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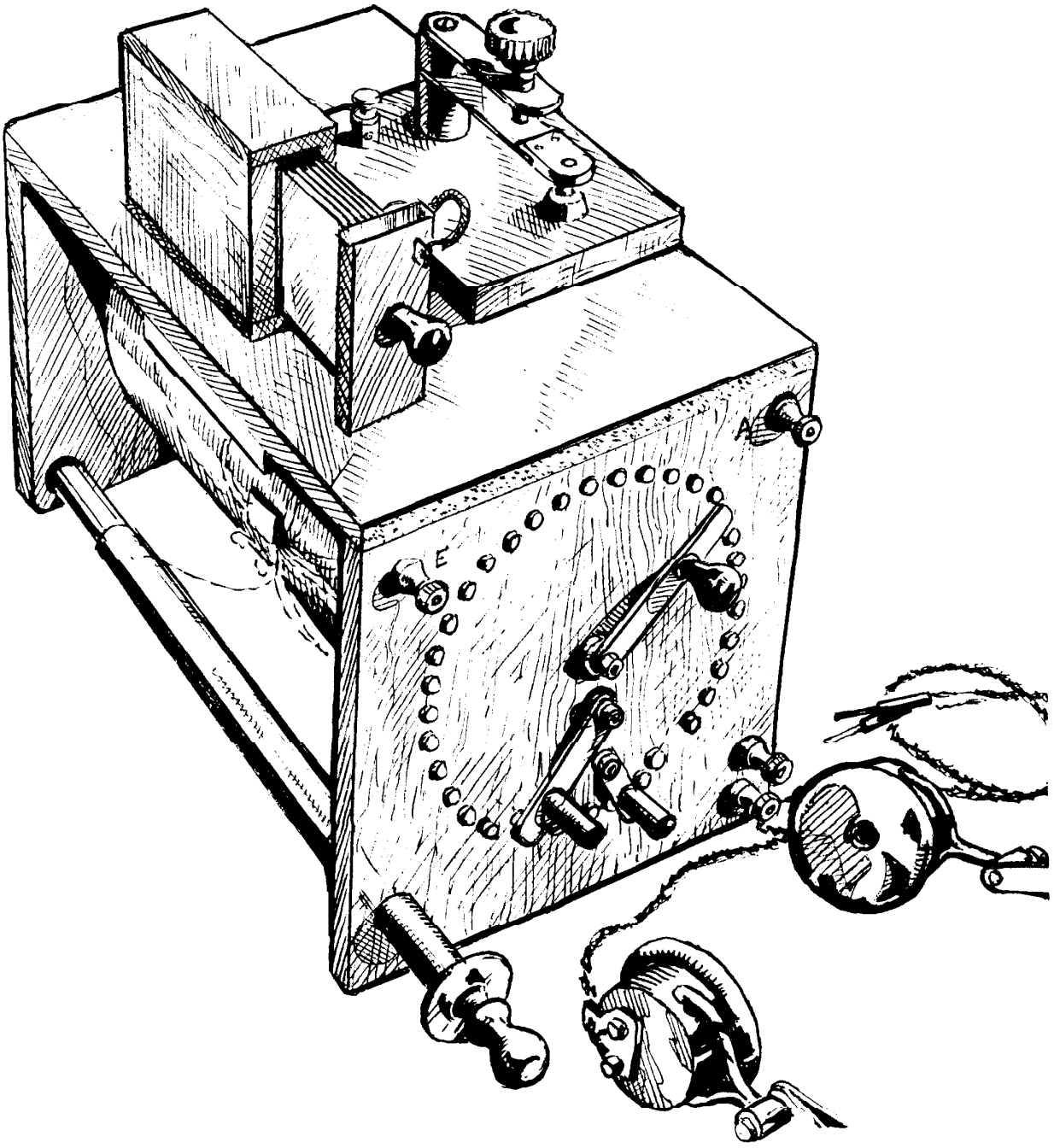
BULLETIN OF THE BRITISH

VINTAGE WIRELESS

SOCIETY



Norman Jackson's drawing here, shows an Edwardian crystal set, as constructed by Eric Westman from plans in 'The Amateur Mechanic' first published in about 1913. An article in this issue by Chas.E.Miller describes the set and tells about the sort of broadcasts the early 'Listener-in' could hope to hear.

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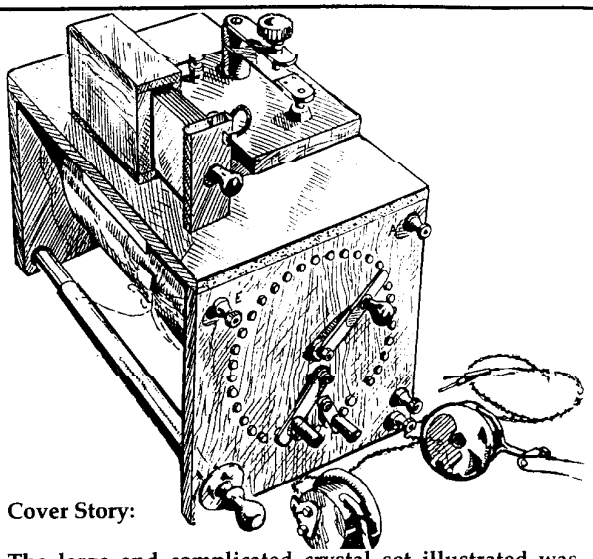
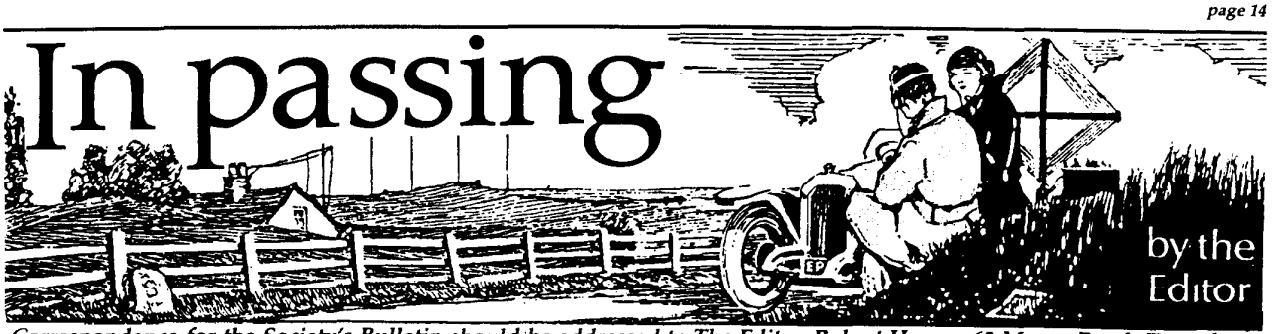


Cover Story:

The large and complicated crystal set illustrated was built about ten years ago by Eric Westman, exactly to instructions first published in 'The Amateur Mechanic' of 1918 (although the design is thought to have been first published in 1910). The construction is a considerable achievement. About a foot square, with a mahogany frame, it has huge co-axial coils of more than 1,000 turns, hand-made condensers and detector and tunes to over 7,000 metres. Chas. E. Miller writes about the set in this issue. What could the set builder of those days hope to be able to tune-in to? Well, with a very large aerial, ships at sea and perhaps the time-signals from Paris, but then on 6th November 1919 the first planned and advertised broadcasts of music and speech 'programmes' went on the air from Idzerda's station at the Hague, and at last there was something really worth while 'on the air'.



Correspondence for the Society's Bulletin should be addressed to The Editor, Robert Hawes, 63 Manor Road, Tottenham, London, N17 OJH. Telephone: (01) 808 2838.

The Bulletin

Members might like to know that the BVWS Bulletin has now been allocated an International Standard Serial Number (ISSN 0955-9345), which helps with cataloguing, location and communication in libraries and universities worldwide. The Bulletin now goes to the British Library, and the libraries of the universities of Oxford, Cambridge, the National Library of Scotland, the Library of Trinity College Dublin and the National Library of Wales. The contents are protected by copyright and at the same time, individual authors may themselves retain copyright on particular articles.

International meeting

As we go to press, our International meeting is imminent, which has drawn a record number of members to events ranging from visits to see a special display and lecture at the London Science Museum, another at Marconis at Chelmsford, to the garden party at Dulwich Museum and our gigantic meeting, display and 'fleamarket' at Harpenden which has attracted very nearly 400 people, equivalent to half our total membership at home and abroad.
Included among those attending the events were representatives from wireless history and preservation societies of America, Australia, Austria, Belgium, Canada, Eire, Italy, the Netherlands, Norway, Sweden and West Germany, as well as from all parts of the United Kingdom, making it the largest event of its kind ever held in Britain.

Diary dates

Members might like to have a note of the BVWS activities arranged for later in the year. They are: Harpenden 22nd October, Tunbridge Wells 12th November. It is hoped also to arrange another Seminar and details of this will be given later. Members might also like to know that Rudi Sillen, of the Belgian Society (and also the BVWS), whose address is: Limberg 31, B-3170 Herselt, Belgium, is arranging an International meeting in a riverside hotel in the Ardennes on September 9-10th. It includes a swapmeet, Nipkow disc demonstration, lectures, dancing to low-fi-music and an auction. Hotel bed-and-all-meals costs are £30 per person per day and trips can be arranged for wives and children.
Another European event which may be of interest to members is the International Vintage Radio and Technology swapmeet on August 5th at the Dutch Museum, NL-3861, Nijkerk, Marktplein 2a, arranged by the curator Marcel Ritmeester, who is also a member of the BVWS.

New Irish Society

An Irish Vintage Radio and Sound Society has been formed to promote interest in wireless equipment and gramophones and their preservation. For the time being the members of the society, which is non profit making, will be taking displays around Ireland but eventually they hope to set up a museum that will complement several private museums there. They also hope to set up a library of service data and to help members with spare parts and restoration work. The society is affiliated to the BVWS which offers it a warm welcome and all support. The subscription is £10E a year and prospective members do not, of course, have to be residents of Ireland. Details can be obtained from Vincent Farrell at 39a Lower Drumcondra Road, Dublin 9, Eire.

Contents: Bulletin of the British Vintage Wireless Society Volume 14 no. 2.

Scottish exhibition

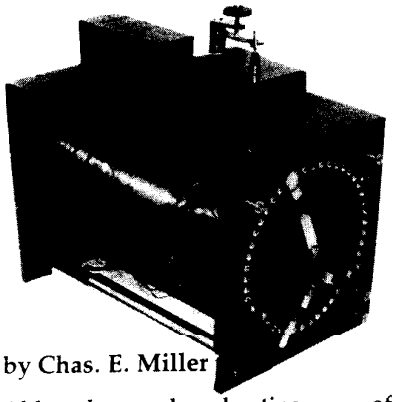
The Scottish Museum of Communication will be displaying some of the interesting items from the museum's collection in the Upper Library, Bo'ness on the weekend of the 16th to the 18th of September.
Amongst some of the things on show, will be examples of early spark transmission, telegraph and telephone mechanisms, a cylinder recorder and horn gramophone, crystal recievers, horn loudspeakers, early single and multi-valve receivers, a 1930's radio, radiograms, and motor tuned sets, services communication receivers and transmitters, clandestine radios, search and rescue apparatus, talking book machines and signalling lamps. These are just a few of the many items collected over many years by Curator of the collection, BVWS member Harry Matthews.
Bo'ness is the home of the Kinneil and Bo'ness Steam Railway. The steam trains will be operating on the 7 mile return journey to the Birkhill Clay Mine

Sussex exhibition

An exhibition of vintage wireless has been arranged at the Local History Museum, Park Lodge, High Street, Bognor Regis, Sussex, by BVWS member Ron Simpson, who invites any member who would like to visit the show outside normal opening hours, to contact him. His number is Bognor Regis 865278. The museum is open until September on Sundays, Wednesdays and Fridays from 1pm till 5pm.

History

An Edwardian Receiver.



by Chas. E. Miller

Although broadcasting of entertainment material began in Britain in only 1922, interest in radio had been aroused a very long time before that. Virtually from the turn of the century growing numbers of amateur enthusiasts were building receivers that would pick up the messages sent out in morse code from various commercial stations located in this country and the continent, and in this respect they were far better served than the listeners to 2MT and the like. Whereas the seekers of speech and music were limited to a miserly half an hour a week, their Edwardian predecessors with a knowledge of morse could have many hours of reception every day. Thus the time and money invested in the construction of a receiver were well rewarded in the potential amount of use to which it could be put.

Although radio was in itself "news" in those early days certain sensational events in which it played a part were certain to swell the ranks of amateur listeners. Of those happenings, until the loss of the "Titanic" in 1912, none captured the public's imagination more than the Crippen murder case in 1910. On the 13th July of that year human remains were discovered buried in the coal cellar of a house belonging to patent-medicine dealer Dr. Hawley Harvey Crippen. The body indentified as that of Dr. Crippen's wife and on the 16th July a warrant was issued for his arrest on a charge of murder. In the meantime, however, the doctor and his girl friend, Miss Ethel Le Neve, had fled the country on the SS Montrose, bound for Canada via Antwerp.

Descriptions of the fugitives were sent out by radio to shipping, and unluckily for them the Montrose possessed both a radio installation and a sharp-eyed Captain by the name of Kendal. The young lady had disguised herself as a boy, a ploy with a good chance of success in days when it was virtually unheard of for a woman to wear trousers in public, and Crippen and she were travelling as a Mr. Robinson and his son. Unwisely the couple allowed their feelings to show by fervent hand-holding, which aroused Captain Kendall's suspicions and he kept an eye on them. The suit hastily purchased by the doctor for his "son" was a poor fit and Miss Le Neve's trousers were hitched with safety pins that the Captain spotted. On the 22nd July he sent a radio message to Scotland Yard reporting his doubts as to the couple's bona fides. It was the first time radio had ever been used in a criminal case. The Yard reacted promptly and the next day officers left for Canada on a fast vessel that arrived before the Montrose and captured them. Confirmation was sent back to Scotland Yard, which had the appropriate telegraphic address of "Handcuffs".

We may be fairly sure that there were a number of private individuals eavesdropping on the messages that flew between the SS Montrose and Scotland Yard that July nearly 80 years ago. The affair caused a great upsurge of interest in radio and in the building of receivers. The subject began to be covered in such magazines as "The Amateur Mechanic", an article in which gives a fascinating glimpse of the state of the art for crystal set construction before World War One.

The "long-distance receiving apparatus" described was designed to cover wavelengths from about 7500m down to 300m. To achieve this, tuning coils having a large number of tappings selected by two rotary stud-type switches, were used, forming an RF transformer with tuned primary and secondary. A diagram shows how painstakingly both coils and switches had to be constructed, using a home-made coil-winding device. The coils were mounted co-axially and no fewer than 44 switch studs had to be fitted on one end of the coil holder: brass wood screws with washers beneath which the tappings from the coils could be clamped. Then the switch arms had to be made and fitted. These tasks alone were formidable and indicate the perseverance necessary to a successful constructor in those days.

Since manufactured components were not available the various condensers also had to be home-made. Tuning condensers were not rotary but had a push-pull action as favoured much later by Philips in some well-known push button receivers. The 1910 protoype for the primary tuning was simple: a brass tube sliding in another with an operating knob. The secondary tuning condenser was of the more familiar fixed-and-moving-vanes type but involved a great deal of work. The vanes had to be made up from sheet zinc and mounted in a teak box. Five of the nine vanes were fixed and the other four interleaved and movable. Accuracy of construction was not depended upon to maintain working clearances between fixed and moving vanes: they were provided with a solid dielectric consisting of old photograpic plates, cleaned off and cut to size. The fixed, or blocking condenser was made from zinc plates but with "Presspahn" (an early chip-board) as a dielectric.

The crystal detector eschewed the cat's whisker and was of the semi-permanent type employing bornite and zincite in steady contact. The stopper from a contemporary beer bottle provided an excellent knob.

The total cost of materials to make up the set was estimated as approximately 12/2d. It is pointless to convert this directly into present day terms (i.e. 61p) without considering the different values of money between 1910 and now. One guide is to estimate the number of letters that might be posted for the two sums; in 1910 one could post 292 seaside post-cards for 12/2d, whilst today one could send only 3 at first class rate. so to send 292 cards today would cost over £52, giving a realistic price for the materials.

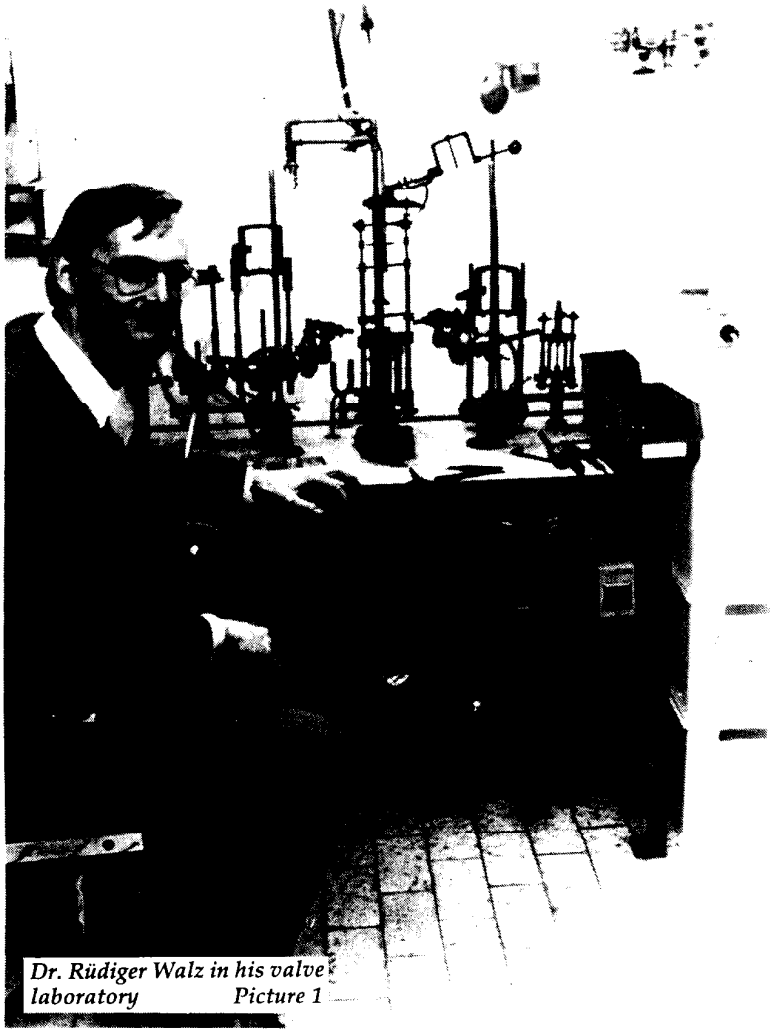
The sole item not home-made for the receiver was the "telephones", Gamage 1000-ohm types which probably cost a good deal more than all the rest of the items put together. Radio was not a poor man's hobby.

A thoughtful touch in the article was to suggest a simple "signal generator" for setting up the detector for optimum performance. It was no more than an old electric bell with the gong removed so that it merely produced sparks and acted as a transmitter producing a "buzz" in the earphones over a distance of several feet. Once the detector had been adjusted an actual aerial test sequence was proposed, together with the appropriate settings for the coil switches. An evening's listening might begin at 8 p.m with Paris on 1900m, with a switch to Cleethorpes on 4000m at 8.30, 9.00 and 10.00. Back to Paris at 10.20 for 50 minutes, and then over to Poldhu on 3000m for the new broadcasts which continued until 1.30 a.m. If the listener had any energy left after that he might search for shipping on the short waves between 600m and 300m, or go to the low end of the the range for Clifden on 7,200m, which might well go on transmitting until 3 a.m Those who stayed the course must have received a great deal of satisfaction from their night's work!

*One of our German members, **Dr. Rüdiger Walz, and his friend Franz Pemmerl** undertook the daunting task of producing replicas of vintage valves and succeeded despite fairly primitive equipment. Here, Rüdiger tells of some of the problems they encountered. Now, having successfully produced bright emitters, they are working on the production of some replicas of rare early dull-emitters but although they now have the technology, they have run into a serious snag: where does one obtain thoriated tungsten wire of 0.015 to 0.020mm diameter? If you have an idea, let the Editor know please.*

Problems of making radio valves at home

by Dr. Rüdiger Walz



Dr. Rüdiger Walz in his valve laboratory Picture 1

My friend Franz Pemmerl and I have, for the past five years, been producing replicas of vintage radio valves. The title of my article certainly does not mean that we are producing radio valves in our living rooms! 'Making radio valves at home' means that we have had no help from any factory and we are doing everything ourselves.

The first pre-condition for producing valves is a proper workshop. In our case we have converted two garages. Secondly, you need some know-how about vacuum technology and glass blowing. One should have some experience in glass-blowing, physics and chemistry too. But without a book of the early nineteen-thirties, Espe and Knoll 'Werkstoffkunde der Hochvakuumtechnik' (Materials for Vacuum Technology), we should never have been able to begin.

I am a chemist and Franz is a radio engineer, so we are an ideal team for the job. The third pre-condition is the specialised equipment such as vacuum pumps, a spot welding machine, a machine for handling the glass and an oven for tempering the glass. We obtained all our machines from a defunct light-bulb manufacturers as new apparatus would have been too expensive and possible not even available. Unfortunately radio valve production had closed down in Germany and the equipment disappeared before we began the project, so the light-bulb machines had to be modified for our purpose.

Our 'works' has a vacuum device with an oven for heating up the valves to 400°C while pumping. In the background is a vacuum oven for heating the anode sheet before mounting. Beside this oven is a glass-blowing machine, which is the most important tool in our shop. 'Machine' means a device for handling the hot glass and not any sort of automatic producing machine. (*see Picture 2*) In our second garage, which is connected to the first by a door, there is a big oven for slowly cooling the hot bulbs after sealing.

The fourth pre-condition is to chose the right type of valve to reproduce. It should be a simple one: an early bright-emitter type with a pure tungsten filament. These valves are often exposed to view on top of receivers so they cannot be replaced by more readily available modern valves without spoiling the nice original look of the receiver.

The production methods need to be very simple, so that the valve can be produced by an amateur using primitive tools. The original valves to be copied need to be rare and expensive types, so that potential buyers will be prepared to pay a suitable fee for your work. The valve must be of a type commonly used in former times, so that enough receivers still exist which require replacements, so that there is a good demand for them by collectors.

• *continued on next page*

Project

• *"Valve making" continued from previous page*

We chose the British-French 'R' valve (called TM in France) It has a simple electrode system, the grid having a diameter of 3mm and the wire used having a diamater of 0.2 mm, which is a dimension which can be handled on a primitive turning lathe. For the German market we decided to make the Telefunken RE11 and the RE71 which is the same as RE11 but with a European base.

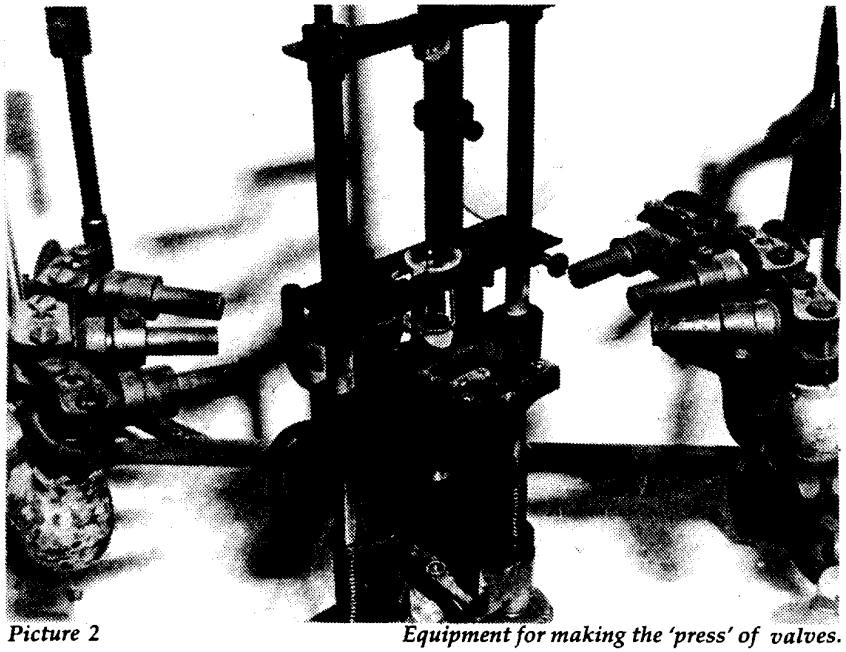
You may be astonished to hear that the bases of the valves caused most of our problems. To shape the glass to the desired form by hand and give it the appearance of the original machined product is no problem, but to give this appearance to a hand-made base is quite difficult. The first bases we sold were made of turned steel, nickel plated but now we have brass bases with a ceramic insert identical to the original ones.

There are about 40 steps on the way to a good, working valve so we had to make many experiments and practice many skills. At first the whole lot of valves we made at a weekend failed. The overall time to make one valve was about three hours. This brings me to my own, most important pre-condition: a patient wife who accepts her husband spending weekends in a workshop while the sun shines and the family seeks an excursion.

To find suppliers for the special parts who are willing to sell or to produce small amounts is also very difficult. For example, we were first told that we could buy only 20,000 of a certain component we needed for bases. In the end, we managed to get the order down to just 2,000. Even that meant a large investment and enough components to last us for the next 20 years. Another example was the lead glass needed for the press. Some materials are not available at all today. After five years of experience we now would like to produce some 'modern' dull emitter valves, like the Marconi D.E.3 or the German Telefunken RE78, RE83. But the tungsten filament for such valves contained about 1.2 to 1.5% of Thorium.

Does any member of the BVWS have any of this wire or know a supplier of it?

Another problem was the special know-how concerning this filament wire. It needs special treatment before it will produce satisfactory emission and have a satisfactory lifetime. There is a special procedure needed while pumping the valves too, and after pumping, tests of about 1,000 hours have to be carried out with the prototypes to check if procedures were correct and to make sure bad valves were not sold.



Picture 2 *Equipment for making the 'press' of valves.*

Most people who are interested in the 'R'-valve are in France and so we now make our valves with 'TM'. There is also a small demand from Switzerland, USA, Australia, Italy and Germany, but only a few go to Great Britain, where it seems that there may still be enough orignal valves to meet demands.

Most people cannot imagine the work which is neccessary to make a valve. I know people who have acquired an old vacuum pump and some parts of valves and dream about making valves, but only very few have the time and facilities to do it.

John Stokes reported in his book *'70 Years of Radio Tubes and Valves'* that some replicas were produced in America in the sixties but few were made. In Britain replicas were built by a retired worker of a valve manufacturer in the seventies, but again in small numbers. Replicas of the DeForest audions have been available in America since 1987 and in Germany Professor Künzel at University of Ulm has made RE11 valves since 1985 in small quantities. We are proud to have been able to produce and supply valves to collectors since 1983. Our valves are signed with 'Replica' and '19PW89' on the press inside the valve to avoid them being passed off as originals on any subsequent re-sale. The '19PW89' code represents the first letters of our names and the year of production. When a 'getter' is used, the sign 'Replica' is embossed on the bulb.

We are often asked if we can repair old valves. We do not undertake this for various reasons. Firstly, old valves are historical artefacts which would be destroyed by repairing, and perhaps they are not suitable for 'daily' use. Secondly, there are some technical reasons why repair is not recommended. Glass becomes brittle after 50 years and the 'press' often breaks even with the most careful heating-up. Even if this problem could be solved, it is necessary for pumping, to heat the valve up to 400°C and for that you have to remove the base. The copper wire leadouts will be corroded after 50 years and usually these break at the point they are joined in the 'press'. We think it is better to use replicas of the old valves for operating vintage sets, rather than original ones. They are now in good supply, enabling demonstrations without the risk of burning out originals.

Letter: 'Free Grid' *from Paul Anderson*

Just before reading your historial research article I happened to turn up Wireless World for March 1961 in which "free Grid" says he arrived from New Zealand "nights on 40 years ago" just in time for the first radio show at the Horticultural hall. He continues "Even to this day I have an electric razor brought in 1922 from a shop in Wellington"

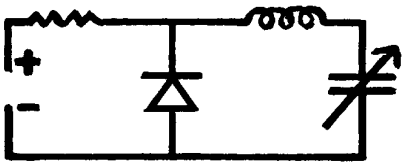
Oscillating Crystals

CRACKING THE PROBLEM OF A 60- year- OLD WIRLESS MYSTERY BVWS Member **HELMUT KRÜGER** *injects some science into the black art of OSCILLATING CRYSTALS, writes Desmond Thackeray*

***Oscillating Crystals* is a subject which engaged a lot of interest over a couple of years, 1924-5, with over 30 articles in wireless magazines, and then vanished into oblivion by the end of the decade.**

While the extra sensitivity conferred on a crystal set by this curious source of negative resistance would have been welcome, its instability and unpredictability no doubt made it useless to anybody but the curious experimenter. Since the "oscillatory" crystal was often zincite, a familiar component of the Red Diamond detector, the negative-resistance mechanism involved might have been associated with semiconduction. But there seems to have been no publication of dynamic electrical investigations.

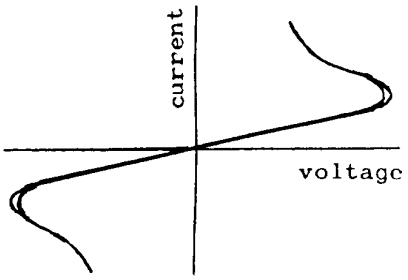
The circuit is attractively simple:



An Adjustable constant-current bias is passed through the crystal contact,and the crystal bridged by a series tuned circuit, as in the arc transmitter of the time. The patient experimenter is then rewarded by oscillations; or if the negative resistance is just insufficient to cancel all losses in the tuned circuit, the effect should be that of the "Q-Multiplier" in later valve technolgy.

Helmut Krüger has gone beyond this purely empirical achievement in two ways, opening-up our understanding of what is happening: Firstly, he examines the oscillatory waveforms up to about 500 kHz, which may be either sinusoidal or be distorted by obvious second-harmonic content; again, this reminds us of the arc-transmitter :

Secondly, he has displayed the current-voltage characteristics on a curve-tracer.The characteristic not only folds back rather like the characteristic of a gas diode, UJT or gas-arc, but is symmetrical about zero current and voltage as if the rectifying junction formed by the electrode materials is not involved. Clearly too, the curve is *not* shaped like that of a tunnel diode or a valve dynatron, which are negative-*conductance* devices.



Questions come to mind: If there is no involvement electrically of a rectifying junction, can one make up the "crystal" contact device with two pieces of carborundum, or even two pieces of carbon? Or indeed any combination which includes at least one material of moderate resistivity ? Can one design around reproducible materials and obtain more stability ? Or is Helmut dealing with an arcing contact, perhaps ?

Reference: Wireless World, August 1980, "Letters", 36, D. P. C. Thackeray IEEE Spectrum, August 1981, "Letters", page 14, A. C. Goodnow; Wireless World, 1 February 1928, page, 28 (Adv.), "Russell's"

Letter:

from Frank Brittain

Valve Notes

I should like to offer a few notes with reference to Vol. 14 no.1.
Firstly, Pat Leggatt says that the word "Pentone" was soon changed to "Pentode" by Philips/ Mullard. I am not certain but think Mullard output pentodes were branded "Pentone" at least up to 1939, and RF types may also have been. It might be of interest that some of the first Cossor pentodes were advertised as "Quintodes" for a very short time. I think that the only *two-volt double ended* screened grid was the SG210 marketed for a matter of months in 1927-8. It was produced solely for converting the first Melody Maker (1927) det+ 2LF to SG3. The appearance of the first MM kit (SG3) in 1928 (BK229 in brown crackle metal cabinet) promptly killed it as the 215SG was single-ended and had a top terminal.

Now to Philips. John Stokes says that Philips valves were not licenced for sale in Great Britain. This is not correct as a licence was not needed. In fact, when Philips acquired part of Mullard in 1926-7 the PM range of valves was launched and the PM4 was widely advertised as the "loudspeaker valve" at 22s. 6d. At the same time a genuine Philips PM4 with a brown base could be bought for 17s.6d. This did not last long as Philips soon realised they could not have two different prices for the same thing.

Most of the 2514 sets and the two-valve 2515 were marked "Made in Holland". They could not be shown at Olympia because the RMA rules were that no more than five percent of set content could be foreign.

All Philips sets sold in the UK were fitted with Mullard valves except for the rectifiers, which were branded Philips. Whether the Mullard branded valves fitted in the early sets (eg 2514) were made in Holland I do not know but the 2506 rectifier certainly was. Philips were members of the BVA but for *rectifiers only*. It was a curious situation really but I suppose that Philips in their wisdom felt that they needed a presence in the BVA as well as Mullard. They served on only two committees, the General Purposes and the Board of Management (the House of Commons and the Lords!).

from John Stokes (24.4.89):
Philips ***rectifiers*** *(or rectifiers of any imported make) could be sold and used in the UK at this period as they were not subject to any patent restrictions, which is why they were used in British made Philips receivers. All other types had to be branded Mullard, even if they were only badge-engineered Philips imports.*

Letter:

from Bruce Adams

The Tetrode

I was surprised by Pat Leggatt's assertion that the tetrode valves ceased to exist in 1934. Does he not remember the kinkless tetrode and the beam tetrode in America? The KT63 and KTW63 are in the Marconi list for 1953 and the 6V6GT in the Brimar list for 1961. A post war type was the KT81.

Editor's note: *I requested Pat's comments and he writes: 'Of course you are right in saying that tetrode valves persisted beyond the mid-1930's. My excuse (a poor one!) for saying otherwise is that kinkless tetrodes behaved like pentodes and the distinction between them was often ignored: in some valve data books kinkless tetrodes were included in a section entitled "pentodes". Furthermore, kinkless tetrodes were not usually called screened grid valves. I should, I suppose, have mentioned the kinkless development and said that "pentodes, and tetrodes with pentode characteristics, entirely superseded the simple screen grid types ..."'*

• *more letters on page 26*

Museums

Above: a display which includes both accoustic and electric gramophones, sets by Pye, Gambrell-Halfords and Stromberg-Carlsson. ***Below:*** *a row of pre-war radiograms, a cabinet containing Ekco sets including SH25 and AC85, and in the background British and German 'People's Sets' plus a wartime communications receiver.*

The little museum at Southend on the Essex coast has a small and specialised but important wireless collection, which BVWS member Dr. Tom Going, who is associated with the display, here describes.

Southend Museum

by Dr. Tom Going

Priory Park Museum, in Southend, is one of the few local-authority museums to have a gallery dealing with 'communications' – and what could be more fitting when the doorstep of the former Ekco factory is not three hundred yards away.

In 1982, one of the temporary exhibitions held was of BVWS member Bill Caten's well-known collection, and this was so popular that the Museum negotiated to acquire it for permanent display. Subsequently, through the generous help of Mr. Caten and other local donors, the collection has been enlarged.

The main accent of the collection is on the products of E. K. Cole Ltd, whose founders, Eric Kirkham Cole and William Streatfield Verrells, began operations above a sweetshop at 505, London Road, Southend in 1926. The museum has early examples of their sets, the 'P2' and 'SGP3' in wooden cases, and the metal 'mains-drive three' in two versions. The AC version, which came from Alan Carter of the BVWS, remains on permanent loan to the Science Museum; our displayed version, a recently-acquired D.C. model, uses nothing but the best components – for example glass-sealed Loewe resistances – and exemplifies the high standards which gave Ekco sets their good reputation. Naturally, with the wide range of models produced, only a small proportion are on display, and certain key models – e.g. the -64, -78 series and the AC97 are missing from the collections.

Television is represented, with a very large mirror-lid set, the Marconiphone 705, which came from a house in Plumstead, the table-top 707, and also an Ekco add-on TA201 vision-only receiver. The TA201 is in working order, the others are in good mechanical condition awaiting restoration. It is not museum policy to

• *continued on next page*

• *"Museum" continued from previous page*

run the old televisions; however, certain of the radios, for example a fine Pye Q49FS 'firescreen' receiver of 1937, are demonstrated by request, as are the wind-up gramophones.

The display is a fairly densely-packed medley, as can be seen from the illustrations. One large piece is an enormous Gambrell-Halfords radiogram (ca. 1937) with an Epoch loudspeaker which weighs seventy pounds on its own. It features push-pull 6B5's and is a switchable TRF/ superhet.

Another gross machine is the famous HMV 'Automatic Model 1' gramophone. This acoustic player has an electric motor, remote control, and a three-jawed 'record cruncher' autochanger with felt-lined dump for collecting the recently played discs. These are poked up off the turntable at one edge before they spin unceremoniously into the dump.

Other unusual items include projection televisions (Philips and Decca); wire recorders (K.B.); a 2HF multiple valve (Loewe); Hammarlund 'Comet Pro' communications receiver (ca. 1933); Brush Soundmirror and EMI clockwork portable tape recorders (1950 and 1955); photographs and other sundries, including a 1930's Ekco dealers' sign kindly donated by Tudor Rees.

The collection is housed in two rooms in Prittlewell Priory, an attractive, though somewhat over-restored farmhouse and attached monastic buildings, given to Southend with substantial parklands in 1917. In the same buildings there are natural history, printing, farm machinery and local history displays, and the Museum is one of four parts of Southend Museums Service. The other branches are Southchurch Hall, a mediaeval moated hall house; the Beecroft Art Gallery and the main Central Museum.

For rail travellers, Southend may be approached from London, Liverpool Street (via Shenfield) or Fenchurch Street (check station opening times) – journey time about one hour. The museum is not open on Sundays and Mondays, and because of staffing shortages, intending visitors should telephone Central Museum on Southend (0702) 330214 for details of opening times. At the time of writing, admission is free to all branches. General enquiries should go to the Central Museum, Victoria Avenue, Southend, Essex SS2 6EW, where the main offices are. The Central Museum is adjacent to Southend Victoria Station, and Priory Park Museum is a brisk twenty minute walk due North (twenty five minutes from Southend Central) in the park next to Victoria Avenue. Motorists should come in on the A127 (dual carriageway) and they will find adequate parking inside the park. The museum would always be glad to have the opportunity to study Ekco ephemera such as price lists, etc, and will try to help answer Ekco enquiries, but please be patient with their Honorary Adviser, – Yours truly, **Tom Going.**

Above: *A cabinet of Ekco sets, including an early wood-cabinet SGP3 and circular models, a disc-recorder and motor-tuned PB289 'Radio Brain' chassis.* ***Below:*** *Ekco sets including AC85, AD65, 'Radiotime' and 'Princess', plus information on designers Wells Coates and Serge Chermayeff.*

Research

*The year 1926 was a watershed for both valve and tuning-coil designs, which together put the **Everyman Four** amongst the last of the truly vintage receivers. **Desmond Thackeray** explains the coil situation.*

Some thoughts on the Everyman Four

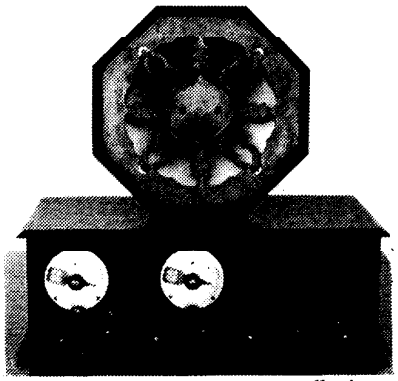
by Desmond Thackeray

Readers of the recently-published *History of Radio at the National Bureau of Standards (NBS)* **may be excused if they fail to recognise in its verbosity, the substantial technical contributions to radio that appeared in the NBS scientific and technological publications.**

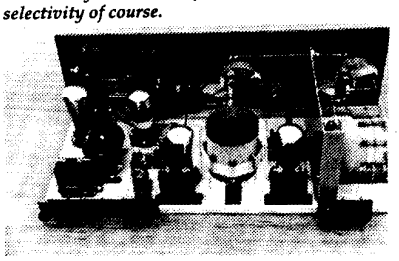
For a mere 10 cents in 1925 one could buy the *NBS* 17-page account by *Hunt* and *de Groot* about losses in broadcast-band tuning-coils. Six different coil designs were wound to a common value of inductance (291 μH) in both solid wire and in litzendraht, and the series-loss resistances determined over the range 300 to 1500 kHz. Just as their numerical results indicated, single-layer solenoids and basket-weaves are less lossy in the medium-wave band than honeycombs and bank windings. Readers may verify this using the signal-powered Q meter of ***Ted Beddoes*** (*BVWS Bulletin* 12:3:38-9 and 12:4:53), on their own coil collections. Also, ***Hunt*** and ***de Groot*** showed that 'litz' wire has a distinct advantage at 300 kHz, though very little at 1500 kHz.

Yet for all this, one unsubstantiated comment these authors make about dielectric losses was demolished by ***Butterworth*** in *Experimental Wireless & Wireless Engineer* (EW & WE) the following year. What he had found was that the largest contribution to coil loss at such frequencies was the copper loss. But this is to run ahead of the story.

A second empirical investigation of coil design was that involving allegedly hundreds of readers of *Wireless World* (WW) who submitted home-wound tuning coils in the *WW* coil competition. The results appeared in *WW* for February 17 and 24, and March 3, 1926, with some further coil notes on March 17. The winning coil was a single-layer solenoid wound from litz wire. Its shape and size was close to



BVWS member L. Williams set about collecting an authentic 'set' of parts to build this splendid reconstruction of an Everyman 4. He reports that it works well and has a sensitivity not far short of some early thirties superhets – but with less selectivity of course.



that of the NBS best single-layer solenoid:

	WW	*NBS 'AL'*
Gauge	20-38	32-38
Diameter	76mm	81
Length/ Diameter	1.06	0.73
Inductance/ Resistance	65.4	60
(both at 400 metres)		

After this mountain of experimental work in two countries *seemingly* spotlighting the virtues of coils about 3" diameter wound with litz wire to a squarish aspect ratio, how could one hope to do better? Yet at the end of March in *WW* we find ***Butterworth*** of the *Admiralty* stubbornly asserting the virtues of a winding only ¾" long on a 3" diameter. He also gave data for a coil to beat the winner with a length/ diameter ratio of 0.5, and a calculated inductance/resistance figure of 123!

This suggestion was clearly too improbable to be taken seriously. Lone voices crying in the wilderness have often found that there is little reward for being right at the wrong time. Be that as it may, from May 26 to November 3 in the pages of *WW* we find a series of radio designs, the most famous of which, the *Everyman's Four-Valve* of 28 July and 4 August, used tuning coils which are close to 'square' in length/diameter, are 3" in diameter and wound with 27-42 litz wire (to about 280 μH).

Was this then a crushing dismissal of the Admiralty scientist? Not so! ***Butterworth***'s comments turned out to be the merest pre-echo of a series of formidable articles on coil design, running to a total of 36 pages in *EW* and *WE* between April and August. This proved so indigestible to one ***B. B. Austin***, that ***Austin*** published a five-page precis in *EW & WE* for January 1934. Nevertheless, any diligent reader will discover clear wisdom therein, ***Butterworth*** hammering home the ideas that there is always an optimum winding shape, as well as wire gauge and spacing, and in the case of litzendraht number of strands. He also makes the point that intuition is a totally unreliable guide to these parameters. So much have ***Butterworth***'s results become the received wisdom in our time, that we expect a single-layer solenoid to have a winding length of ⅓ the diameter, *and* spacing of about 1.65 times the wire diameter.

However, in looking more closely at the design of the *Everyman Four*, I would not ascribe too much importance to coil losses that may have been bigger than they need have been. ***Butterworth*** himself points out that tuning coils were usually substantially damped anyway by losses in aerial and in valves. This would certainly be so in the *Everyman Four*, which seems to have fairly tight coupling between tuning coils, aerial and triode RF valve. A sufficient total of losses would be required to ensure stability, with adequate 'nose' selectivity being recovered by the use of fixed reaction.

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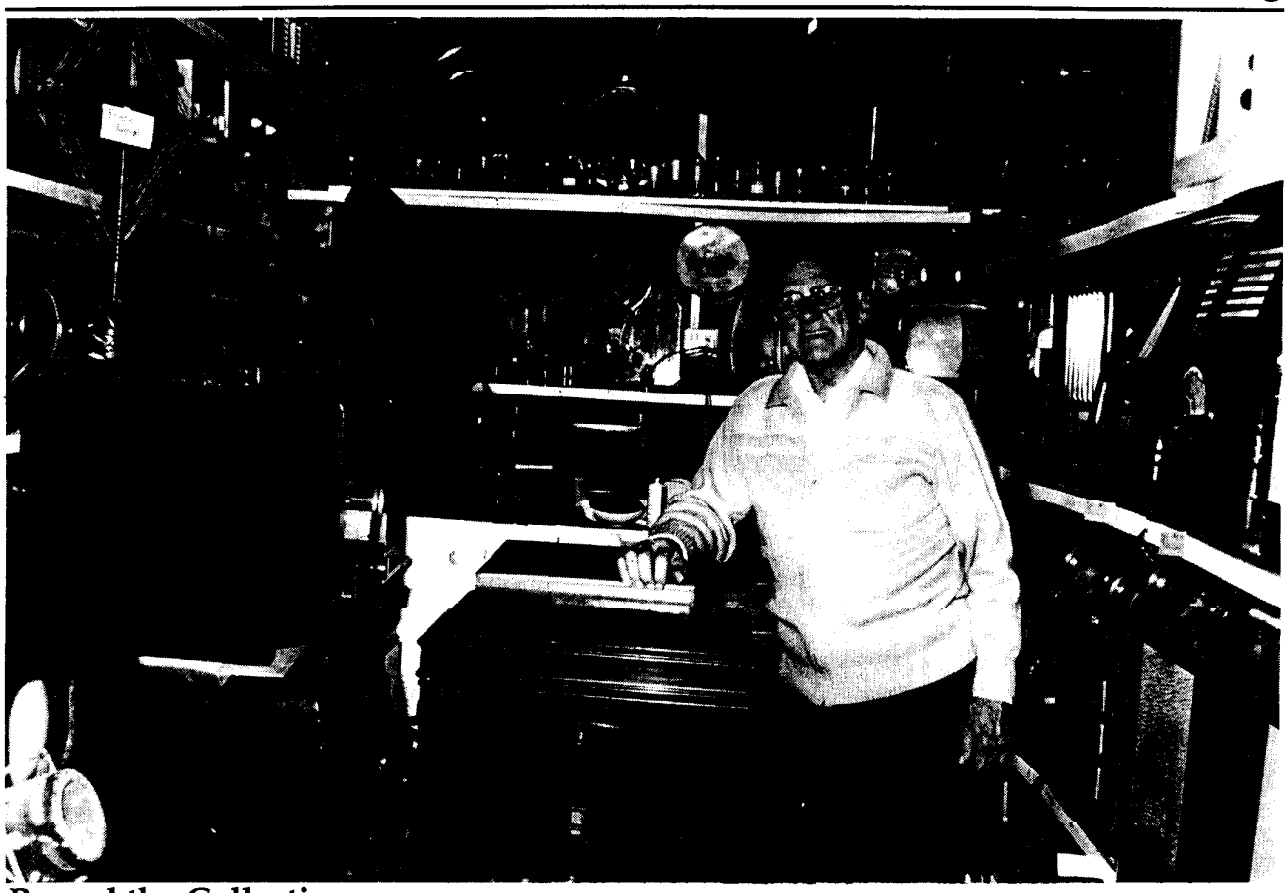
• *continued at foot of next page*

Collecting



Round the Collections

Society member Bill Caten of Eastwood in Essex, has been collecting for a quarter of a century and has already sent a first collection to a museum and has since amassed another, for which he has erected a special building in the back garden of his bungalow. He is now 72 and remembers building his own crystal and valve sets as a schoolboy, although he is more interested in the wireless as part of social history than as a technical object. Bill has always retained his enthusiasm for early technology, and he collects wind-up gramaphones too. His present display appropriately includes more than fifty Ekco receivers – he lives a few miles away from the old Ekco factory. He also has a small collection of television sets including a pre-war 'sound only' one.

• *"Everyman 4" continued from previous page*

In situ measurements at 750 kHz on some *Wearite* Everyman Four coils showed that the aerial transformer has an L/R of only 31 compared with 40 for the R-F coupling transformer, probably due to losses in the metal screen. It is instructive to see what size of solid-wire coils would give such values or better. Winding a ***Butterworth*** shape with 0.4 mm solid wire on a 111 mm diameter former resulted in L/R of 46; and with 20 swg solid wire spaced over 91 mm on an 83 mm diameter the L/R was 50. Neither coil is as convenient a shape or size as the *Everyman Four* coils, requiring around 40% increase in either length or diameter to get a similar performance with solid wire. Incidentally, litz on the 111 mm diameter former gives an L/R of 76. In retrospect it is reasonable to conclude that the compactness of the *Everyman Four* coils was gained at the expense of using litz wire for the secondary windings.

In most respects they were clearly coils of their day, a half-way point between long coils and short coils, and with losses reassuringly predictable from what was then recent NBS work. The adoption in the ***Everyman Four*** of Butterworth's innovatory coil shapes would have required at least a rethink of the layout; and the ready availability of litz wire at that time meant that solid-wire design was not overwhelmingly important. Contentious though arguments **might** have been between these big-endians and small-endians, in the event Butterworth's conclusions were only accessible to readers prepared to tackle his massive publication. Moreover, within a few years the use of dust cores had greatly eased the copper-loss problem anyway, as well as helping indirectly to reduce stray capacitance and dielectric loss in tuned circuits; small became beautiful, indeed.

The mid-twenties favourite

Butterworth shape has the lowest copper loss

This traditional shape is copper hungry

Nevertheless, if any reader is building a 1989 ***Everyperson Four-Transistor*** and can't get the litz wire, how about winding some large diameter coils for it?

* *See the article on this receiver by* ***Ian Higginbottom*** *in BVWS Bulletin, 4:1:2-3*

An Aerial Distribution Amplifier

by Bill Williams (G8AVX)

Many BVWS members I know delight in demonstrating their radios working exactly as they did 60 or more years ago. To this end considerable effort has been devoted to building substitutes for the HT batteries and LT accumulators sadly no longer available as current manufacture. Aerials are not quite such a problem. Most of us can get a few feet of wire up somewhere, although it is not always very satisfactory.

Some early radios depend on the aerial capacity to define their tuning range. A crystal set designed for a 100 ft aerial may work very well on the local radio transmitter, if not too far away, on only 20 ft of wire, but may not tune BBC R2 on 433 m because its variometer-tuning requires the loading of a 100 ft aerial to tune that far.

A few years ago I got to thinking how nice it would be to have aerials available to suit the whole collection in the same way that I have HT supplies of 30 to 150 V and LT supplies of 2, 4 or 6 v.

Some of my radios need a high capacity aerial but, because they were never designed to handle very strong signals, they cannot take a 100 ft wire without producing severe overloading symptoms.

The solution to all the problems was a distribution amplifier. A single aerial was sited to give the cleanest signals obtainable. The signal from this aerial was passed through a wide band unity gain voltage amplifier having an output impedance of a fraction of an ohm. Each radio is fed from this amplifier via a network which attenuates the signal if necessary and supplies each radio with the loading of the aerial length it was designed for. Since each of these networks present an impedance of at least 1000 ohms to the amplifier, it was possible to supply the entire collection with optimum aerials and have them all permanently connected without any detectable interaction.

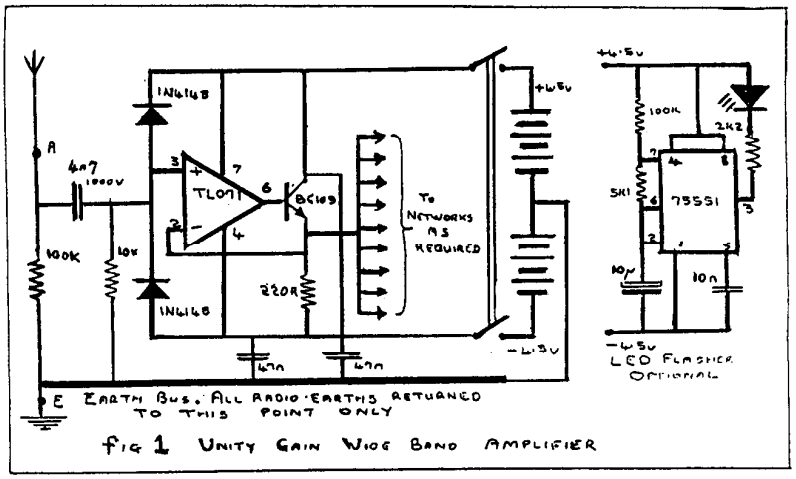


Fig 1 Unity Gain Wide Band Amplifier

Fig 1 shows the circuit of the amplifier. For freedom from mains-borne noise and added safety, the amplifier is made battery powered. The heart of the circuit is an FET input wide-band operational amplifier type TL 071 CP. Most operational amplifiers have class B output stages which are not ideal for this type of application; consequently a discrete transistor has been added to make a class A output. When considerable numbers of crystal sets or simple valve detectors are connected, the total radio frequency current supplied may be several mA. The standing current in the output stage was therefore made about 20 mA. With this load it is not a good idea to leave the batteries on when they are not needed. A flashing warning light was therefore added. This uses an integrated circuit to flash the LED for a mean extra current of about ⅓ mA. It is a bit complicated, but a worthwhile reminder to switch off and save the batteries.

The static discharge resistor and clamp diodes at the aerial input are essential to the protection of the integrated circuit during thunderstorms. Semiconductors are very vulnerable to static, being much less robust than valves. The prototype has survived for two years including a few nearby lightning strikes.

Wire aerials, used with a good earth, load the aerial terminals of the radio with a resistance of about 20 ohms in series with a capacity which depends on the frequency being received and the length of the aerial. A 100ft aerial on the medium waveband approximates to 200 pF; shorter lengths give proportionally less capacity. If a simple network of 22 ohms in series with the appropriate capacity is used, the full signal is applied.

Members requiring a *large* copy should send a 9" x 4" stamped and addressed envelope to the Editor.

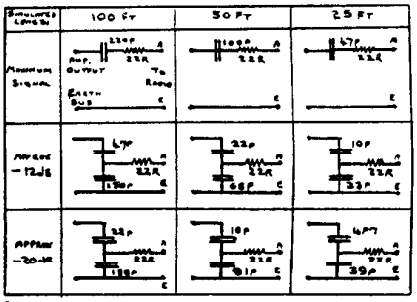


Fig 2 Networks to provide strong or weak signals simulating long or short aerials

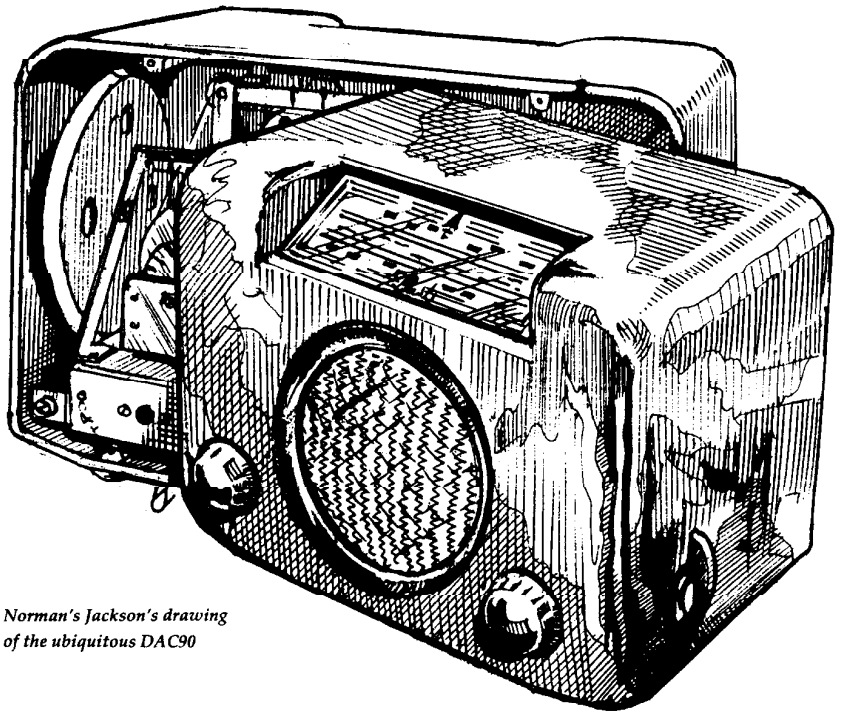
Although the amplifier has unity voltage gain, the signal applied in this mode will be significantly stronger than would be obtained if the aerial were used direct, because the amplifier only lightly loads the aerial. If a weaker signal is required, the capacity part of the network is made as a potential divider to give the required total capacity for the desired fraction of the signal voltage. For safety the capacity element of the network should be at least 630 v.a.c. working. Thus failure of insulation on a radio which applies full mains voltage to the distribution amplifier can be tolerated and no other radios will be made live.

Fig 2 shows some typical networks giving various signal strengths and aerial loading.

The circuit is very straightforward but, of course, an amplifier with a low frequency open loop gain of 106 dB and 6 MHz bandwidth requires sensible circuit layout.

The Classics:

There are certain pieces of vintage wireless equipment which because they are unique in some way or are technological milestones, earn the title 'The Classics'. Candidates for the title range from the Marconi V2 of the 'twenties to the round Ecko A22 of post-war vintage. Hardly innovative, but a best- seller and a great survivor, the DAC90 produced by Bush Radio of Shepherd's Bush, London, (Advertising slogan: 'It's a wise bird that settles on a Bush'), deserves a place.



Norman's Jackson's drawing of the ubiquitous DAC90

BUSH DAC 90

by Don Turner

The British radio industry was still working flat out on military contracts as World War II came to its quite rapid end. Without doubt, most manufacturers had given thought to restarting in the civilian market but a very different set of priorities and problems now existed compared with the pre-war situation. New models were needed quickly to service the pent-up demand. They needed to use easily available parts in a well tried technology to save time. They had to meet Government directives on export priorities to finance the huge war debts.

From this scenario the Bush DAC 90 emerged. A small transportable table model, well made but not greatly different from the products of other makers, it became a firm favourite with the public. In its first form it appeared in 1946, going through various developments before being withdrawn, well into the 1950's. It can be found in markets and sales still in working condition and has probably started many a budding collector on his way.

The cabinet is of Bakelite – a departure for Bush who had made their reputation on solid/veneered wood table models. The choice was undoubtedly made because of shortage of wood, the lack of skilled craftsmen, cost, and the requirements of mass production. Changes over the lifetime of the series were minimal being either internal or cosmetic, to details such as speaker grilles, knobs, scales and to a limited extent, colour.

The original design used the widely popular Mullard E series valves with octal bases and 200 mA heaters. These were a sensible choice for the British and to a lesser extent the European markets but quite unsuitable outside the old Empire markets and it is doubtful if this was considered. The circuit is quite straightforward, using a very well made frame aerial rather than the 'throw out' aerial often found in small receivers. A major redesign to the chassis and circuit was made and issued in 1950 as the DAC 90A.

The changes were quite extensive. The tuning control was now brought to the front of the cabinet in the more usual position with the now vacant hole in the side of the cabinet used for the wavechange switch. The valves were changed to the latest 'new' standard B8A Rimlock series which, although a good design, were doomed to a short lifespan. These smaller valves with 100 mA heaters permitted a much improved layout and a tiny mains dropper, leading to a very much cooler-running radio. The circuit was still conventional but cost-cutting was creeping in. The long wave oscillator coil was dispensed with by switching a large capacitor across the medium wave coil. This ploy means that tracking cannot be achieved across the band and is correct at one point only. 214kHz was chosen as this is midway between Droitwich and Luxembourg transmitters, these being the only ones of interest to most purchasers. Unfortunately Luxembourg moved to medium wave in 1951!

Variations:

DAC 90 the original receiver, was supplied in a brown or black Bakelite case. They usually had a yellow dial with black markings but black dials with yellow markings and blue lines are known. The first knobs were elegant but difficult to grip. A green 'Marble' case was seen at the 1946 show but was probably a one-off. The speaker fabric was of cloth.

DAC 90A, the redesigned model, is often confused with the 90. A cream case was now available and many more dial variants. It could have a black dial with red and yellow markings; or gold dial with station names and red markings. It had new deeper knobs with gold and aluminium inserts or lines and finally clear plastic skirts. The speaker grille is of expanded anodised aluminium and all plastic later.

AC 81 and **DAC 81** had a similar octal valve line up to the DAC 90 but had 3 bands and only external aerial. Cabinet details are unknown.

AC 91 and **DAC 91** had an almost identical circuit to AC 81/DAC 81 and the familiar cabinet but an all plastic grille. The change from AC/DC to AC only model was by the fitting of an auto transformer, the valves remaining in series. Minimum changes between models simplified production.

EBS3 was produced for overseas and has three long-wave bands and no frame aerial.

• *continued on next page*

The Classics

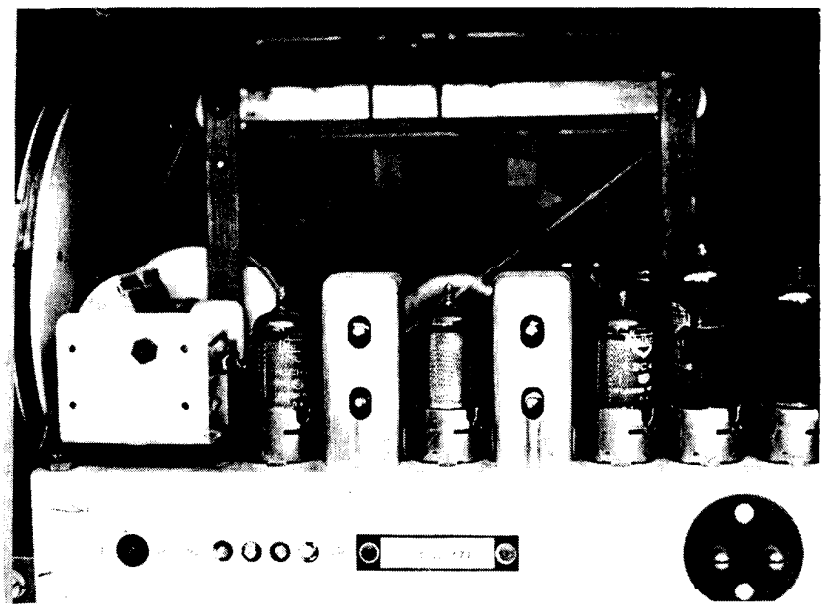
• *"Dac 90" continued from previous page*

EAC 91 and Export AC 91 had one MW and two SW bands and were made for Indian and South African markets – and maybe others. One has been seen moulded in the usual brown Bakelite but factory sprayed in bright red.

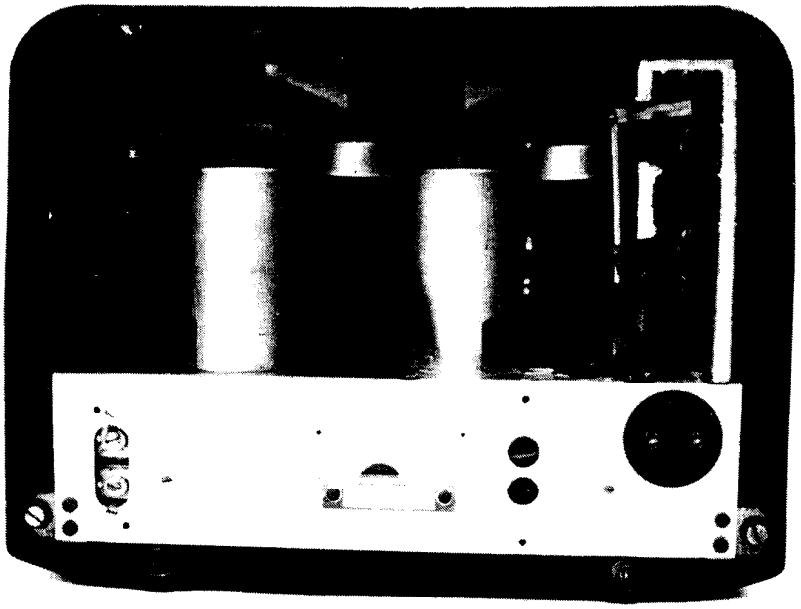
BP 90 was an all dry battery portable introduced 1946. It used a rexine-covered woooden cabinet but general layout followed the ideas of the DAC 90 to some extent. It had a plywood frame-aerial and 1.4 V octal valves. Two battery types were fitted and it had 2 bands.

BA 91 had familiar Bakelite cabinet as the conventional British battery model and used external batteries: two-volt accumulator and 120 Volt HT battery. Valves were 2 volt octals and the set had three bands.

EU 3A was a very unusual receiver. A mains dropper was tapped from 110 V to 250 V for mains use. Removing a shorting octal plug at the rear allowed a vibrator unit to be plugged in. The valves stay in series, both heaters and HT supplied from the vibrator unit operating on 6 Volts. The type number probably gives the thinking behind the marketing = Export Univeral 3A perhaps? Bands are MW and two SW (3.5 to 24MHz). It has an external aerial. Valves follow the DAC 90A style.



The interiors of the two basic models compared: at the top, the DAC90A and below the earlier DAC90.



We are grateful to Gordon Green for the photographs here.

Servicing

The receivers are well made, but there are some problems. Those known are:

DAC 90: Burnt and charred section of cabinet back where the mains dropper dissipates heat, making this model very dangerous to prying fingers. Repairs are most difficult, but glueing in a section from an elderly TV back is possible, or making a sandwich with glass fibre plain circuit board either side, short of fitting a heat-resistant plastic insert. Dust cores break away from brass adjusting screws. New ones can be made with infinite patience by filing threads from salvaged TV cores and glueing onto the adjusting screws. The fault can be detected by inverting the chassis when tuning changes. The wavechange switch can be forced past the stops in this model. Dismantling and replacing wafers may be required. The frame aerial is subject to differential metal corrosion between tags, washers and screws. To cure, clean and re-assemble with WD40.

In the DAC 90A the UL41 output valve is a high-slope close-clearance type very prone to grid emission and therefore grid current with excessive plate current. This shows as overheating and gross distortion. Some relief can sometimes be obtained by lowering the grid resistor – try 47k. Also try raising bias resistor in the cathode, perhaps 500Ω. Short of changing the base, replacements are almost impossible – a 10P13 will work, but check the operating conditions. All this presupposes that the grid coupling capacitor has been replaced by one of impeccable quality, something which should be checked in any receiver.

This is a far from complete survey of this well known and respected receiver. Many other variations will no doubt come to light and a complete analysis would probably fill more space than the Editor can spare. I would be happy to act as collator for information, photographs, circuits and literature. My thanks to all those members at home and overseas who replied to my questionnaire and in particular to Phil Savage who was a mine of information.

The Trader Sheet giving details of the DAC90 is dated 1 April 1950. A Xerox copy of this or of the details of the DAC90A will be sent to members sending a C4 SAE to the Editor.

Letters

• *letters continued from page 18*

Letter:

from Bruce Adams

The Pocketphone – 1

There was a factual error in your excellent article on the Pocketphone. You stated that the layer type of battery was not available before 1937 and was introduced at the end of the war. But in the BBC Yearbook 1930 there is an advert for the Columbia 'Layerbilt' battery.

Also the Hivac valve was still in use after the war. In 1952 I was working repairing hearing aids in the customer service department at the factory in Oxford and clearly remember using them.

Editor's Note: Bruce is quite right and his discovery of the 1930 advertisement for a Columbia 'Layerbilt' battery is most interesting. In the 'cutaway' drawing the battery certainly seems to be layered – rather like a wafer-biscuit but the construction bears little resemblance to the layer battery which was apparently first produced in America just before the 1939-45 War (and, according to veteran BVWS member Frank Brittain was used in at least one British portable of this period, a Cossor). This battery was built from small tablet-type units rather than large sheets, resulting in the miniaturised HT used to power 'personal' portables. If any member has details of the Columbia 'Layerbilt' battery, information would be much appreciated. Bruce Adams rightly points out that Hivacs continued to be used after the war. The article should have said that the Hivac was 'banished to the deaf-aid market by the practices of the BVA' but by mistake read 'banished from ...' Apologies for this error and for the mis spelling of Reyner as 'Reynart' several times in the text.

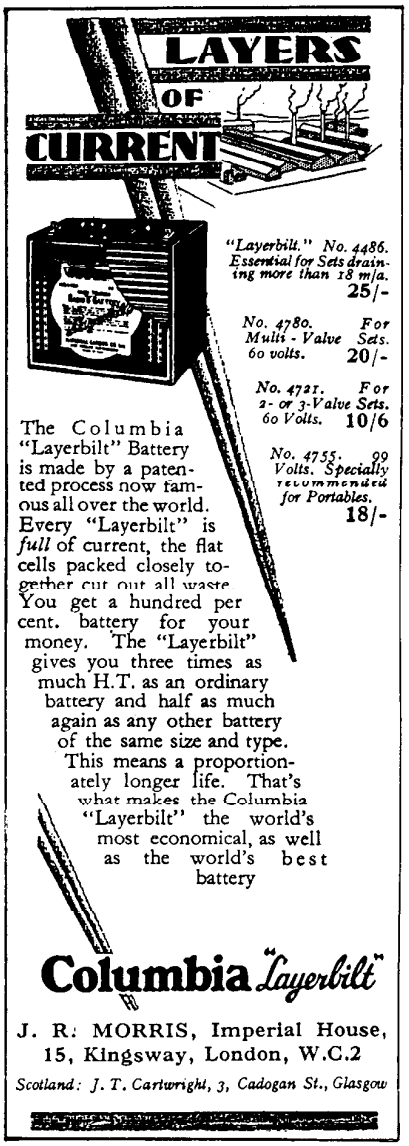
Letter:

from John Narborough

The Pocketphone – 2

I enjoyed reading your interesting and entertaining article in the recent issue (Vol 14 no.1) concerning the 'Grid Leak's Pocketphone' receiver.

However, for the benefit of those who do not themselves have access to the relevant issues of 'Wireless World', I would like to point out that the gremlins have mis-spelt the name of 'Free Grid', who was in fact Norman Vincer- (not 'Vincent') Minter. His obituary appeared in the April 1964 issue of 'W.W.' The designer of the 'Radio Companion' was J. H. Reyner, who according to his well-known 1930's text books (Modern Radio Communication; Testing Radio Sets, etc) was a graduate of Imperial College, which may confute the Manchester College reference in the 'Grid Leak' handbook. Reyner had published a design for an early portable receiver in the April 2 1924 issue of 'W.W.', where he was credited with a plain 'BSc', suggesting that he had yet to obtain his



later qualifications and was therefore at that time a recent graduate. An interest dating back to 1897 would seem to have been rather precocious, but of course Vincer-Minter would have been born about that time (having lived to 67) and this could have been an example of the usual 'Free Grid' wit!

The photograph accompanying the 'Free Grid' obituary bears no apparent resemblance to the 'Grid Leak' photograph (nor is he shown with the cartoon spectacles!) and so I support your opinion that the real identity of 'Grid Leak' has yet to be discovered. Surely even in 1989 someone must still have first-hand or documentary evidence to solve this mystery? Researchers may be interested to know that the current Hastings telephone directory lists one person with the unusual surname of Vincer-Minter and if this should prove to be a relative of 'Free Grid' then perhaps more light can be shed on the matter. A short biographical feature on that entertaining writer who was an institution in 'Wireless World' for so long would itself be of interest to many Society members.

Carry on the good work with the Bulletin, it is much appreciated.

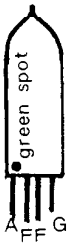
Letter:

from James Grant

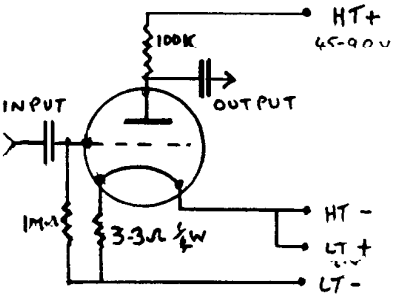
Pocketphone-3

Thank you for your interesting article on the *Pocketphone*. I enclose a photocopy of the cover of a booklet by G. P. Kendall (c. 1932), whose unsmiling face bears, in all other aspects, a remarkable resemblance to 'Grid Leak'. Could he be your man? Members contemplating construction of a replica *Pocketphone* may be interested to know that The Vintage Wireless Company Limited of Bristol are offering sub-miniature valves type CV122.

This modest price will help to off-set its voracious appetite for LT batteries. I enclose data for the valve, which I have successfully used as a substitute for 2-volt 4-pin valves, where the valve can be concealed. As these old triodes become ever more scarce, this option will become more attractive.



CV22 (actual size)
Fil: 1.5v 0.15a
Anode v(max) 100
Anode resist 40KO
Mutual cond. 0.8MA/V
Grid volts not spec.
but small bias req.
for best results



CV22 as substitute for 2 volt 4-pin triode (PM1HF,HL2 etc. Note use of ½ volt LT drop

Layout and Design: Robert Hawes