. 1 control box. The No. 19 set intercom amplifier was used to amplify the No. 38 set receiver output. This enabled all crew members to hear signals coming from the No. 38 set link via the intercom circuit. The 38 set had a separate 8ft vertical rod aerial, mounted on an aerial base and secured to a bracket on the tank turret. It was connected to the set by a 2ft aerial lead giving a range of approximately 1km when on the move.

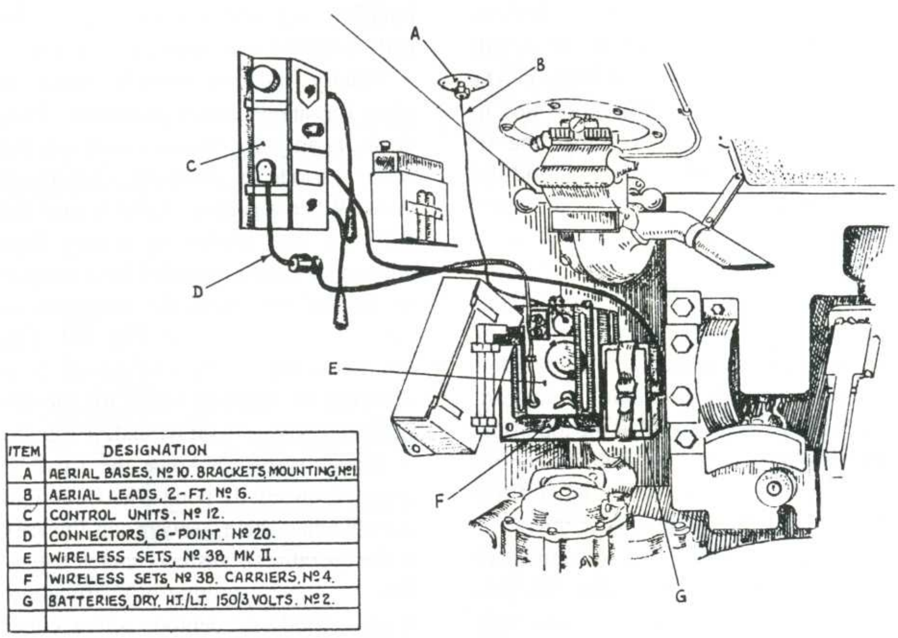
This arrangement in original form, issued from late 1943, was suitable for Churchill tanks only, but later modified to fit Sherman tanks as well.



Schematic layout of equipment in plan 'A'. The set consisted of a normal dry battery powered man-pack No. 38 set, connected to the existing No. 19 set by a special No. 12 control unit. A separate 38 set volume control was provided

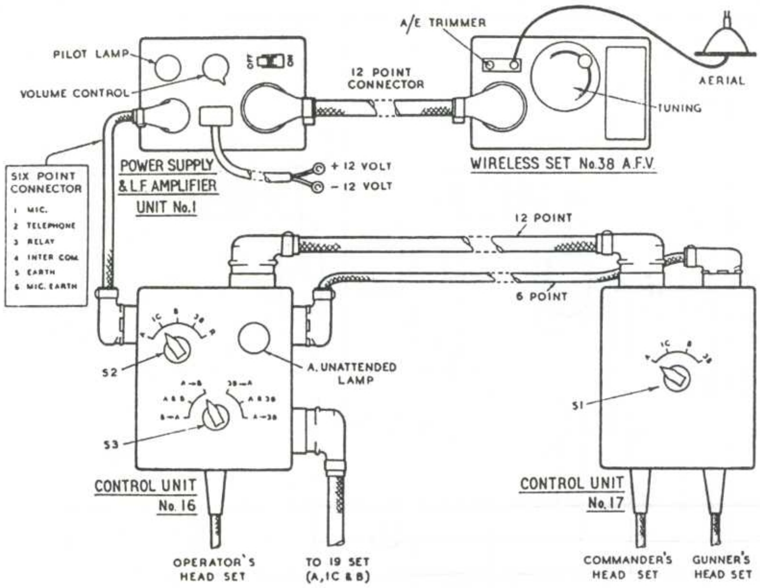
Plan 'B'

A second plan, 'B', which eventually replaced plan 'A', came into operation in mid-1944. WS No. 38 AFV was basically a modified No. 38 MkII* set with pressel-operated transmit/receive switching. A vibrator power supply enabled the set to operate from the vehicle battery. A separate AF amplifier was provided which did away with the



ITEM	DESIGNATION
A	AERIAL BASES, Nº 10. BRACKETS MOUNTING Nº1
B	AERIAL LEADS, 2-FT. Nº 6.
C	CONTROL UNITS. Nº 12.
D	CONNECTORS, 6-POINT. Nº 20.
E	WIRELESS SETS, Nº 38, MK II.
F	WIRELESS SETS, Nº 38. CARRIERS. Nº 4.
G	BATTERIES, DRY, H.T./L.T. 150/3 VOLTS. Nº 2.

Wireless Set No. 38 MkII fitted in a Churchill III tank. Despite the confined space in the turret, a small place near the gun was found to mount the set



Wireless Set No. 38 AFV. Diagram of installation. Note the extra switch position on the control units, providing a quick selection of either WS No. 19 A/B set, intercom or 38 set. The 38 set and Power Supply & LF Amplifier Unit No.1 are connected by means of a 12-point connector similar to the cable connecting the 19 set to its Power Supply unit

necessity of using the No. 19 set intercom amplifier. The set was operated by the No. 19 set microphone and headphones. Special control units No. 16 and No. 17, provided with extra switch functions, replaced the existing No. 1 and No. 3 control units.

The set consisted of two units, WS No. 38 AFV and Power Supply & LF Amplifier Unit No.1, both mounted on top of the No. 19 set and connected to it by a 6-point connector cable.

Relay-operated

The circuit of the WS No. 38 AFV is almost identical to that of the MkII* model. A major change is the substitution of a relay for the send/receive switch. Other differences are altered values of filament dropping resistances and an additional WX6 Westector rectifier acting as a limiter. Only one aerial socket is provided, while no capacity trimmer is fitted across the aerial circuit. The aerial trimmer, adjustable by a screwdriver from the front, must be adjusted for different lengths of feeder or aerials. The AF output transformer is replaced by a capacitor and resistor, feeding the AF output to the AF amplifier.

Power Supply

The power supply consists of a 12 volt vibrator and bridge metal rectifier, providing 150 volts HT. Mounted in the same case is an AF amplifier, using an ATP4 valve, providing additional gain to the receiver output and sidetone on send. The Power Supply & LF Amplifier Unit No. 1 and WS No. 38 AFV are connected by means of a 12-point connector.

Airborne Signals

The No. 38 set found wide use throughout the Army and saw service virtually everywhere in the world. They were even used by partisans to communicate with submarines at rendezvous points. For short range communication, 38 sets were issued to Parachute Brigades at Company level. They functioned quite satisfactorily: '... this set appears to have worked well, the only criticism being the old one of junction box (apparently some early MkI models were issued for this operation) ... batteries appear to have required replenishment only every 48 hours...' (Signals Report, Operation Market Garden).

Individual sets were usually taken in a 'Kitbag, Parachutist', similar to an enlarged Army kitbag, but having a laced side and provided with leg straps. The set was padded in such a way that the normal shape of the bag was unaltered without uneven bulging of the sides. Small sets such as WS No. 38 were also dropped packed in CLE MKIII general purpose containers.

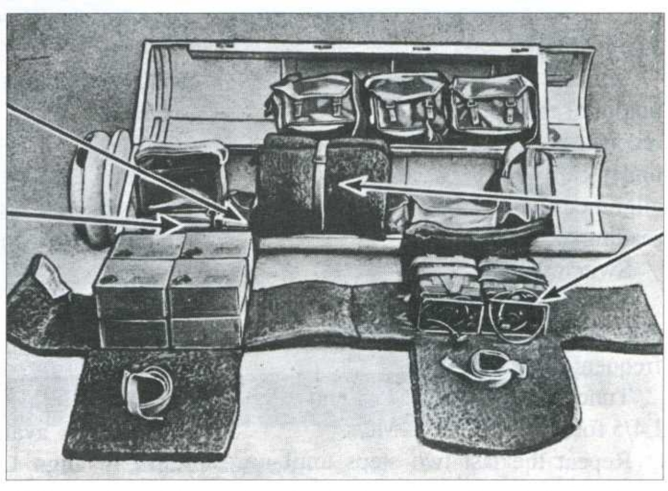
Abridged Alignment Procedure

A simplified procedure is set up for MkI and II sets. In the circuit diagram of the AFV model different component notations are given. This does, however, not affect the procedure. It is essential that the dummy aerial is connected during alignment of the transmitter to avoid unwanted radiation. Alignment must be carried out in the order given below. Usually alignment is close to the optimum unless someone has been fiddling with the set.

Preliminary

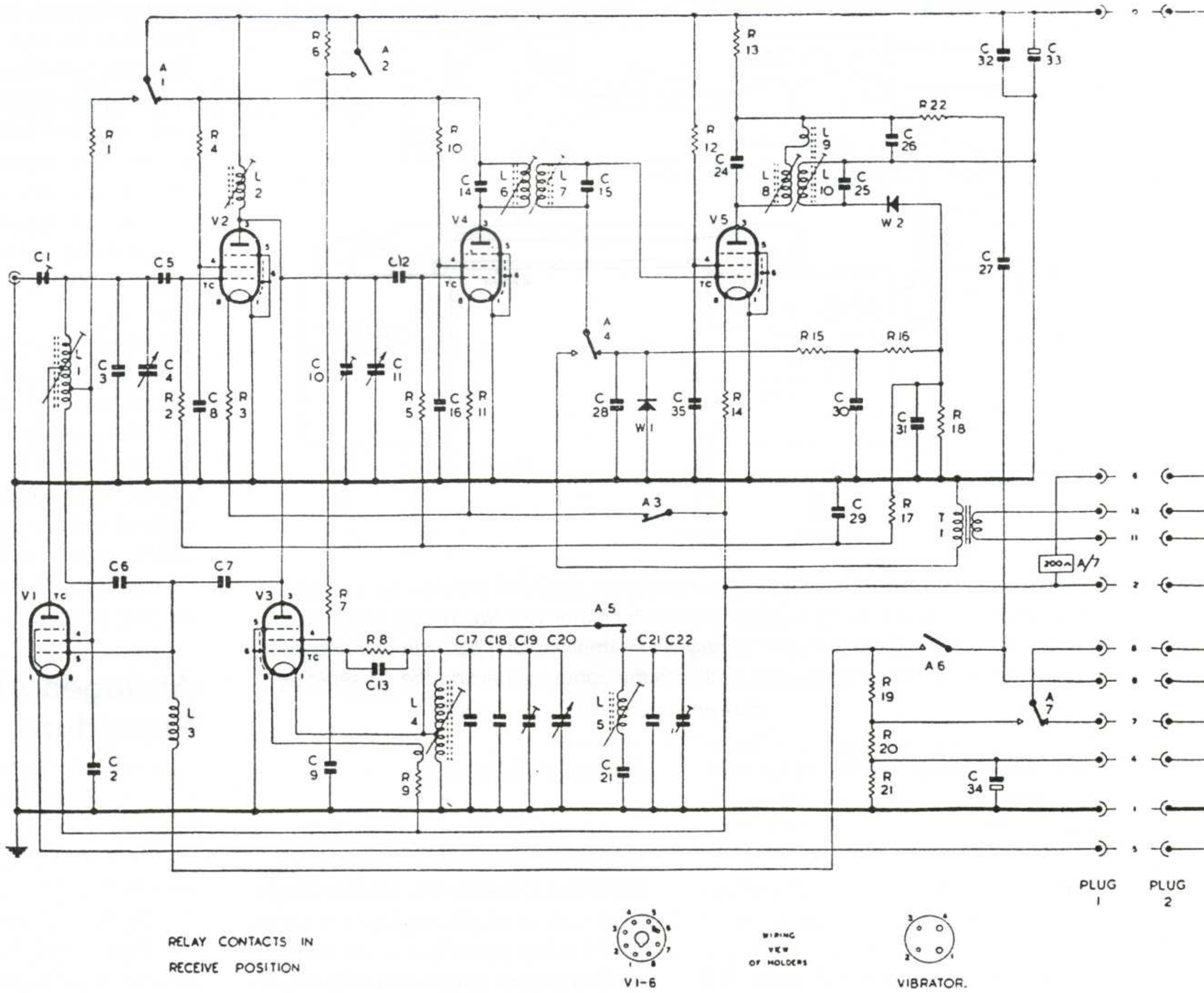
Connect the set to a suitable power supply which provides 3 volts LT and 150 volts HT.

Connect a dummy aerial, consisting of a 27 ohm resistor and a 12pF capacitor (RF test unit, described in this article), between the 3ft aerial plug (Ae 1) and set



Four complete Wireless Sets No. 38 packed in a CLE Mk.III arms container. The batteries, forming the heaviest load, are placed in the container 'crash-head' end. The sets, packed in special strips specifically provided for such purposes, are stowed towards the parachute end of the container

COMPONENTS



C1	5-50pF
C2	0.01µF
C3	15pF
C4	5-30pF
C5	100pF
C6	47pF
C7	180pF
C8	0.01µF
C9	0.01µF
C10	3-35pF
C11	5-50pF
C12	180pF
C13	100pF
C14	47pF
C15	47pF
C16	0.01µF
C17	39pF
C18	15pF
C19	3-25pF
C20	5-50pF
C21	680pF
C22	18pF
C23	3-30pF
C24	47pF
C25	180pF
C26	180pF
C27	0.01µF
C28	180pF
C29	0.1µF
C30	100pF
C31	100pF
C32	0.1µF
C33	4µF
C34	50µF
C35/43	0.1µF
C44	4µF
C45	50µF
C46	0.1µF
C47	0.001µF

R1	470Ω	R9	190Ω	R17	1MΩ	R25	470Ω	V1	ATP4
R2	1MΩ	R10	0.47MΩ	R18	0.22MΩ	R26	24Ω	V2	ARP12
R3	190Ω	R11	190Ω	R19	0.22MΩ	R27	33kΩ	V3	ARP12
R4	0.15MΩ	R12	0.15MΩ	R20	47kΩ	R28	150Ω	V4	ARP12
R5	1MΩ	R13	33kΩ	R21	390Ω			V5	ARP12
R6	0.15MΩ	R14	190Ω	R22	47kΩ			V6	ATP4
R7	0.1MΩ	R15	47kΩ	R23	1MΩ	W1	WX6		
R8	47kΩ	R16	47kΩ	R24	470Ω	W2	WX6		

Circuit diagram of WS No. 38 AFV and Power Supply/LF Amplifier No. 1

chassis. Keep the connection cables as short as possible.

Transmitter

Connect a frequency counter to the output of the RF test unit. A calibrated receiver (not connected to the RF test unit!) can also be used. In that case alignment should be at the maximum reading of the S-meter.

Switch the 38 set to 'send'.

Tune the dial to 8.9Mc/s and align C4c for a reading of 8.9Mc/s on the frequency counter.

Tune the dial to 7.4Mc/s and align L4/5 for a reading of 7.4Mc/s.

Repeat the last two steps until no further adjustment is necessary.

Connect the RF output meter to the output of the RF test unit. Tune the dial to 8.9Mc/s and align C4b and C4a for maximum deflection on the RF output meter.

Tune the dial to 7.4Mc/s and align L3 and L1 for maximum deflection.

Repeat the last two steps until no further adjustment is necessary.

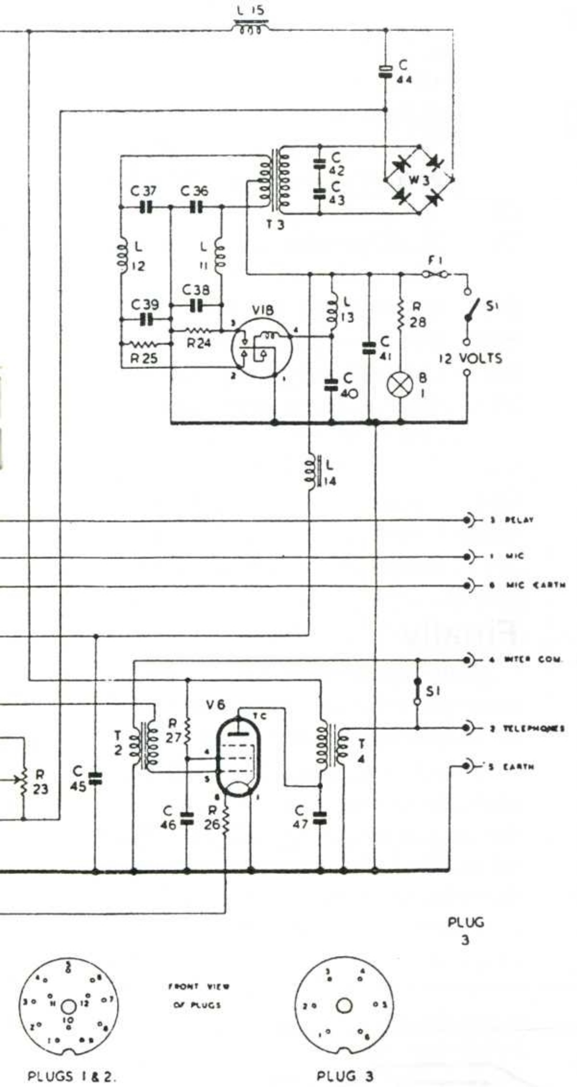
Receiver

No attempt will be made to realign the IF transformers. They are usually found optimal, though if a signal generator is available it would do no harm to align L7a,b,c and L9 for a maximum reading on the AF output meter, connected to 'Phones'. The signal generator should be set to 285kc/s and connected to the top clip of V1c. Always adjust the signal generator output level to a convenient reading on the AF output meter.

Switch the set to 'send' and tune the dial accurately to 8.9Mc/s to the frequency counter or test receiver.

Switch the set to 'receive' (without touching the tuning dial!). Connect a signal generator, tuned to 8.9Mc/s and modulated with 400c/s to the output of the RF test unit.

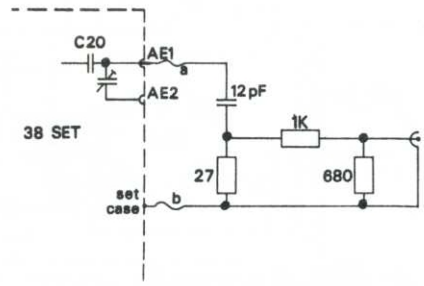
Connect the AF output meter to 'Phones'.



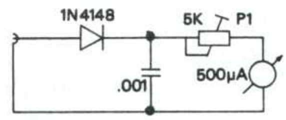
TEST UNITS

With only a few components from the junk-box a number of very useful test units can be made, invaluable for proper tuning of the 38 set.

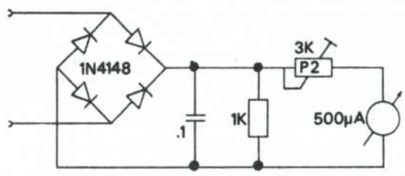
RF test unit incorporating dummy aerial and RF attenuator for connecting frequency counter, signal generator and RF output meter.
Keep the leads to the Aerial and set case ('a' and 'b') as short as possible



RF output meter used for alignment of RF output. Set P1 for a convenient meter reading



AF output meter used to align the receiver, only necessary when an accurate signal generator is available. Set P2 for a convenient (mid-scale) meter reading



Align C10a for maximum reading on the AF output meter.

Repeat this procedure at 7.4Mc/s and align L6 for maximum reading on the meter. Repeat the last two steps until no difference is noticeable. When no accurate signal generator is available an alternative method with the aid of the test receiver can be used as follows.

Tune the test receiver to a fairly strong broadcast signal around 8.9Mc/s. Switch the 38 set (still connected to the dummy aerial!) to send and set the tuning dial to 'zero beat' with the broadcast station on the test receiver.

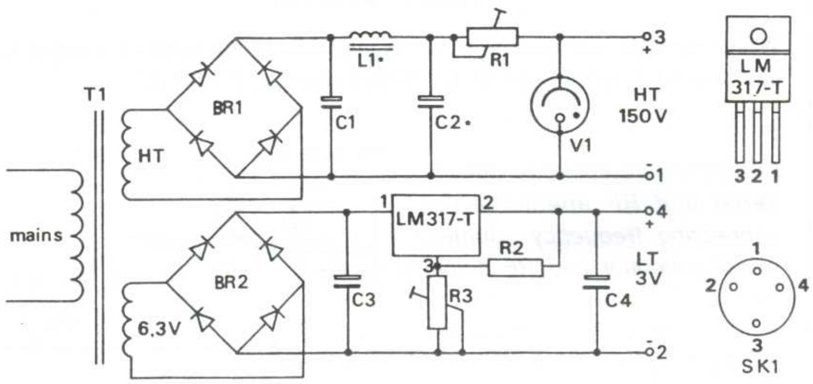
Switch the 38 set to receive (without touching the tuning dial!) and align C10a until the same broadcast station is heard in the headphones.

Repeat this at 7.4Mc/s and align L6. Both steps must be repeated until no further adjustment is necessary.

Finally remove the dummy aerial and place the 12ft rod in the large aerial plug. Switch the set to receive and tune to a weak broadcast station around 8.2Mc/s. Tune C1a for maximum loudness.

Infantry support!

Mains Power Supply for the WS No. 38



Since HT batteries are quite expensive and difficult to obtain it is definitely an advantage to build a mains PSU.

First, obtain a mains transformer from an old valved radio set delivering 6.3 volts and 140-250 volts. Rectified HT is reduced and regulated to 150 volts by means of a 5 watt adjustable resistor and a 150 volt regulator valve. The resistor must be adjusted, starting at the highest value, until the output voltage remains at approximately 150 volts with the set switched between 'receive' and 'send'. Alternatively a 10kΩ 10 watt resistor should be connected in parallel with the HT. A tap on this resistor should be set to 150 volts with the set switched to 'receive'. Because most capacitors of the 38 set are rated at only 200 volts (and unless you have found a transformer with a lower voltage) it is not recommended to use a series resistor only. When the set is switched to 'off' the HT will rise to an unpleasant value and may possibly damage some capacitors. The required LT is obtained from rectified 6.3 volts, regulated by an LM317-T. Set the LT output voltage to 3 volts before connecting the 38 set. No constructional details of the mains power supply are given as this depends largely upon the components used.

COMPONENTS

R1	5kΩ 5W W/W with adj. tap
R2	100Ω ½W
R3	330Ω potentiometer
C1,C2	16µF electrolytics, 300V Wkg.
C3	2200µF electrolytic, 30V Wkg.
C4	1µF electrolytic, 10V Wkg.
T1	Mains transformer, secondaries 6.3V at 1A, 140 – 250V at 30mA
BR1	Silicon bridge, e.g. B250 C800
BR2	Silicon bridge, e.g. B40 C800
IC1	LM317-T voltage regulator
V1	150V regulator valve OD3, OA2 or VR150
L1	Choke 10H, 30mA
SK1	Socket for connecting 38 set
*Note	L1 and C2 might be omitted. Socket SK1 viewed from rear.

Finally

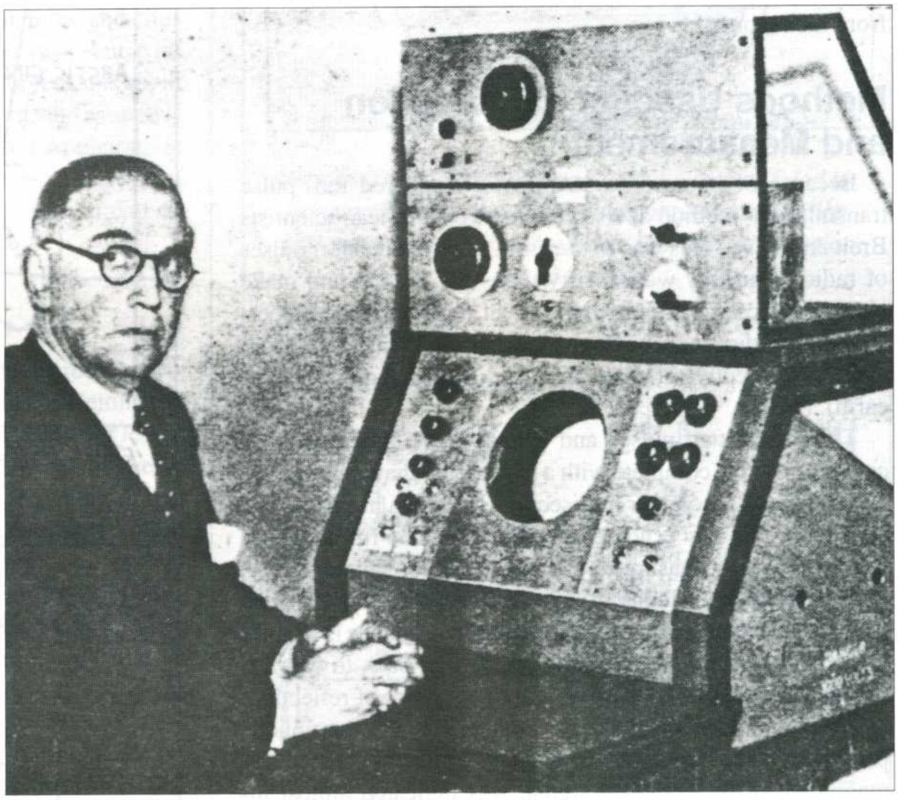
In the course of WWII similar and more powerful man-pack radios were developed for the Army, while towards 1945 trials were carried out with fully tropicalised miniature sets. After 1947 the set was replaced by WS No. 88 (on which development had started in 1944). In forthcoming articles successful man-pack sets such as WS No. 46 will be featured. ***RB***

International Polar Year 1932/33

Radio Observations in Northern Norway

by F. C. Judd G2BCX

Observations made during the first Polar Year in 1882 were concerned solely with meteorological data at ground level, but by 1932 it was decided that investigation of the normal atmosphere up to heights of 5 to 10 miles had become essential. Moreover, observations carried out during the intervening 50 years had shown intimate connection between magnetic storms, auroral displays and electric currents in the very high regions above the normal atmosphere – the ionosphere.



Professor E. V. Appleton FRS seated at a cathode ray tube display similar to that used during the 1932 Polar Year observations

The 1932 Polar Year

For the second International Polar Year, a team of scientists led by Professor E. V. Appleton travelled to Tromsö, above the Arctic Circle, in northern Norway. The main task was to investigate much of the ionospheric phenomena mentioned above, to determine how the different regions of the ionosphere became ionised and why the intensity of this varied to such an extent as not only to affect the reflection and refraction of wireless waves reaching them from earth, but often to cause the waves to become completely absorbed. The true reason for either effect was completely unknown before this time.

At the Royal Institution in 1933

The following extracts from a lecture given by Professor Appleton at the Royal Institution in October 1933 may provide a better realisation of the importance of the discoveries he made during the 1932 Polar Year.

'Fortunately the emergence of new problems has coincided with the development of new methods for attempting their solution. Five years after the end of the first Polar Year, Heinrich Hertz, the "father of wireless telegraphy", succeeded in producing and detecting electric waves. The rapid expansion of this branch of physics, especially on its applied side, is now familiar to all, resulting in the service of wireless telephony and broadcasting as we know it today.

'We can', he said, 'purposely send up (vertically) wireless signals to the upper atmosphere where they are reflected and come back to us again. From the time they take on their up and down journey, from their polarisation and intensity when they return, we can obtain information concerning the situation and structure of the electrified ceiling in the atmosphere which reflected them.'

Appleton looked upon 'wireless waves' purely as a 'geophysical tool' to be used as a probe for investigating what he called the electrified regions of the upper atmosphere (now the ionospheric regions D, E, F1 and F2) in a very direct fashion.

Previous work on this subject, carried out in England by the Radio Research Board of the DSIR (Department of Scientific and Industrial Research), had already suggested the need for similar observations to be made in high latitudes. Accordingly a site was chosen in Northern Norway where Appleton and his team were fortunate in having an Auroral Observatory placed at their disposal, where they were able to set up a receiving station, a laboratory and living quarters.

The Experiments at Tromsö

The map section (**Fig. 1**) shows that Tromsö, a town of some 10 000 inhabitants, is located at latitude 69.5°N. Preliminary investigation of the area by R. Watson Watt (later Sir Robert Watson Watt of World War II radar fame) revealed a hydroelectric station at Simavik about ten miles away which supplied electricity to Tromsö as well. This enabled the receiving and transmitting stations to be synchronised on the same power supply with the transmitter installed at Simavik itself. Moreover there was a telephone link between the two locations.

These facilities, together with other information acquired, enabled Appleton to decide on the kind of 'ionospheric' observations that could be carried out. To use his own terminology these were:

'(a) to make frequent measurements of the density of electrification of the ionised regions and (b) keep a close watch on wireless "conditions" so as not to omit any "abnormalities" from the records.'

Methods Used for Observation and Measurement

Because of its accuracy, Appleton employed the 'pulse transmission' method devised by the two American scientists Breit and Tuve. This was to transmit, from earth, short pulses of radio frequency waves, fifty times per second and make photographic records of both the direct signals and the echoes. (Echoes: Radio frequency pulses, originally transmitted from earth and directly reflected from an ionised region back to earth). [1]

The transmitted pulses and echoes were displayed on a cathode ray tube complete with a 'time scale' having intervals of 1000th of a second, or millisecond, as shown in **Fig. 2**. The 'time delay' of any echo appearing on the tube further along the timebase is measured by the time scale. This quantity, multiplied by the velocity of light, indicates the *total* distance the original signal has travelled; as this total distance is straight up to the respective ionospheric region and back to earth, it is divided by two to give the height of the point of reflection.

As the cathode ray tube provided a visually continuous picture, any change in the height of reflection, or in the magnitude of the reflected signal, was indicated almost instantaneously. The photograph, **Fig. 3**, obtained using modern equipment, shows the transmitted pulse and its reflected signal from the ionospheric F region.

A study of the echo patterns, over as wide a range of frequencies as possible, enabled Appleton to find the lowest frequency (known as the 'critical frequency') at which the pulse signals went straight through any region of the ionosphere into outer space. By using this 'critical frequency' method, he was able to compare the ionospheric ionisation intensities in Tromsö with those in south-east England.

Work Commences – August 1932

Although a certain amount was known concerning the structure of the ionised regions, the nature of the radiations which caused the ionisation was in dispute. This was what Appleton hoped to discover from observations and measurements made at Tromsö.

For example, some held the view that ultraviolet radiation from the sun constituted the ionising agency, while others favoured streams of charged or uncharged particles, shot with great speed from the sun and ionising these upper regions of the atmosphere by collisions with air molecules.

Ionisation of the Atmosphere

Appleton maintained that since ultraviolet radiation travelled in straight lines one would expect the ionisation to be stronger

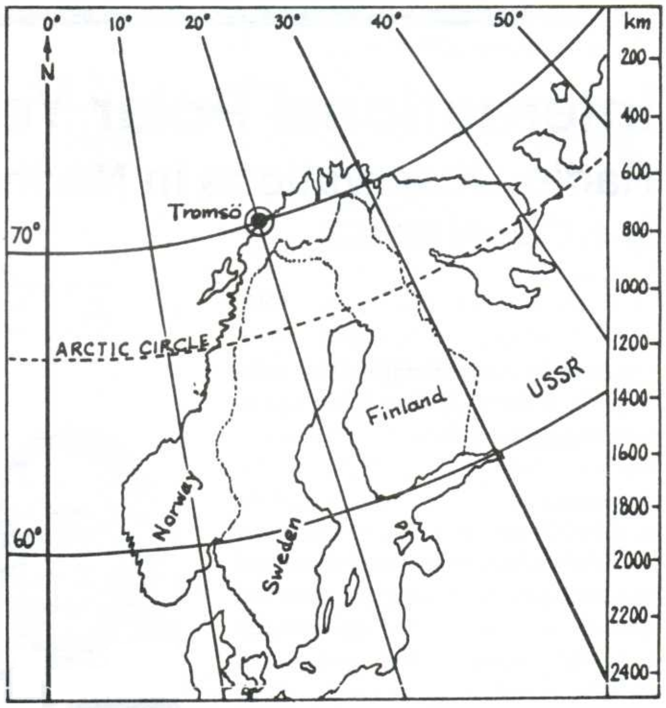


Fig. 1 - Map section showing the location of Tromsö in northern Norway at latitude 69.5°N

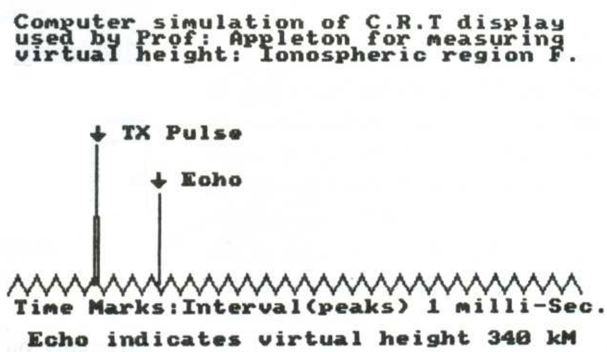


Fig. 2 - The method used in 1932 for timing echoes from ionospheric regions when using pulse transmission

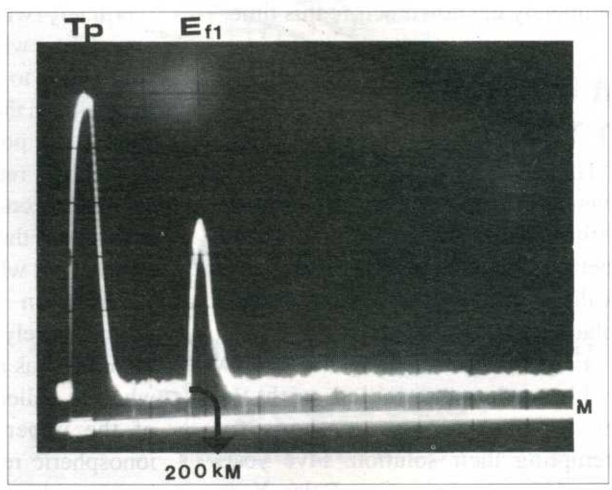


Fig. 3 - Transmitted pulse (Tp) and echo (E_{f1}) from ionospheric F1 region. Indicated virtual height 200km. The lower trace (M) carries 1 millisecond time markers

by day that by night. Replenishment by day would be followed by a night-time decay. His own explanation at the time was: since the intensity of the influence (ultraviolet rays) should increase with the altitude angle of the sun, we should expect stronger electrification (ionisation intensity) at noon above south-east England than that above Tromsö.

He also believed that, if the ionising agency consisted of neutral and charged particles travelling at high speed, the expected effects would be much more complicated. The neutral particles would, it is true, travel in straight lines and thus behave very similarly in effect to ultraviolet rays, but with 'charged' particles this would not be so. As soon as it is set in motion a 'charged' particle is an electric current, and as such is influenced by a magnetic field. 'The earth' said Appleton, 'is a great big magnetised sphere, so that as soon as electrified particles come under its influence they cease to travel in straight lines.'

The Tromsö Observations

The first observations at Tromsö showed that there were two main reflecting regions, the same as in England. Appleton then had to find out whether they were ionised to a greater or lesser extent. He also found the area very liable to magnetic disturbances, or magnetic storms, in which the value of the earth's magnetic field varied noticeably from the normal. This gave different results in the 'wireless' measurements according to whether the day was magnetically 'quiet' or magnetically 'active'. On a magnetically quiet day, he found the ionisation at Tromsö for both ionospheric regions (E and F) to be less at noon than it would be in south-east England. Therefore, on magnetically quiet days it was, quite rightly, assumed that ultraviolet radiation was the ionising agency for both regions.

One remarkable feature of the Tromsö observations was the frequent occurrence of disturbed conditions associated with magnetic activity and auroral displays. During such periods the evidence was entirely in favour of the particle theory. Magnetic disturbances at Tromsö usually occurred during the night, between 8pm and 4am local time. During these periods it was noted that the ionisation in the lower (E) region could actually increase at a time when ultraviolet radiation from the sun could not possibly be reaching it. This does happen with small magnetic disturbances, but with intense magnetic disturbances a result was obtained which was a complete surprise. No echoes at all were received on any of the available wavelengths that could be used.

Recording the Results

Using the pulse transmission system (Fig. 2) and 'masking' the cathode ray tube display as in **Fig. 4**, semi-photographic records could be made on 'bromide' paper slowly moved across the slot at constant speed. Movement of an echo, i.e., changes in reflection time could be continuously recorded as the transmission/reception frequency was changed, or as the virtual height of the region changed. Another method of recording (**Fig. 5**) shows the results obtained on a magnetically quiet day when echoes appear on all frequencies. On 22 May 1933 when a magnetic storm was in progress, no echoes were obtained on any frequency, as shown in **Fig. 6**. A similar method of photographically recording ionospheric data was developed in 1933 and used in conjunction with a continuous

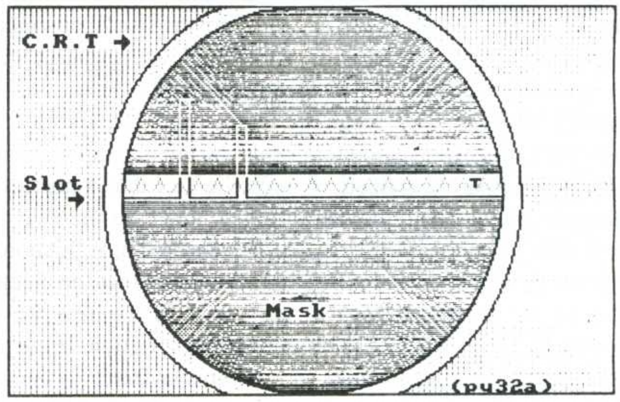


Fig. 4 - The masked cathode ray tube display used in conjunction with moving bromide paper for recording variations in ionospheric echo timing, etc., or in region virtual heights

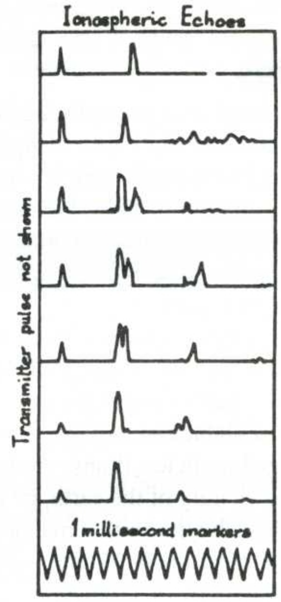


Fig. 5 - Echo pictures obtained on a magnetically quiet day – see text (redrawn from the original)

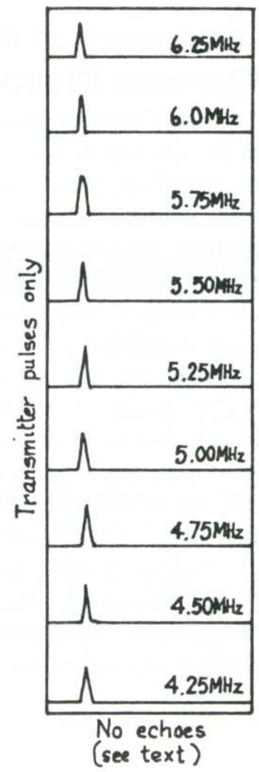


Fig. 6 (above right) - Recordings made at different frequencies showing the absence of echoes during a magnetic storm. Only the transmitted pulse is visible (redrawn from the original)

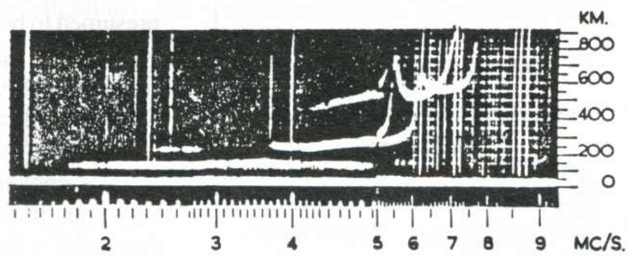


Fig. 7 - An 'ionogram'. A photographic record taken with a frequency-scanning pulse transmitter and receiver called an 'Ionosonde'. This typical summer-time recording made in southern England shows variation in the virtual heights of E and F regions

'frequency scanning' system. This also incorporated the pulse transmitter and receiver and became known as an 'Ionosonde'. A typical readout, known as an 'ionogram', is shown in **Fig. 7**.

From the data obtained, Appleton observed: 'We see that the agency which causes magnetic storms and the aurora, can influence the lower region ionisation during the night and can also give impaired reflection. Now the fact that a nocturnal increase of lower region ionisation is found to precede the cessation of echoes suggests that the absence of reflection is caused by TOO MUCH ionisation. We know that the electricity in the upper atmosphere only reflects wireless waves copiously when it is free to vibrate without friction. If the gas pressure is high the electrons do not move so freely so there is frictional effect and the wireless waves are absorbed. Thus the absence of reflection can be explained, i.e., by assuming that the ionisation is so intense that it extends to below the usual 100 kilometres where the pressure of air is great enough to cause marked absorption.'

A Summary of the Important Discoveries

1. Prior to Tromsö it was understood and generally agreed that the sun was in one way or another the cause of upper atmosphere ionisation. There were two ways in which ionisation could be produced: (a) by radiation of light, including ultraviolet, X-rays or gamma-rays; (b) by particle bombardment. Experimental evidence was required to establish which, or the relative merits of the different causes.
2. Tromsö, being in polar latitudes, offered opportunity for the experiments because: (a) the higher latitude would result in a different density of radiation per square centimetre than in south-east England, but this was calculable and, in particular as well as more important; (b) charged particles, if any, emitted by the sun would, on reaching the vicinity of the earth, be diverted in their path towards the poles by the earth's magnetic field. Thus the effect of particle bombardment, if any, would be more pronounced in the higher latitude of Tromsö.

The results of the experiments showed – for the first time in the history of wireless-wave propagation via the ionosphere – that while solar radiation was the principle cause of upper atmosphere ionisation, particularly in lower latitudes, the effect on ionisation by particle bombardment became more noticeable at higher latitudes. While the ionisation due to solar radiation (at lower latitudes) showed a pronounced diurnal variation, the ionisation due to particle bombardment showed no such effect.

In brief, the experiments confirmed the expected difference between the two causes of ionisation.

3. It was found on occasions, during a severe magnetic storm, that *no* returns (echoes) from the upper atmosphere were observed. It was concluded therefore that intense particle bombardment had penetrated into the lower regions of the atmosphere, i.e., regions of higher gas density, such that any radiation (wireless signals) passing through the region was severely attenuated by the loss of energy due to the collision of free electrons with gas molecules. It should be noted, however, that this is not the same as loss of HF propagation due to what is sometimes called the 'Dellinger Effect'.

Acknowledgements

My grateful thanks go to the Rutherford Appleton Laboratory (World Data Centre), Oxfordshire, for information and photographs concerned with the International Polar Year 1932/33 (Radio Observations).

Also to L. W. Brown PhD (G0FFD) (formerly assistant to Professor Appleton at King's College, London), for his valuable contributions to the Summary above, which highlights the importance of Professor Appleton's work at Tromsö during the 1932 Polar Year.

References

[1] Professor E. V. Appleton, *Wireless World*, January 1931, 'The Timing of Wireless Echoes'.
[2] R. Naismith and W. C. Brown, *World Radio*, 22 December 1933, 'Winter in the Arctic' (account of the British Radio Expedition to Tromsö).
[3] F. C. Judd G2BCX, *Radio Wave Propagation (HF Bands)*, Heinemann Newnes, 1987.

RB

In the next RADIO BYGONES

Due out October 23

Magnetic Wire Recording Machines

Saved by Radio – Evolution of Air-Sea Rescue Transmitters

A Radio Bygones Collection in North Yorkshire

The Coming of the Superhet

Contents subject to last-minute revision

News & Events Extra

What Is It?

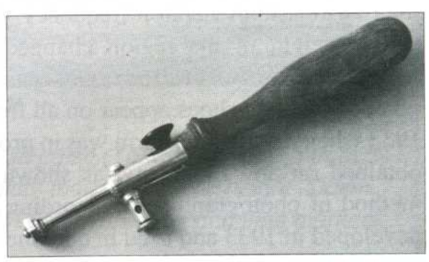
The object in the photograph, (right) presumed to be some sort of Morse key, was picked up by a friend of *Radio Bygones* reader Stan Meadows at a local bric-à-brac sale.

It is about 7¼ inches long, and differs from a conventional key in that the points are in contact until the button is depressed – thus opening the points – which would suggest an interrupted constant carrier.

Does anyone know anything of the age, make or purpose of the object? Your suggestions or answers, please, to the editorial offices.

Equipment Wanted

Continuing with his quest to put together a ship's radio office display of the late valve era, G4YXX is now seeking a Marconi 'Autokey' – the main station type first fitted about 1954. Contact him on 0963 32389.



FREE READERS' ADVERTISEMENTS

You can advertise your goods for sale or wanted, using up to a maximum of 30 words including whatever details of your name, address, telephone number, etc., that you wish to be published in the advert.

Please ensure that you write your advertisement clearly, preferably in block letters or typewritten, and include the corner flash cut from the current issue of *Radio Bygones*, (see below).

Every advertisement sent in **must** have your full name and address attached, even if you do not want those details published in full.

This service is for the use of *Radio Bygones* readers for their private sales and wants only. Any advertisements from traders, or apparent traders, will be rejected.

SEND YOUR ADVERTISEMENT TO:
Radio Bygones, 8A Corfe View Road, Corfe Mullen, Wimborne, Dorset BH21 3LZ, marking the envelope 'Readers' Advert'.

The closing date for adverts to appear in our next issue, due out on 23 October 1990, is October 4.

WANTED

Disc cutter, wire recorder, cylinder Dictaphone (phonograph in metal case with voice pipe), anything pre-Ferrograph, Kalee sound rack. J. Gomer, 55 Hythe Hill, Colchester CO1 2NH or phone 0206 574656.

Codar AT5 transmitters with AC PU. Please send price required and condition details to Marris, 35 Kingswood House, Farnham Road, Slough, Berks SL2 1DA.

Wireless Set No. 19 equipment and information such as manuals, anecdotes, etc. Especially looking for power amplifier and operator's pocket-watch. Thank you. Chris Bisaillion VE3CBK, c/o Whiskeytown Wireless Collection, 1324 Old Carp Road, RR#1 Kanata, Ontario, Canada K2K 1X7.

Early Pye sets: Unit set, 222, 275AC, 555. Cabinet for Pye 548 as illustrated on cover of *Story of Pye Wireless*. Athol porcelain coil holders. Mike Kemp, Cambridge (0223) 353551.

Genuine crystal sets; a working horn loudspeaker; a working 1920s two-valve set; WWI military wireless components and valves. Ron Irving, Fir Glen, Beesby Road, Maltby-le-Marsh, Alford, Lincs LN13 0JJ.

High impedance headphones. Eric Page GU3HKV, Seacroft, Clos du Murier, St Sampson, Guernsey, CI.

Any information, circuit on McMichael DC mains radio Type 'D', Serial 57239. J. Bettsworth, 34 St Johns Cresc., Broadbridge Heath, Horsham, Sussex RH12 3NE.

Handbook (pref.) or circuit for KW2000A required. Condition immaterial if complete and legible. Photocopy quite acceptable. All costs paid. John Burgess, 3 Duke's Way, Axminster, Devon EX13 5QP or phone 0297 34104.

Power supply and interconnecting leads for C13 army set, plus any information on it. Will photocopy and return any data, and pay all expenses. Mike Stott, Wellview, 12 Castle View, Ovingham-on-Tyne, Northumberland NE42 6AT.

Owner of DL2BO cards dated February 1964 to collect. Please contact Paul Brinklow on Camberley (0276) 25472.

Grundig reel to reel recorders particularly models TK9 and TK12. Horn loudspeaker radios, any condition. Telephone Mike G8CTJ on Hinckley (0455) 250570 anytime.

Circuit & info for WS A41. Also a full-size photo-copy of the chart on front of T1154. Will pay costs. Phone Ben on Kidderminster (0562) 743253.

FOR SALE

Wireless Sets: HMV1381, GEC 5243, Murphy A168, Philco 547B, Philips B2G04U, Marconi T37DA. Also BTH Horn speaker base, Pioneer Amplifier SA500A. C.R.H. Broadhurst, 65 Church Walk, Atherstone, Warks CV9 1PS.

A number of No. 38 Sets MkII with phones, mic, haversack, webbing, etc. Complete station, no aerial. New condition, some parts boxed. Offers with SAE to P. Brown, 82E Galgate, Barnard Castle, Co. Durham DL12 8BJ.

Bomber Command R1155 receiver. Good condition all front panel controls. Only mods DF valves removed, built-in output stage. Offers with SAE to P. Brown, 82E Galgate, Barnard Castle, Co. Durham DL12 8BJ.

Collins TCS12 TX and RX. RX working, TX 90% original. Suit restore. £30. Phone Ben on Kidderminster (0562) 743253.

Marconi TF144G RF signal generator, bench type, used RAF one time. 8 ranges 95kc/s – 25Mc/s, ext mod. Handbook. Reasonable offer accepted, buyer collects. P. Bradbury, 2A Coleswood Road, Harpenden, Herts AL5 1EL or phone 0582 763942.

New crystal wireless sets, £30. For details send 50p, not stamps, please. Eric Page GU3HKV, Seacroft, Clos du Murier, St Sampson, Guernsey, CI.

14 inch loudspeaker cabinet, mahogany, with fret as shown in sketch (right). No holes, knobs or names. Best offer to Romsey (0794) 516884.

EXCHANGE

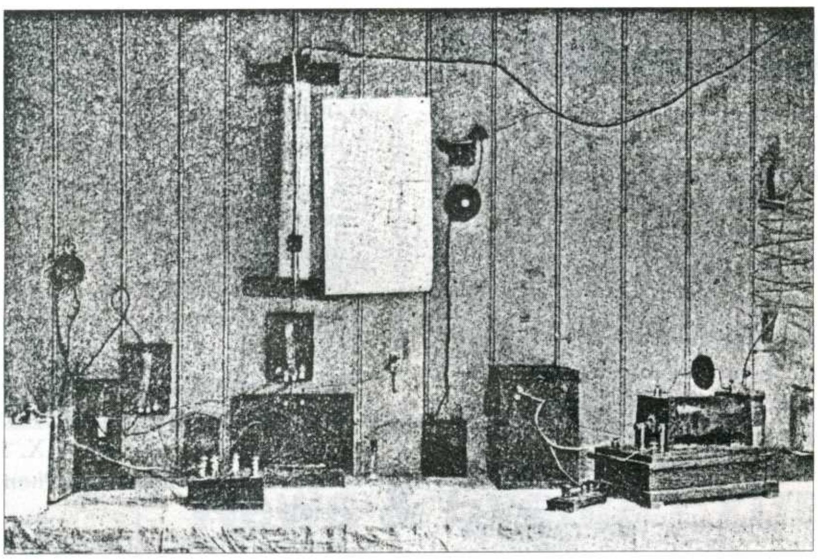
No. 38 Set MkII for No. 38 Set MkIII. P. Brown, 82E Galgate, Barnard Castle, Co. Durham DL12 8BJ.

RB No. 7 READERS ADVERT

The Vintage Years of Amateur Wireless
Part 6
by Stan Crabtree

Proof that Britain's youth were also to be found amongst the amateur wireless fraternity came to light in an article in the *Model Engineer* of 11 March 1909. Two Kent Grammar School boys, G. K. and N. K. Johnson described their station in detail and explained some of the innovations they had devised. A feed-through insulator was made up of an old motor spark plug fitted into one end of a piece of glass tube. The aerial was soldered to the wire end of the plug and the tube filled with paraffin wax. The assembly was then fixed through a hole in the wall.

The article aroused much interest amongst their elders who queried certain points in later editions of the journal. The duo appeared quite confident in their equipment and were able to give sensible answers to all the questions raised. The final paragraph in the article was composed in a style that might well have been lifted from a typical school-boy adventure book of the period.



The station of two Kent schoolboys which caused much interest in the spring of 1909

'The station we communicate with is the school we attend. We have not received any messages from New York yet, and, what is more, we have been told that we are "jolly lucky" to be able to communicate just across Canterbury!'

A competition to assess the effectiveness of 'pairs of stations' was briefly referred to in the *Model Engineer* editorial of 29April 1909. Captain H. P. Lefroy RE suggested the factor of efficiency could be determined by the expression:

$$\frac{\text{(Range in miles)}}{\text{(Sum of height of sending and receiving masts in feet)}}$$

He stated that 0.5 would thus represent a high efficiency station. Stations would be classed by their mast height, limited say to 30ft.

The editor suggested those interested in this project should let him know. He commented: 'In America, we believe, wireless telegraphy clubs have been formed – the members each having an installation and communicating by its means with their fellow members'. He doubted, however, whether such organisations would find any support in this country!

Also appearing during April were comments from 'HPTL' extolling the galena-graphite detector as being very sensitive, cheap, simple, reliable and small. This was formed by resting a small piece of 4H pencil, well sharpened, on a 'flat' (not granular) crystal of galena, the pencil being mounted on a spring so that the pressure of its point on the galena could be adjusted. No battery was required; the assembly was simply connected to the aerial and earth with a pair of phones across it.

Wireless Signposts

'HPTL' then went on to give some very useful information on 'wave measurers' – or how to know where you were tuned. For experimenters in the southeast, he suggested North Foreland MNF (later GNF) was to be found on 300 metres and the Goodwin Lightship on 100 and 200 metres. At the opposite end of the range he suggested Scheveningen SCH (later PCH) and Norddeich KND (later KAV and now DAN) could be searched for at 0930 and 2130 hrs.

He advised that an elaborate aerial installation was not essential. A 30ft flagstaff in the garden from the top of which six wires about 40ft long hanging like spokes on an umbrella were all that were required! The spokes of course must be supported by insulators of wood which had been soaked in wax.

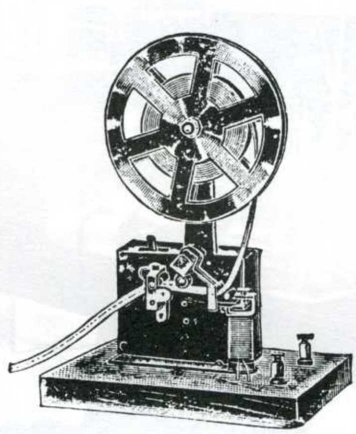
The fact that there was actually something to hear on the air had produced an increase in devotee listeners; amateurs who were not interested in contacting other enthusiasts but content to merely monitor transmissions. In this respect there was now plenty of activity. Clifden MFT now ran a close second to Poldhu MPD as the most heard station in the UK. The station was at Connemara on the west coast of Ireland and in regular night-time communication on 4300m (70kHz) with Glace Bay, Nova Scotia. For Continental DX there was Nauen POZ near Berlin which had been operational since 1906. Broadcasting on 2000m (150kHz) and running 250kW with the Telefunken system it was reputed to be the most powerful station in the world at this time.

Radiating from the Eiffel Tower in Paris, FL was not to start its famous time signals until the following year but irregular W/T operation had been taking place since 1908 using spark transmissions on a variety of wavelengths around 2000m (150kHz). It was already a well recognised signal in the UK more especially because of a characteristic note which was likened to the crumpling of tissue paper.

Wake Up, England!

In the following month of May, a letter to the editor from a correspondent signing himself 'Wireless' complimented 'HPTL' on his earlier letter and said he felt sure a great many readers would be indebted to him and commented it was 'time some of your readers came out of their shells and gave a little information now and again'. He went on to say if more prominence were given to the subject of wireless telegraphy, a large number of readers would soon have a station fitted up when they knew how simple it was. 'Wireless' said he sent to America for his information and stated 'right gladly did they give it'. American catalogues, he pointed out, had over 200 pages of wireless telegraphy apparatus with details of the connections. As an example he said he ordered some items from America and England at the same time and to his utter surprise the goods from America arrived two days before he received the items from the English firm. He ended with the stirring phrase: 'Wake up England!'

Readers may remember the scenario I painted in the last issue of *Radio Bygones* of the favoured Edwardian boy allowed to enter the sacred workshop to watch his father's wireless experiments. This may well have been the situation in the Bottone family of Wallington, Surrey. The acknowledged expert of the columns of the English Mechanic and World of Science Electrical Engineer, Mr S. R. Bottone had now apparently retired from the scene but his place had been ably taken by his son Arthur E. R. Bottone who appeared to have knowledge at least comparable with his father. A letter addressed to him from H. W. Willis gave a rather pitiful account of his varied attempts to construct a coherer – all unsuccessfully. Arthur was keen to be of service and asked for more details.



A Morse writing machine in the catalogue of Ward & Goldstone, Springfield Lane, Salford, Manchester, who offered many wireless items by mail order in 1909

Another reply to H. W. Willis came from a new correspondent who appeared on the scene in the form of W. J. Shaw (Twickenham) who was later to be issued with the callsign TWX and be elected to the committee of the Wireless Society of London in the Autumn of 1913. Joining the discussion, Mr Shaw suggested H. W. Willis drop the coherer construction and make an electrolytic detector. He pointed out they were simple, had no troublesome relay and were much more sensitive. As if to prove the point he ended: 'with an 80' aerial I can get Hamburg!' Mr Shaw was truly an electrolytic detector devotee. Responding to a query in the *Model Engineer* around the same time Mr Shaw answered a cry for help in the construction details of a magnetic detector with: 'Why bother with a "maggie" which requires a clockwork mechanism when you can use an electrolytic detector – I prefer this to any other.'

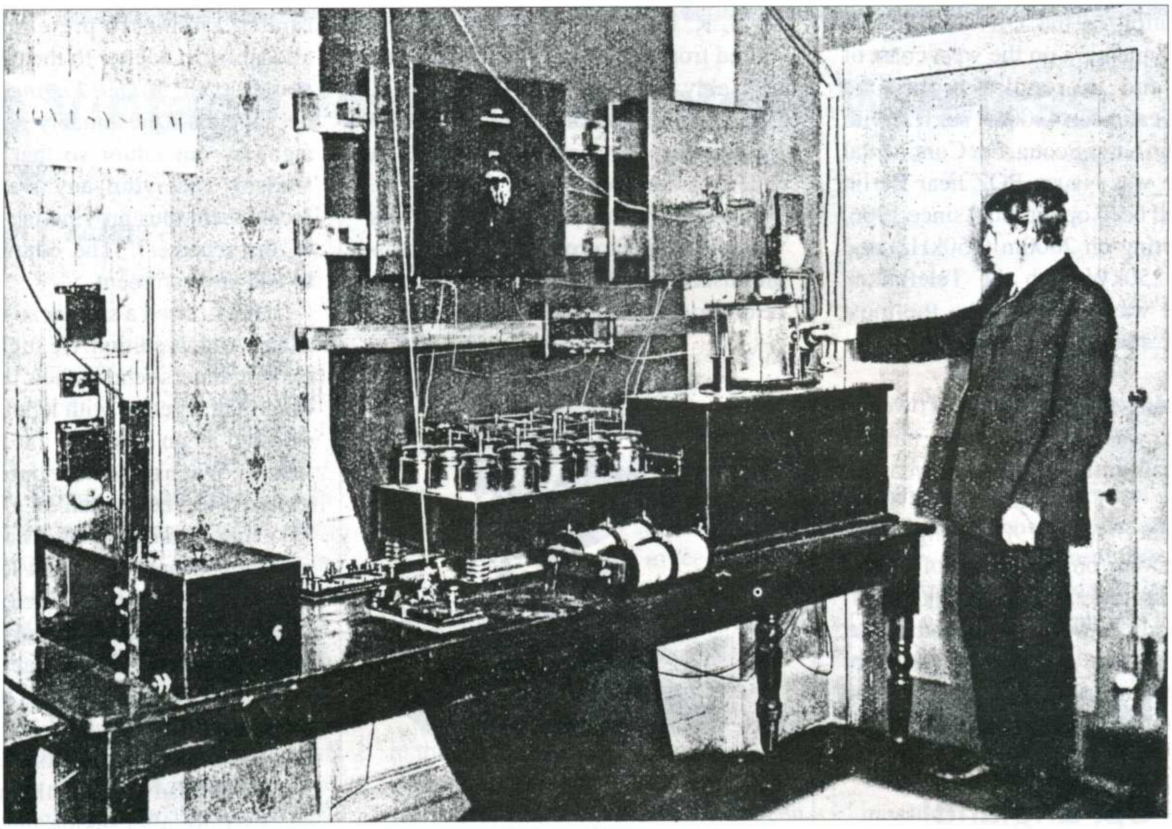
Labels

Call letters were not issued by the Post Office to amateur experimenters until the following year but 'Freeman Lee', writing in a June 1909 issue of the *Model Engineer*, pre-empted their allocation in a letter to the editor. Why couldn't all *Model Engineer* readers be 'labelled' (presumably given a callsign) by our editor so that any other student 'receiving any waves could locate them thus proving the efficiency of the receiver?' The editor declined to add any comment.

'HPTL' tried a similar suggestion in a later August edition. He suggested that experimenters send in their latitude and longitude together with letters they had selected as an identifier (at least three letters). When these were published 'the letters could be written on a flag, ½" x ¾" using an ordinary pin as a flag staff, and pinned onto the exact location on a map'. The editor remained silent.

Mr H. W. Willis who had previously experienced problems in getting a coherer to work, also wrote in the August columns of the *Model Engineer* praising the virtues of the electrolytic detector which he had apparently assembled successfully after taking the advice of W. J. Shaw. However, there was a limitation which he pointed out. Using this method of detection it was unfortunately not now possible to set up a station to work unattended at a prearranged time as there were no means of using a Morse inker. (It could almost be said he was obliged to work in 'real time'). He also endorsed the idea of 'HPTL' in organising a list of experimenters but suggested the editor allocate code letters as otherwise there could be duplication where two subscribers quoted the same letters. He suggested a wireless club be formed and felt a lot would join. Still silence from the editorial chair.

On 15 October 1909 a very successful Model Engineer Exhibition was opened in the Horticultural Hall, London, sponsored by the magazine of the same name. At the opening ceremony Sir Hiram Maxim, the principal guest, was introduced by the editor and publisher Mr Percival Marshall and 'heralded onto the platform by a stirring bugle call from the orchestra'. Sir Hiram was in fact the inventor of the Maxim Gun and the father of Hiram Percy Maxim, who was to become one of the founders of the ARRL in Hartford, Connecticut a few years later. Sir Hiram later toured the exhibition hall spending time at many stands. At one he accepted a tin of 'Fluxite' which he is reported as 'recognising as an old and trusted friend!'



The British School of Telegraphy's stand at the Model Engineer Exhibition held in October 1909. Contact was made with a passenger liner in the English Channel

A principal feature of the exhibition was a wireless telegraphy demonstration mounted by the British School of Telegraphy. The *Model Engineer* reported that 'instructors and students were on hand to answer the incessant flow of questions and requests for information as to "how it is done"'. The equipment had been lent by Marconi's Wireless Telegraph Company Ltd and was operated by students of the school. An aerial fixed on the roof of the hall provided regular communication with the school's headquarters at 179 Clapham Road, London SW. So effective was the installation, states a report, that on the opening day, one of the principals, Mr A. W. Ward, operating from the wireless stand, was able to hold a conversation with an old student of the school who was at the key on an ocean liner steaming down the English Channel. The legality of this communication does not appear to have been questioned.

Over-sensitive

In a December issue of the *English Mechanic and World of Science*, Mr W. J. Shaw of Twickenham continued to praise the electrolytic detector which he felt was better than the 'maggie', galena, carborundum, tellurium or indeed any other type. To drive the point home he wrote: 'When I was playing with coherers ten years ago my coherer used to "go off" every time the door bell was rung – and the bell was on another floor in the flat above. Don't waste time on them (coherers) when such splendid detectors of all types are obtainable. People don't use oil lamps when they can get electric light!'

A reader 'WN' in the *English Mechanic* wanted to know if Mr Shaw could tune out the French station (presumably 'FL') while the German was on. He thought it was on the same wavelength and much louder – or was it less sharply tuned? In any case it was difficult to get rid of. Mr Shaw confirmed that the wavelength of the two stations was almost identical and he thought 'FL' was badly tuned. His suggestion was to use loose coupling and try to distinguish the characteristic of the note.

'Nemo', writing in January 1910, announced he was expecting to fit up a 4-wire aerial between two towers on a building in the City of London, each 80ft high and 100ft apart. Would this suffice to copy signals from France and Germany? He also wanted to know if he could work a 4-inch coil from 220 volt mains using an iron wire resistor in series. He needed 12 volts for the coil. He ended with the question: 'What is the HP of a transmitter station?'.

W. J. Shaw provided the answers. He thought the aerial arrangement specified would serve adequately for receiving stations from the Continent. On the use of the mains as a power source he was quite rightly a little sceptical. He felt it would be very risky indeed apart from being an enormous waste of current. Down to earth as always he questioned: 'Why can't you use 3 4-volt accumulators?'

Shaw advised that the horsepower of a transmitter site varied from station to station. He stated: 'The "FL" station in Paris is 100HP. The Admiralty in Whitehall has, I believe, 12kW or 16HP. At my station I have only .25kW.' There must have been something in the questioner's letter that made Shaw feel he was dealing with a newcomer to the game as he ended: 'Of course, you understand that HP only affects the transmitter – not the receiving apparatus'. **RB**

Feedback...

The page where you can air your views

Letters should be original and not copied to or from other magazines

Baghdad Morse – the Sequel

I am afraid I cannot grasp the concept of Baghdad Morse. During the time I spent in Group HQ Signals in S. India from its inception to mid-1943, when I moved on, I had never heard of it. Perhaps it was peculiar to Habbaniya.

TJ of Bamber has described a situation which also pertained to Bangalore, and, most probably, to other RAF Signals HQs.

In Bangalore, signals traffic increased in volume by the minute, and operators RAF and IAF (great operators) were in short supply. Fancy operating practices were frowned upon. New ops were always put on less busy channels to gain experience. In these circumstances, what was the point of increasing sending speed if the receiving op was put under such pressure that, in quick time, Cypher section initiated a request for a full message repeat.

The constant heavy traffic was cleared by working duplex as often as possible, i.e., control would order a detuning of one transmitter by 10kc/s, so that messages could pass both ways simultaneously with the help of two ops at each end. There was no room for histrionics in this system.

The only time I can recall using a 'fast' form of Morse was in the sending of long Met weather synopses composed of five-figure groups (very rarely coded into Type-x), i.e., a dash for a '0'; a dit for a '5'; di-dah for a '1'; dah-dit for a '9', and so on. Being all figures, there was no ambiguity. That was all right provided the receiving op agreed to its use.

All the PO telegraphists I worked with before WWII never developed such odd techniques like BM (Mad Key disease?), and they were all highly skilled. It is a romantic idea, but not at all practical. It seems to be all part of the nostalgia connected with CW operating. This romanticism may have something to do with the present controversy over the retention of the Morse Code in the Radio Amateurs' Licence A. A lot of the post-war 'hams' had become experienced 'hands-on' operators in one or other branch of the Forces, and there is no way present-day hopefuls can indulge in that experience.

Ah well, I've enjoyed this dip into the nostalgic past. I shall now re-read my *Tales from the Arabian (K)nights* with greater appreciation.

Warren James G3SKK
Beccles, Suffolk

I was interested to read the letter from Ted Jones in RB No. 6 regarding Baghdad Morse, and his time at Habbaniya in 1942/43. His comments seem to form a sequel to what I had heard a couple of years earlier.

The last mention I heard of Baghdad Morse was in late 1940 or early 1941, from an NCO who had been at Habbaniya in the 1930s. By 1940/41, of course, the wartime input of operators already seemed to exceed the peacetime regulars. This intake, it must not be forgotten, included many licensed amateurs who had been in the pre-war RAFVR, which had also incorporated many amateurs from the pre-war CWR, which was 100 per cent amateur!

Baghdad Morse, I was informed by this NCO, was used by only a small percentage of the pre-war 1930s operators. He himself was a proficient 35wpm man, but was also quite a wizard with Baghdad, which sounded like a foreign language to me. He told me that the so-called Inter-Command Network had incorporated Habbaniya which was, he said, HQ Middle East Command in the 1930s.

Of course by WWII there had been many changes in Command structures in the RAF – we had lost Singapore, Burma, Hong Kong, etc., and the war was raging in Europe, North Africa, the Med, Near East and Far East. In the Far East many operators had probably become POWs or been killed by the Japanese.

One thing comes out of all this, which is that Baghdad Morse did exist in the 1930s and, therefore, is an interesting part of wireless telegraphy. Whether it was good, bad or indifferent is another matter, and open to question, which could probably be best answered by any readers who actually used it in the 1930s.

Richard Q. Marris
Slough

National Revisited?

The National HFS receiver ('Feedback', *RB* Issue No. 5) is to say the least an unusual receiver, being a super-regenerative superheterodyne, and is possibly based on a like receiver described in the *ARRL Handbook* of 1945 – the handbook version used Loctal valves.

Like the author of the letter, I have never seen an HFS but the National Company had on the market at the time of the 1-10 a receiver designated the NC510, of which I recall an example in Webb's Radio in London, a month or two before the outbreak of WWII.

It would appear to have been the National Co's answer to the Hallicrafters 5-10 since it covered the range 28 to 64Mc/s, roughly the same as the Hallicrafters. It used acorns in the front end and had an RF stage. Band change was by turret which, according to the blurb, was located below the tuning gang. It was a normal superheterodyne with an IF more suited to the frequency range.

I see examples now and then of the 1-10 offered for sale in magazines, and don't doubt they are snapped up quickly by collectors. I don't have one but I do have a 'genuine imitation "Chinese copy"', built by myself from photos of the 1-10 and the circuit diagram. The dial and gearbox, though similar in appearance, are actually Australian-made, being from one of the 'Kingsley AR7' receivers made for the military during WWII. The AR7 was similar in appearance to an HRO but with circuit differences and the coil ranges were also different.

Norman Burton
Revesby, NSW, Australia

More on the R-390A

Regarding the letters which appeared in *RB* No. 6, I should like to add the following comments.

1. All the slug cores are at zero potential. In particular those on the RF chassis are screwed into slug racks, which slide on sliders, which in turn are screwed directly to the chassis. None, therefore, should be at B+.

2. The VFO is as linear as can be made. The core slides in and out of the coil on a contoured slider made up of 50 clamped plates which can be adjusted to speed or slow the advance of the core into the coil. This coil slider stack is adjusted at the factory, and after setting the VFO at 000 and 1000, the plates then balance out any slight inaccuracies. Each plate will cover about a 25kHz segment, giving an adjustment range of about 2 to 3kHz. It is not easy to adjust a VFO at home but it can be done. Adjustment of the stack is only necessary if some major VFO part, such as the core or coil, is replaced.

The later replacement Cosmos VFOs used a slightly different arrangement, with a small capacitor appearing in a window every 25kHz.

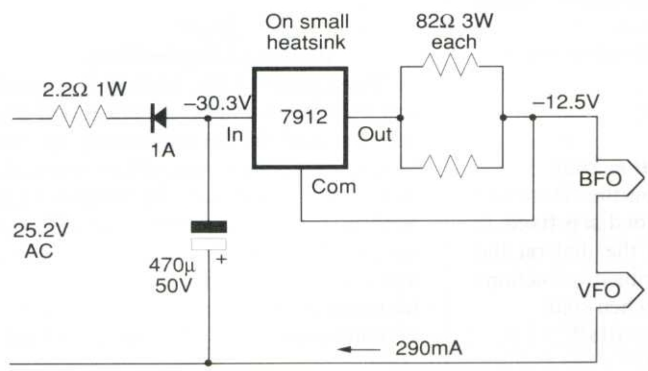
3. Most sets released in the UK in recent years used a plug-in replacement rectifier. The US Navy noticed that the life of the 6AK6 audio amplifiers was low on several of their sets and correctly diagnosed that the increased B+ produced by the solid-state rectifier was the reason. The solution was a dropper in the AF B+ line. I prefer a dropper in the PSU B+ line, to protect all stages.

4. It is true the sets are designed to run from 220 – 240V, but my experience is that running close to the maximum will greatly increase the chance of ultimate failure. National sets were particularly prone to this. All components in the set will benefit from running at 230V or less.

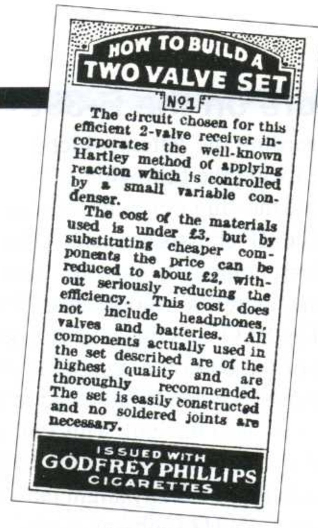
Finally, I enclose a letter *(see below)* I received from W3YBF which may be of interest to readers of *RB*:

'When faced with the need of a replacement for the RTS-10 current regulator, I must admit the simple idea of a 12BY7A as a "dropping resistor" did not occur to me, although I used a high wattage resistor for a time.

The solution ultimately tried was to use a 3-terminal regulator IC (type 7912) in the standard current regulator hookup. The parts were assembled on a small piece of perfboard and mounted adjacent to the RTS-10 socket. It has performed flawlessly for ten years or more and does indeed limit the current through the VFO and BFO valves as they heat. The schematic shows the arrangement, which may be of some interest to you or others. – 73 de Ray W3YBF.'



Peter A. Hopwood
Newcastle on Tyne



How to Build a Two Valve Set

Collecting cigarette cards was at one time a favourite pastime of many a girl and boy. Father (or occasionally mother) would carefully open each new packet of cigarettes to see which of the current series of cards might be inside, whilst the youngsters crowded round.

If the card turned out to be one that was wanted towards a set, there was great joy, or perhaps a squabble over whose turn it was to receive the prized item! If not, well, no matter, the duplicate card was useful currency to swap with friends. With luck, you could be sure of finding someone with a 'swap' that you wanted.

Most cigarette manufacturers included cards in their products – almost certainly one of the earliest examples of the promotional 'gimmick'. The urge to collect a complete set of perhaps 25 cards was obviously a great inducement towards maintaining 'brand loyalty' at the tobacconists.

The range of subject-matter appearing on the cards over the years was varied indeed. They would naturally reflect the interests and events of the day; armaments and uniforms in time of war, sporting personalities in peace, to name but two.

The cards which we feature here were issued with Godfrey Phillips cigarettes, and give step by step instructions (reproduced here) on assembling a simple two-valve (detector and LF amplifier, or 0-V-1) broadcast receiver. Notice that no attempt was made to include a theoretical circuit diagram – the target audience would not understand such technicalities! The picture side of the cards are shown on the following two pages.

No. 1

The circuit chosen for this efficient 2-valve receiver incorporates the well-known Hartley method of applying reaction which is controlled by a small variable condenser.

The cost of the materials used is under £3, but by substituting cheaper components the price can be reduced to about £2, without seriously reducing the efficiency. This cost does not include headphones, valves and batteries. All components actually used in the set described are of the highest quality and are thoroughly recommended. The set is easily constructed and no soldered joints are necessary.

No. 2
The Panel.

The panel is of ebonite ¼in. thick and measures 14in. x 7in. It may be bought from any radio store and it would be advisable for those who do not possess suitable drills to have the 10 holes drilled at the shop when making the purchase. The positions of the holes will depend to a certain extent upon the components used. The sizes and positions indicated are suitable for the components recommended.

No.3
Screwing Panel to Baseboard.

The baseboard is of ½ inch soft wood and measures 14in. x 7½in. The panel is fixed to the baseboard with two 1in. No. 6 brass or iron countersunk screws, the necessary holes in the panel being countersunk with a rose drill. The screw holes are drilled with a 5/32in. drill ¼ of an inch from the bottom edge of the panel and 2½in. to 3in. from each end.

The panel is then secured as shewn; the operation will be greatly facilitated if the panel is supported on a pile of books or boxes whilst the screws are being inserted.

No. 4
Fixing the Tuning Condenser.

The variable condenser is an "Ormond" .0005 micro farad S.L.F. No. 3 and is fitted into the ⅜in. hole nearest the left of the panel when viewed from the front. The fixing is by the well-known "one hole" method, the instrument being held in place by a single nut, which is secured firmly by means of a suitable spanner. Care must be exercised when handling to avoid bending or damaging the thin vanes.

The slow motion dial is also shewn on the bench.

No. 5
Fixing Slow Motion Dial.

This picture shews how the "Ormond" slow motion dual indicator dial is fixed. A coin is used to tighten the dial on the condenser spindle. Full printed instructions are issued with the dial when sold.

No. 6
Panel with Condenser Fixed.

This is a view of the baseboard and back of panel with tuning condenser in position. The four terminals also have been fitted. These are standard 4 B.A. Brass W.O. pattern terminals, but may be obtained nickel plated if desired. The two nearest the condenser are (top) aerial and (bottom) earth connections. The remaining two are for headphones or loud speaker.

No. 7
Fixing Reaction Condenser.

This small variable condenser has a capacity of .0001 micro farad and is made by Messrs. Ormond Ltd. It is fixed in a similar manner to the tuning condenser. The control knob which has a pointer fixed to it is secured on the spindle by a grub screw, which is tightened up as shewn. The instrument has two sets of fixed vanes, these should be connected together with a length of tinned copper wire, as is used to wire up the other components, the two ends being secured under the nuts which hold on the end plate.

No. 8
Fixing Valve Holder.

The two valve holders are next fixed to the baseboard with ordinary screws – ¾in. No. 6 are suitable. "Lotus" valveholders were used. The one being screwed down in the picture should be fixed with its edge 1 inch from the back edge of the baseboard and ½ inch from the end. The other one 4 ½ inches towards the other end of the baseboard. The positions are more clearly indicated on card No. 11. Care must be taken to see that the filament terminals are in line and that the anode terminals are to the left when viewed from the back.

No. 9
Bending Loop in Wire.

Three yards of No. 16 S.W.G. tinned copper wire should be obtained, and the lengths required for connecting up the various components cut off as required. Any slight bends can be removed by slightly stretching the wire, one end being held in a vice and the other in the jaws of a pair of pliers. Loops to fix on the various terminals are easily bent as shewn. A pair of round nosed pliers only, being required.

No. 10
Inside of Cabinet.

The cabinet may be as simple or elaborate as taste and pocket decree. Oak or mahogany is suitable and the material should be ½ inch thick. A 5ft. length of 7½in. wood is sufficient to make a cabinet with plain butt joints fixed with 1 inch No. 6 screws. The illustration shews how the grid bias battery (9 volt) is secured to the back of the cabinet. Two large washers being used to enable the two 1¼in. No. 6 screws to hold the battery in position.

No. 11
Wiring the Filament Circuit.

A filament rheostat is fitted into the remaining hole in the panel. The instrument shewn is a "Microstat", but any make of panel mounting rheostat will do. The resistance will depend upon the valves used. Advice upon this point will be readily given at the place of purchase.

5 ohms is suitable for the valves recommended. The filament terminals of the valve holders are connected in parallel, and the side nearer the panel is wired to either one of the terminals on the rheostat.

No. 12
The Earth Terminal Connections.

A baseboard mounting coil holder is fitted two inches from the back edge and ½ inch from the end of the baseboard as shewn. The earth (bottom) terminal is then connected to the filament terminal (nearest the back edge of baseboard) on the first valve holder. A 6in. length of insulated flexible wire is also attached to the earth terminal, the other end of this flex is attached to the split connecting plug which is supplied with the centre tapped coil (see card 22).

No. 13
Tuning Coil Connections.

The grid condenser (Dubilier .0003 micro farad) is now screwed to the baseboard between the coil holder and first valve holder. One terminal is joined to the grid terminal of the valve holder, the other to the fixed plates of the tuning condenser, and also to one side of coil holder and to the aerial terminal.

The other terminal of coil holder is connected to the centre (moving vanes) of the tuning condenser.

No. 14
The Anode Connections.

Here is shewn the high frequency choke ("Igranic") which is fixed to the baseboard as near to the filament rheostat as possible (without touching). One terminal of the H.F. choke is joined to the anode (or plate) terminal of the first valve holder. The anode terminal of second valve holder may now be connected to the lower of the two phone terminals. All terminals should be screwed up tightly.

No. 15
Reaction Condenser Connections.

This picture indicates the connection from the moving (centre) vanes of the reaction condenser, being fixed to the moving vanes of the tuning condenser Care must be taken to see that this wire is bent to clear the moving vanes of the tuning condenser, as they are moved by rotating the knob on the front of the panel.

No. 16
Reaction Condenser Connections (Contd.).

The connection from the fixed vanes of the reaction condenser is made to the same terminal on the H.F. choke that is wired to the anode terminal of the first valve holder.

This connection is indicated by the finger which is shewn touching the wire.

The grid leak of 2 megohms (Dubilier) is also shewn in the clips provided on the grid condenser.

No. 17
The L.F. Transformer.

The L.F. (low frequency) transformer, a Ferranti A.F.3, has now been fixed between the two valve holders and clear of the filament wiring. The terminal marked "Plate" is wired to the free terminal of the H.F. choke. The terminal on the transformer which is marked "Grid" is connected to the grid terminal of the second valve holder.

This completes the wiring with the exception of the battery leads, which are of insulated flexible wire.

No. 18
Grid Bias Leads.

Two lengths of coloured insulated flexible wire, one 6in. long (black) and one 9in. (red) are fixed to black and red "wander" plugs (Lisenin Positive Grip). The other end of the black wire is joined to the terminal on the transformer which is marked "Grid Bias". The red wire is similarly screwed under the filament terminal of the first valve holder to which the earth terminal is connected.

No. 19
Battery Connections.

The set is now ready for the High Tension and Low Tension flexible leads to be fixed. A five-way cable may be purchased complete with plugs, but for economy one may be prepared. Obtain a 6ft. length of thick red and black twin flex, and three 3ft. lengths of single flex. These may be of smaller gauge and of different colours to avoid confusion. The colours used in the set described are gold, green and brown.

A hole large enough to take the bunch of five wires must be bored through the back of the cabinet as shewn on card No. 10.

No. 20
Battery Connections (Contd.).

The five wires are now twisted into a cable leaving 8-inch ends loose for connections to the terminals in the set. 4 inches may be cut off the black and brown wires, the bared ends of both these wires are clamped under the filament terminal of the second valve, as shewn in the picture. The three remaining ends are bared and are connected as follows: Red to the spare terminal on the filament rheostat, Green to the +H.T. terminal on the transformer, Gold to the top earphone terminal.

No. 21
Battery Connections (Contd.).

The five battery connections are now all fixed to their terminals inside the set. The other end of the 5-way cable is passed through the hole in back of cabinet.

The red and black wires should be terminated with spade terminals of the same colours, and the brown, green and gold leads should have wander plugs attached. Care should be taken to ensure that the ends of the wires make good contact with the plugs and spade terminals. Lisenin Positive Grip plugs and terminals are recommended.

No. 22
The Inductance Coil.

The inductance coil shewn is a No. 60 (Edison-Bell Radio) centre tapped. The plug on the short flexible lead from the earth terminal is plugged into the socket as shewn. With the average aerial the tuning range will include most of the broadcast wave band.

For 5XX and Radio Paris stations a coil No. 250 will be required. This also must be centre tapped.

No. 23
The Valves.

2-volt Mullard valves are recommended. The first (detector) is a P.M.1.H.F.valve. This is shewn in position. The valve being placed in its holder is the low frequency amplifier and is a P.M.2.

The set is now ready to be slipped into its cabinet and is ready to work when connected to aerial, earth, batteries and headphones.

No. 24
Connecting Up.

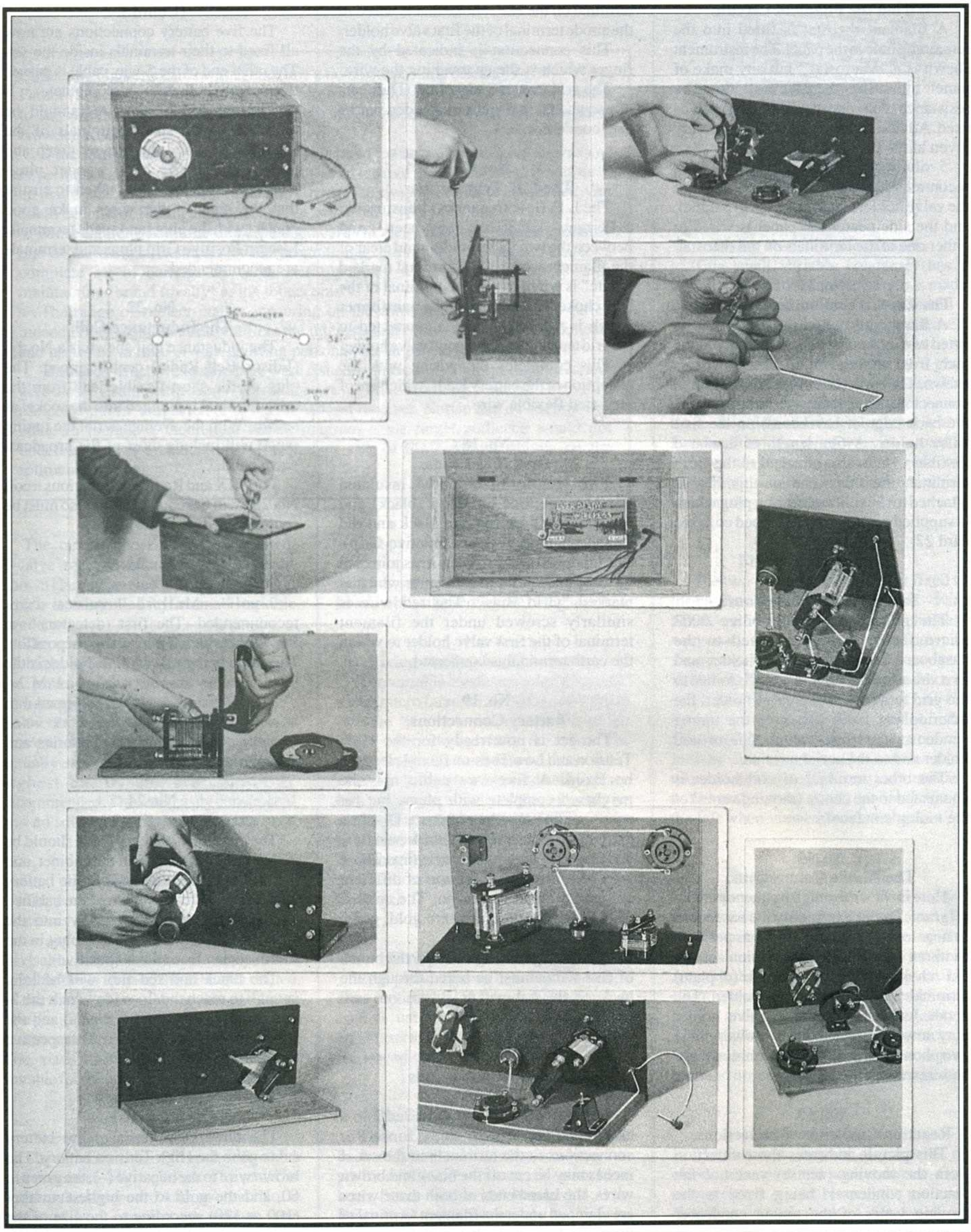
The slack in the battery cable should be pulled through the hole in the cabinet, and the grid bias plugs inserted in the battery which is fixed to the inside of the cabinet. The red plug is pushed firmly into the socket marked + and the black plug in the fourth socket from the + (positive).

The black and red flex will be long enough to reach the floor (on which the 2-volt accumulator usually stands) and the spade terminals are joined to the respective terminals of the accumulator.

No. 25
The Set Finished.

The three short leads of the battery cable go to the High Tension battery. The brown wire to the negative (–), the green to 60, and the gold to the highest number (100 or 120) according to the size of the battery in use. The local station and 5XX will "come in" at fair loud speaker strength, and over a dozen distant stations have been logged in as many minutes.

'How to Build a Two Valve Set'



Published bi-monthly by G C Arnold Partners, 8A Corfe View Road, Corfe Mullen, Wimborne, Dorset BH21 3LZ. Printed in England by The Friary Press Ltd, Dorchester, Dorset. Subscription £13.50 post-paid UK, £14.50 overseas inc Eire, for six issues. Overseas airmail rates on request. Payment welcome by Access/Eurocard/Mastercard or Visa. Overseas cheques or postal orders must be in Sterling. RADIO BYGONES is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first having been given, be lent, re-sold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, re-sold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

‘How to Build a Two Valve Set’

From the personal collection of Peter Cutler

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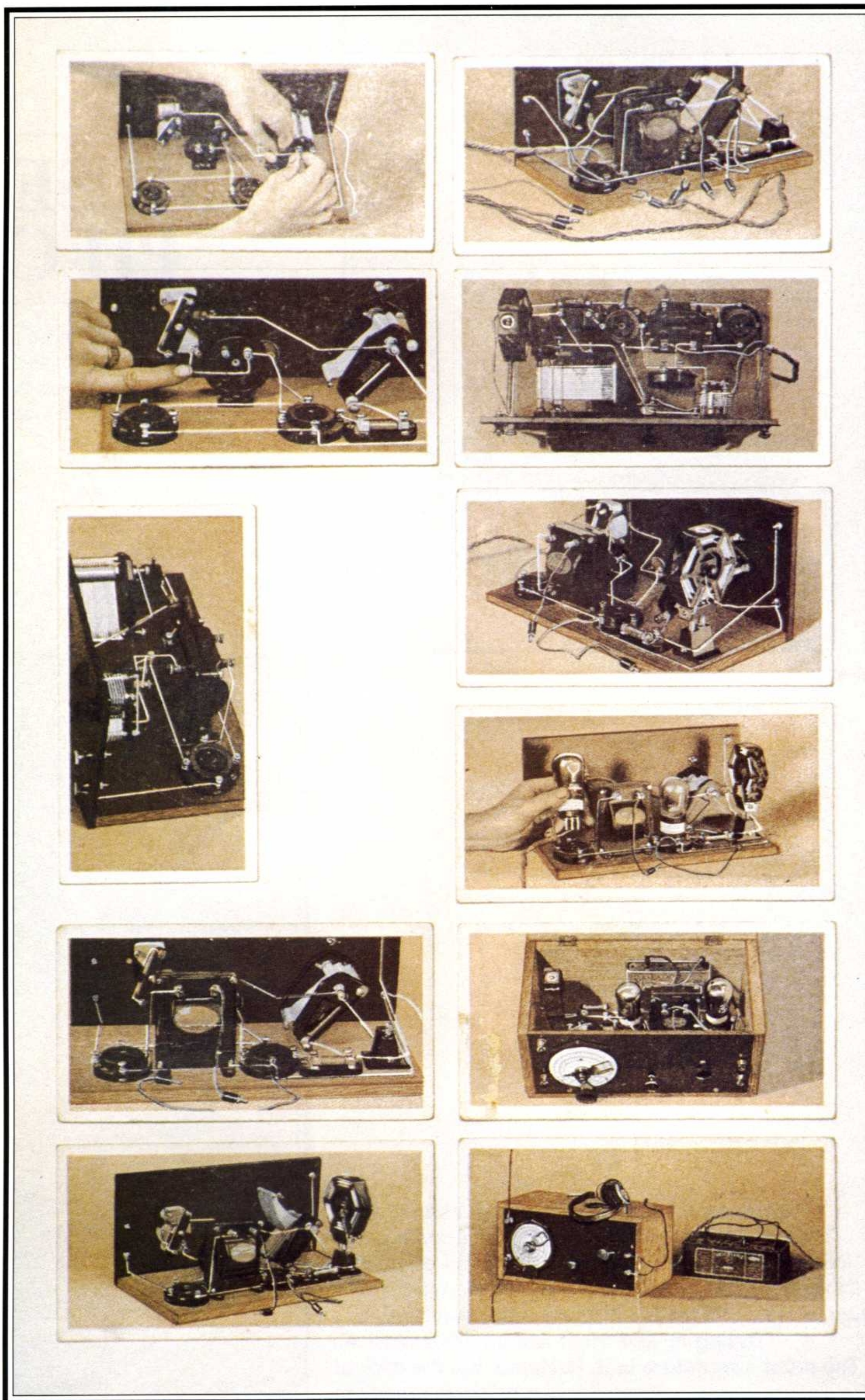

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MUSEUM PIECES

Our thanks to Bill Journeaux for his kind co-operation and assistance in photographing items from his Historic Wireless Collection for our covers this month

JHWC

The 'Grafton' crystal set, built into a china figure some 8½ inches tall. The top hat carries the coil, with a slider at the back for tuning. Headphone, aerial and earth terminals are in the base.
Made by A. B. Jones & Son Ltd at Longton, Staffs, in about 1922

JHWC

One of a set of six pictures in a series called 'Wireless Whispers', each giving an unusual interpretation of a wireless-related term or saying. Other titles are 'The Crystal Set', 'Broadcasting and Listening-in', 'Direction Finding with Loud Speaker', 'Tuning In' and 'High and Low Resistance'. The artist's signature is H. H. Harris, but the date of origin is unknown