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Letters · Letters · Letters · Letters · Let

These are just a few of the many letters and telephone calls we have received at Bicester; many thanks to all of you for the kind words, and interesting comments. Many of the ideas put forward are being acted upon.

I find your magazine to be very interesting and I am pleased to take advantage of the free advertisement service, and hope to advertise with you in the future!

I have two other comments; I am puzzled by the fact that there is no date on the front cover – this would be of help to readers. Secondly, it may be a good idea not to print coupons on the back of companies' adverts, as they may complain that they are losing out, when readers file back copies of *Amateur Radio*.

W. E. Griffiths C.Eng, M.I.E.E. G6CVW

Please let me enlighten you about the activities of the Northern Heights Amateur Radio Society. We meet for a lecture on the second and fourth Wednesday and a noggin and natter night every other Wednesday. All of this happens for the time being at the Bradshaw Tavern, Bradshaw, Halifax.

The following is a list of lectures and visits for the first six months of 1983:

January 26 Visit to Elland Power Station. February 9 RAE participants invite night. February 23 Junk sale. March 9 G4MH Mini Beam by Jim Fish. March 23 Visit to Bradford Police HQ. April 6 AGM. April 20 Alignment evening. May 4 Visit to Leeds/ Bradford Airport. May 18 Construction competition. June 1 Treasure Hunt and family evening. June 29 Radio in light aircraft, by M.Gaunt G3WGW.

The club also has its present project, a monitor receiver for two metres which has been designed by a club member and is available at a low price in kit form. A transmitter is expected to be made available soon.

If anybody requires further information about the club, they can contact me at Bradford 83442.

N. B. Aspinall, G6CJL

I own an FRG 7700 and just recently purchased an AR88, and as you say in general the performance of the AR88 is really very good, I hope you can persuade the editor to publish a design for a pre-amplifier to help it along. But if you cannot run to an article, could you tell me where I can obtain a design?

M. Nixon, 103 Patrick Street, Grimsby, South Humberside.

Good idea – we'll work on something along these lines. Meanwhile though, can any reader help out?-Ed.

Amateur radio has a very constantly growing potential and this is proved by the huge increase in the Home Office and G&G RAE examination applications.

Think of all these new people in amateur radio! Where is their own magazine? The RSGB is useless and expensive at over £12 membership, plus a magazine which requires you to have a doctorate in science before you can understand it. OK, so there is *Practical Wireless*. But it has never quite recovered from the traditions of F.J.Camm, it original editor.

The same circuits and waffle. We want your magazine to help us learn the basics and understand radio, and how to get something out of it *before* we get our degrees. The same applies to computers – but even here many of the new computing magazines are already getting to the end of their useful life with readers.

Finally, I and many others look forward to the next issue of *Amateur Radio*, but unless it goes monthly, I fear it will be another magazine to be stifled and fall into obscurity.

R. Pyatt, Orpington, Kent.

I have had a long standing interest in ham radio since the early 30s but only took it up seriously a year ago. I wish now I'd done it years ago. I was prodded into taking the RAE by my son who is a college lecturer and knows the multiple choice exam system well.

He also took the exam and we both passed, but where I got a credit is PT1, and a pass in Part II. My son got credits in both parts yet he's not an SWL, but has a few more brain cells than me. What I am writing to you for is about Mrs. Frances Knight of Cheltenham, (see last issue, letters page). For goodness' sake, tell her she can do it. I did, and I'm retired because of ill health. I had a severe mental breakdown in 1976, spent a long time in hospital and nearly three years as an outpatient. Fresh interests were suggested, (because the breakdown was caused by overwork) and I took the plunge, bought a new FRG7 with insurance policy payments, obtained advice from G3 XOV on antennas, and finally took the exam.

Before, I couldn't even understand how to fill in the exam paper, but now here I am, writing for my Class B licence. I'm working on my Morse and logging exotic DX. Point the lady in the direction of the Radio Amateur Invalid and Blind Club – they are very helpful, print QSL cards run nets, and generally do a damned good job.

Can you run more articles on construction for people like me, a beginner? I particularly like the small sketches illustrating the wattmeter article

Stan Clark, Great Barr, Birmingham.

I am delighted both with the magazine and your article Don't Interfere – in which you mention the RSGB Interference Committee.

I thought I should tell you that apart from the knowledge and experience that we can draw on, as you said in your article, we also write "social" letters and deal individually with difficult situations where we can. At least one member of the committee is available at most RSGB exhibitions to deal with problems and we are currently engaged in the production of a new *Interference Manual*. This will be much more comprehensive than the present *Television Interference Manual*, and it will encompass a wide range of electronic devices from computers, electronic organs, cardiac pacemakers, to video, audio and aerials, etc.

I hope you'll continue the magazine. 73s

Sheila Gabriel G3HCQ Vice-Chairman, RSGB Interference Committee

Amateur Radio has filled a gaping hole between the turgid magazines like *Radcom* and *Short Wave* and the shallower CB publications. A group of about 15 of us have become dissatisfied with CB and are about to embark on the RAE, we found that *Amateur Radio* (first two issues) gave us much valuable information about basics of radio.

Do please keep the magazine broad based and be experimental with features. I liked the Falklands story. There are lots of other articles we would find useful – frequency allocations, callsign allocations, peripheral communication developments, the appalling cartel that seems to exist – but then I suppose you'd lose all your advertisers. Anyway, I wish you success.

Paul Dicken, Cobham, Surrey

I read with interest volume two of *Amateur Radio*, and in particular the article on short wave listening.

Could you tell me if the computer pictured, was a separate microcomputer, or the TRS80 that was used to decode CW and RTTY signals. If it was the TRS80, would it be possible for you to publish details of any software or hardware used?

D. F. Smith G6HPD 70 Suffield Road, High Wycombe, Bucks HPH2JL

Yes, it was the TRS80, and the experimental programme was written by the owner - Ed

Some years ago I saw a wavelength and frequency chart given away with a magazine. But now I can't obtain one. I would appreciate any information about this elusive chart.

C. Gaven, 7 St. Lawrence, Haddington, East Lothian, Scotland.

Again, can anybody help? - Ed

I have now obtained a copy of your *Amateur Radio*. But it was incredibly difficult to find it among the newsagents in Liverpool. Are you a monthly magazine? And if so, how can I get copies?

E. Rottgardt, Merseyside.

If any readers have difficulty getting hold of* Amateur Radio. *moan at the newsagents, but if you still have no success, write to us and we'll pass the information on to our distributors. Back copies are available however . . .* Amateur Radio *was designed as a quarterly magazine, but as from March 1983 we go monthly. Subscriptions are now being accepted! - Ed

I consider *Amateur Radio* magazine to be a worthwhile contribution to amateur radio, and I hope it will stay on the lines of the first two issues – not too highly technical. You have reviewed books and magazines very accurately in

ters · Letters · Letter

your first issue . . .

As a suggestion for a future article, may I suggest one on tests – necessary to keep within the regulations of the amateur licence, and which are supposed to be carried out from time to time and logged. I am well aware that various books and sections on test equipment, but more often than not it comes out as a highly technical, mathematical and jargoned article which leaves one scratching one's head in bewilderment for very amateur like me!

I am an old age pensioner who has taken up amateur radio as a retirement hobby – I'm not very practically minded, and merely wish to chat round the world and keep within the regulations. There are a lot like me nowadays!

William J. Morey, G6AEM
South Humberside.

Thanks for the suggestions. - Ed

I would like to suggest a club column in your magazine. This would be of great use to newcomers to the hobby who might not know of the existence of a local club.

I enclose a list of club happenings, in the hope that you can publish them. We meet at The Control Tower, Bearley Radio Station, Bearley, nr. Stratford, and we are the Stratford upon Avon & District Amateur Radio Club. Meetings start at 7.30pm on the second and fourth Mondays of the month.

December 13 Probably cw meeting. January 10 Construction evening. January 24 Visit to BBC Pebble Mill. February 10 Intro to 10Ghz microwave equipment, by Glen Ross G8MWR. February 28 Junk sale. March 14 Review of members' equipment. March 28 AGM and cine film. April 14 Quiz on the RAE. April 25 Setting up a station. May 9 Home construction techniques, by Vic Peake G4GEP. May 23 Crime prevention/insurance for the radio amateur. June 13 Test your rig evening. Sophisticated test equipment available. June 20 Making use of Oscar, by Glen Ross.

More information from the club's PRO (me).

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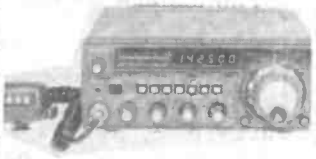

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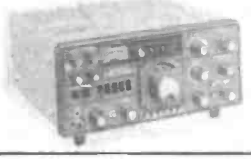

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Current comment

Planning for a bright and busy future

Well folks, largely because of the nice things you've said to us and the amazing response to our questionnaire, we've decided we must be doing something right and we're going to go monthly with this here magazine! We're very aware that there's a gap in the nature of the publications available to the UK radio amateur and we're going to do our level best to fill it, but to do it well we'll need your help.

We need you to tell us what you want to see and what you couldn't care less about, and we promise to listen and do what we can. We aim to make this magazine something that really does things for amateurs and caters for their needs, unlike some of the competition who seem hell-bent on selling magazines no matter how they do it and what garbage they print – so that's our intention. Obviously we need to sell magazines to stay in business, but we intend to have a lot of fun while we're at it and to report on what's what in the amateur radio world from a perspective of being part of it – and committed to it.

Plans are already formulating in our minds for the future, but as we've said it's your magazine as much as ours and it's down to you to praise us if we print the right things and kick us if we get boring. Short of running up against the law of the land, we aim to print the truth as we see it and we're quite prepared to be told we've got it wrong if we have – being human beings we expect to make the occasional blunder, but not because we're trying to mislead and tell half the story if we can help it.

We're hoping to get the best people to write for us too, as you'll see from this issue. The name of Angus McKenzie, G30SS, is known to practically every amateur and hi-fi buff, and we count ourselves lucky to have an in-depth review of a couple of current radios from him in this issue. Likewise, the Reverend George Dobbs is well known to readers of other magazines and from his work as chairman of the G-QRP Club, and he's written one of his delightful articles especially for this issue. So out with the soldering irons, and get stuck in! (didn't mean to be chauvinistic, especially since we see from the questionnaire that we've a good few lady readers – we'll have to mind our manners and not get too rude . . .)

We're looking to have a good relationship with the amateur radio trade as well, although there are one or two things we'll be looking into in the course of the next few months. Obviously we value our advertisers – we need them, in fact, since we couldn't afford to produce a magazine without them – but inevitably there are likely to be times when we get up someone's nose. If we do, it'll be because we're trying to be fair to all parties, not because we want to start a fight.

Okay. Welcome to Issue 3 and it's nearly Christmas, isn't it? Let's hope that the snow hasn't piled up and stopped you getting into the shack, and let's also hope that S. Claus (call sign S4NTA/M) didn't bend all the elements on your beam when he lands on the roof, and that he'll bring you some goodies to get you on the air or keep you on. Me? I'm hoping for a 1296MHz transverter this year, although I don't know whether the message to Santa got through under all the QRM – there was one hell of a pile-up . . .

Seriously, all of us here at Bicester wish you a very happy Christmas and a prosperous New Year bung-full of all the rare DX you want and lots of bargains at the rallies. May your linear never blow up; may the pen with which you fill in your log never run out of ink and may the Home Office get round to sorting out some licences sharpish.

They still owe us two letters . . . if you're in for the RAE this year, we wish you the best of luck with it and we hope to work you when when you get your magic bit of paper.

Thanks for supporting us this year and encouraging us to go ahead – let's hope you become a regular next year!

73 de Chris Drake

There's been a lot happening in the world of amateur radio since the last issue, one way and another. First, though, a few words about the little questionnaire we printed in the last issue – yes, we know we shouldn't have printed it quite where we did since if you cut it out you neatly removed a couple of advertisments, and one of the comments was that people like to keep those for reference. Point taken, and if we do another one we'll print it over the page from this column which is no great loss to anyone. No, wait a minute, that can't be right?? Anyhow, we had a terrific response. A great many of you took the trouble to fill them in, and we've also had more than 100 letters since the last issue; as you can imagine we had a lot of fun reading them and trying to analyse what sort of a magazine you want.

Radio amateurs are an amazingly diverse lot if that questionnaire is anything to go by. You seem to do everything from flying gliders to potholing to archaeology and everything in between, and we were surprised and delighted to note that there's a wide range of ages that read *Amateur Radio*. As far as wireless goes, you're interested in every single aspect of it, right the way from the most basic things of how radio and electronics works to the real state-of-the-art stuff, and you all want to read articles covering your basic interests. Fair enough – we'll do our very best to keep you all interested and get a good mix of basic and advanced stuff.

One interesting thing was that some of you *didn't* want to see pages of who had worked what and when; you say that other magazines did that and it wasn't worth us wasting the space when we could use it for other things. Rightyho – it looks as though, unless we get howls of protest from the rest you'll have to read *RadCom* or *Short Wave Magazine* to get hold of that. Another thing which has emerged is that you'd like to see brief info about what radio clubs are doing. Which is fine by us. It's your magazine, and if you want club news we'll carry it. On that note, a few clubs have sent us details of what they're up to. Good show, keep the info coming – we'll print as much as we have space for.

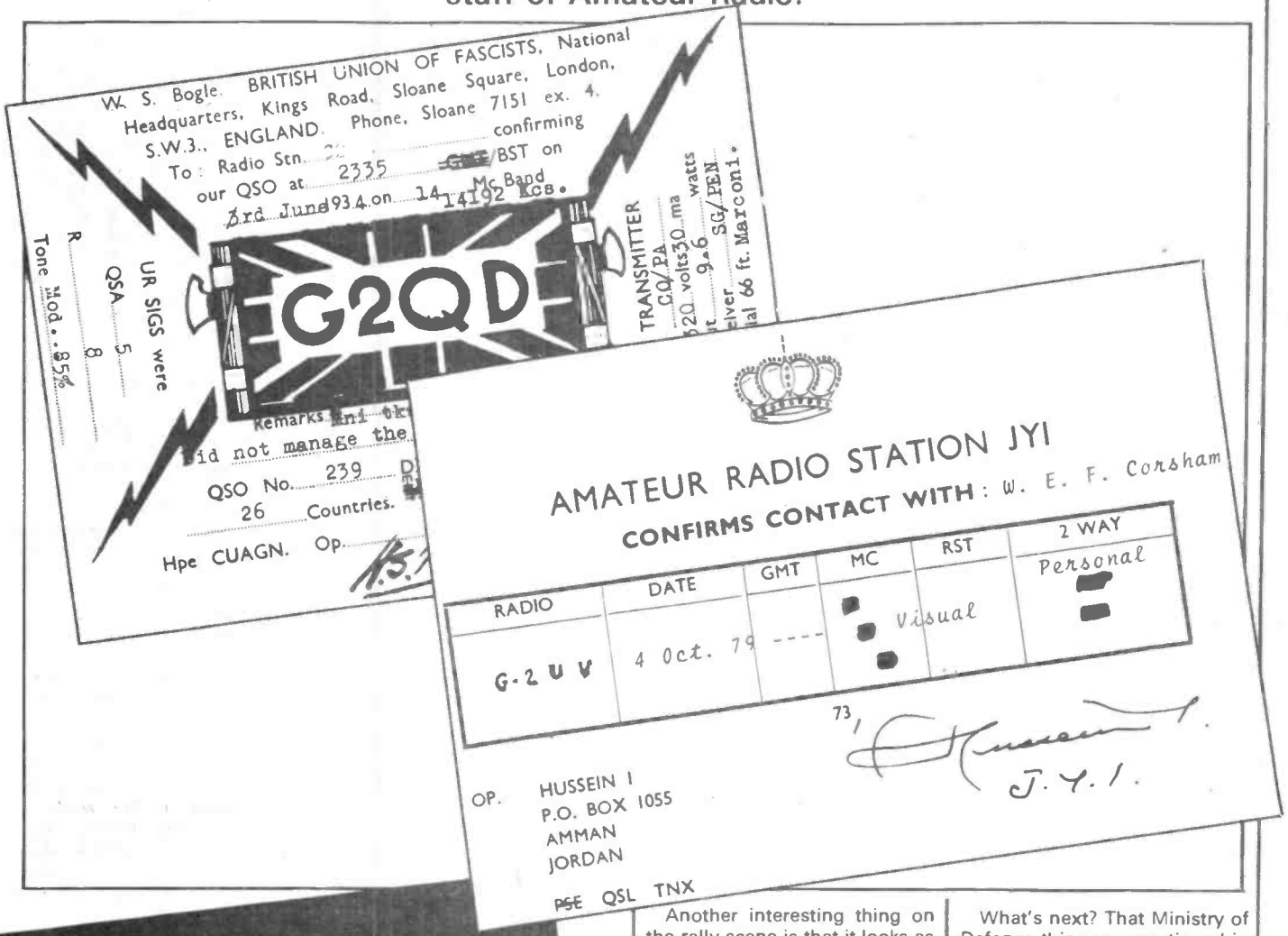
We haven't finished a close analysis of the questionnaire forms and all your letters yet, and actually we must hang our head in shame and admit that we haven't got round to answering all your letters yet because there were so many of them. We hope to incorporate some of your ideas in the next issue, and in the meantime we'd like to say a big thanks to all who completed the form and to say that we'll be doing our best to give you all what you want.

So, what's been happening in the world of wireless itself? There was the Leicester exhibition, which was thought a bit dire by many of the dealers – the Granby Halls were never the most salubrious venue for rallies anyway, but this year some things were really boring. The refreshments(?), for one. There's always a nice atmosphere at Leicester, we must admit, but one way and another we wouldn't be surprised if this years' Leicester show was the last if some remarks from dealers were anything to go by. There's inevitably a lot of politics involved, and we must admit that there are some very odd things in the world of amateur radio dealers; we'd dearly love to find out how come the price of rigs is the same (to the nearest penny) from four quite separate dealers. If you mentioned the word "discount" to one dealer in particular at the Leicester show, you'd have thought you'd just said a Rude Word to the Archbishop of Canterbury to judge from the response.

We've been in the publishing industry a very long time, particularly in things like motor cars and consumer electronics, and we must say that some elements of the way amateur radio equipment is priced make us think of words like "cartel" and "price fixing". If we did a story on prices of amateur radio gear, what's the betting we'd lose rather a lot of our advertising? Watch this space. . . .

ON THE STRAIGHT AND LEVEL

News and views from the world of the radio amateur, compiled by the staff of Amateur Radio.



The two extremely rare QSL cards above are a small number of a collection held by John D. Heys, G3BDQ, of Sussex. They are from King Hussein of Jordan (JY1) dated October 4th 1979; from W. S. Bogle, of the British Union of Fascists national HQ in London (dated June 3rd 1934).

John Heys will be writing about QSLing in the next issue of *Amateur Radio* – it's a fascinating subject, and many cards are now valuable collector's items. More examples and much you'll want to know in the next issue!

Another interesting thing on the rally scene is that it looks as though we've had the last Ally Pally. The RSGB's exhibition next year is taking place in early March at the National Exhibition Centre in Birmingham instead of at Alexandra Palace (where they've been for about the last century) and we feel this is a good thing. From what we know about the costs of the Pavilion at Alexandra Palace, the RSGB must have been lucky to break even on last year's exhibition, whereas most of the traders thought it was expensive to be there! The RSGB are apparently having two sections of the NEC, one for an American style "flea-market", although we haven't had any firm details yet.

What's next? That Ministry of Defence thing we mentioned in the last issue was more interesting for what some other magazines made of it than for much in the way of intrinsic news value; poor old *Practically Witless* got it screwed up in a big way, hinting darkly that we were about to lose all the 432MHz band and coming over all hysterical about the Phase 6 repeaters. Our sources, which we think are impeccable, tell us that Phase 6 will get the go-ahead any time now and that the loss of 431-432MHz was absolutely nothing to do with the MoD system. We're beginning to think that *Practically Witless* is taking an anti-RSGB stance simply to sell some magazines and making out

ON THE STRAIGHT AND LEVEL

that all these nefarious things happen because the RSGB isn't doing its job properly, which, as far as we can see, isn't true. *PW* made something like a dozen errors of fact in the October issue, and followed it up with an anti-RSGB leader in the November issue which was a classic case of what my very first editor in Fleet Street called "not confusing a good story with facts". We don't envy the RSGB in many ways because whatever they do won't go down well with everybody and this 50MHz business is a good case in point. You'd need the judgment of Solomon to pick 40 people without getting kicked by 400 others, and our feeling is that unless the national society gets support from all and sundry it can't hope to do a good job.

OK, so there are heaps of things we could criticise about the RSGB if we put our minds to it. However, we also know that they're trying very hard to do their best with the resources they have and we think they do a pretty good job for much of the time. If we feel it's necessary we wouldn't hesitate to put the boot in – but we do know what it's like trying to run that sort of organisation and cater for 32,000 members who all want different things yesterday.

In case you didn't know, they've just moved to a new headquarters in Potters Bar – having been to Doughty Street ourselves recently, it strikes us as the best thing they could have done. We haven't been to the new building yet, but if the staff have proper offices to work in and there's a bit more space to store books it has to be about a million per cent better than the last place. Good luck to them in their new HQ, and let's hope that some of the things they haven't been able to do very well will change for the better when they've got themselves together. The new phone number for them, we gather, is Potters Bar 59015.

As we said last time, we now have 18 and 24MHz also, subject to the restrictions we've mentioned elsewhere. These look like being very interesting. As mentioned elsewhere, we were trying to suss out exactly who was on them in time for this issue but being miserable wretches who spend too much time in the pub and on the wireless, we haven't. Don't worry – we will for next time, honest!!

One of the lovely ladies in the office just popped in and gave me a few more points from our questionnaire. One of them is on the subject of our style. The vast majority of you like it because it's chatty and informative, although five of you (who all prefer to remain anonymous – well, you don't have a hope of winning the prize, then . . .) took us to task for not writing in a more serious and sober vein. Our feeling on this is that such majestic publications as *Radio Communication* and *Wireless World* are what you read if you want the weighty stuff and if you happen to have at least a B.Sc in electronic engineering – here at Swinging Bicester we work on the assumption that most radio amateurs are ordinary citizens who have come into a complex subject as a hobby and who don't necessarily want to have to wade through several pages and sprain their brain after a hard day's work or a painful day's redundancy. In other words, you don't want to work at it and you don't mind the odd laugh or two. Fair enough – we'll continue to write for human beings unless you all tell us you want us to write as though we were the Proceedings of the Institution of Electrical Engineers. Nothing at all against the IEE, you understand, they're a great body of people, but you know what we mean. . . .

What else? The Americans have now got the 10MHz band as of 28 October – well, 10.100 to 10.109 and 10.115 to the top of the band at any rate. Like ourselves, they have it on a secondary, non-interference basis, although they can run rather more power than we can. Our very first Stateside contact was W5CRR/9 on the 1st of November and he told us that the power limit is 250 watts for CW and RTTY, which are the only modes they're allowed: he was a good 569 on our 10 MHz dipole running an IC740. We were trying out an FT102 at the time, which is a new variant of the FT101 – our initial impression was that it wasn't a very easy wireless to get the best out of but we'll give a proper analysis of it in this issue. The Americans' appearance has certainly livened up 10MHz after about 2300, and given a bit of life to what was becoming something of a quiet band.

SWL · SWL · SWL · SWL · SWL · SWL · SW

The short wave listener's wide world. By the Editor

For this issue we thought we'd have a column especially for the shortwave listener and what we thought we would do is throw it open for any queries or comments that you might have on anything to do with SWLing.

If you've any technical questions we'll have a go at answering them and maybe enlighten others of the faith who are a bit baffled about something or other. Many other magazines run huge columns of who has heard what, and we seriously wonder how many SWLs are really interested in these things; we get the impression that many of you aren't all that bothered, so let us know what you want and we'll see what we can do. so – from here on in, this is your page if you're an SWL.

One thing that's cropped up on the phone a few times is the matter of preamps for elderly receivers. It's a fact that many of the older generation of valve machines tend to get a bit deaf when you get higher up than about 15MHz, and some of them are prone to other assorted ills such as image problems and a rather high tuning rate. One good way round this is to build something called a converter, which takes in signals on one frequency, or frequency band, and converts them to a lower band where your receiver probably works better.

Another good wheeze is to make a little preamplifier – this can be battery-powered and go inside the set if there's room. It needn't have lots of gain – just enough to override the front-end noise in the receiver – and it can bring new sparkle to a receiver that seems a bit tired of life above 15MHz or so.

Elsewhere in this issue there's a superb article of the AR88 by someone who knows it inside out. The AR88 is a really classic receiver of the old school, and we'd recommend any listener who doesn't have a bottomless pocket to investigate the availability of one. Equally, there's the Racal series, if your table can stand the weight, and almost any of the early Collins receivers are well worth having is you can find one at a reasonable price.

Another handy unit to have around if you're a listener is some form of antenna tuning unit. The idea here is to match the impedance of the antenna – which in many cases is a length of wire down the garden – to the input impedance of the receiver, and it does this by means of inductors and capacitors. We've discussed a little of how these work in our article "AC Circuits" in this issue, and we'll be investigating them further in the next few months. The thing is that the impedance of any antenna depends on all sorts of factors, and the main ones as far as the SWL is concerned are the length of the antenna and the frequency you're listening on.

Since any "mismatch" between antenna and receiver will involve a loss of signal strength (do you remember the bit in our last issue about the conditions for optimum power transfer in an AC circuit? No? Ah well, dig it out of the bin and take a look) it isn't a bad idea to buy or build a little matching unit. Many firms make them, or if you read any of the standard textbooks you'll find a circuit made of a couple of variable capacitors and an inductor or two which will do nicely.

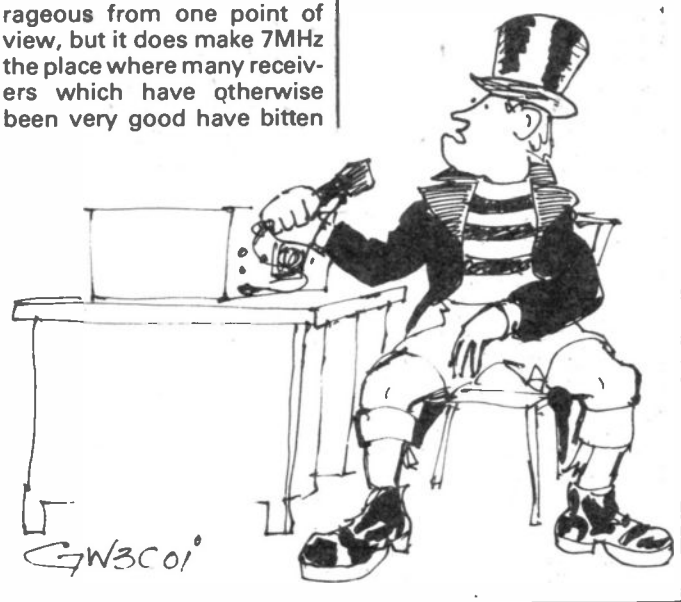
What else? Conditions on the short wave bands have been very up-and-down of late, and it looks as though we're now well into the decline of the solar cycle from its peak of a year or two ago. In general terms, this means that the higher frequency bands aren't going to work as well as they have been for the next few years – the CB DX fraternity are going to be a bit cheesed off, for instance, since 27MHz just isn't going to propagate very far since there won't be enough solar activity to cause the band to open up and CB stands a better chance of being used for what it was always supposed to be in the first place.

The 21MHz band has produced some nice openings all over the world in the last few weeks as winter conditions get well and truly established, but this band by about next April won't be a patch on what it is at the same time last year. As always it'll be 14MHz that carries the majority of amateur traffic round the world for practically the entire 24 hours – at least for a while.

We must confess that we're very fond of 7MHz here in the office, not least because it presents severe tests for all the various receivers that come in and out of the place and it's always fascinating to put two different receivers side-by-side on this band and compare them. As we mentioned last month, the thing with 7MHz is that there are several broadcasting stations in it, or on it, none of whom have the slightest right to be there – so until someone stages a coup in Albania (no kidding – Radio Tirana is the worst offender in this band, and to add insult to injury the Albanians don't seem to know how to make a stable transmitter. If my amateur station wandered about in frequency as much as Radio Tirana does, I'd turn in my licence) we're stuck with a situation whereby the weak amateur signals are in competition with the mighty broadcasters. This is outrageous from one point of view, but it does make 7MHz the place where many receivers which have otherwise been very good have bitten the dust in a big way. You need a good front-end to make much of 7MHz after dark, and it's also an excellent place to learn the skills of driving a receiver properly and getting the best out of it in the presence of nasty great signals, jammers and all the rest of it.

Talking about jammers, does anyone have the *real* explanation for those perennial lists of numbers read out in a heavy continental accent for hours and hours in various parts of the band? We've heard several in our time, and the most common one seems to be that they're coded messages from the Eastern Bloc to its "agents" somewhere or other. We'd have thought ourselves that there were better ways of doing it, such as high-speed Morse or data of some kind, and if I were a secret agent I think I'd go to sleep waiting for my number to come up, as it were – but does anyone know the real truth? Come on, own up! Can it be the various English and Continental radio magazines telling each other what their circulation is? Or isn't?

Anyway, that's it for now. Remember, this is *your* page, so any queries or problems, let's have 'em and we'll try and make this a really good section for the SWL.



WORK THE STATES FOR UNDER £20. . . £10 . . . OR EVEN £5!

Beginning our regular series of home-brew projects, the Rev. George Dobbs G3RJV constructs a miniature crystal-controlled transmitter that can work the Americas

One of the opening clauses in my amateur radio licence now amazingly, at least to me, twenty years old, tells me that it was issued for ". . . the self training of the licensee in communications . . .". How that "self training" seems to have changed in twenty years!

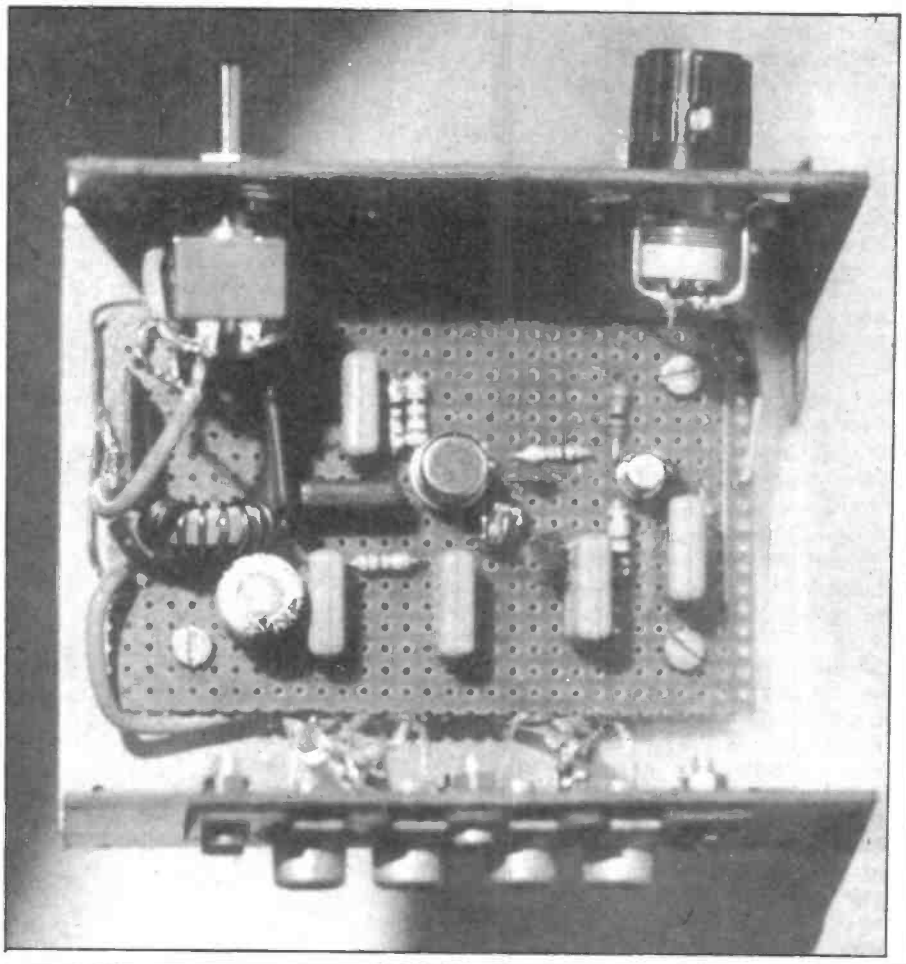
I recall when radio amateurs were known for their skill in operating, their skill in building their own equipment or their skill in modifying surplus equipment. But now it seems as if the only skill required is convincing one's wife that £500 is a reasonable amount to spend on a transceiver. Yet it would be untrue to say that we have degenerated to mere "equipment users", for in recent years a whole new generation of home constructors has appeared on the amateur radio scene. Quite a few of them build very sophisticated equipment but many are happily building and using inexpensive simple equipment. Most of these are QRP operators.

What are QRP operators? QRP is the Morse Q code for "reduce power" and so operators who use low power equipment are said to be QRP. This can mean *really* low power levels. Five watts is common and many use one or two watts and even fractions of a watt on the amateur bands. Daft? Well, not really, as the actual power used in transmitting a radio signal is less of a factor than many seem to think. Taking the common radio amateur RST reporting code, the S point scale of one to nine for signal strength takes a six dB change as equal to one S point change. A power/dB chart soon shows that six dB is equal to a power change of FOUR TIMES. All very technical you might say. What it really adds up to is that a station needs (in theory) to increase its power four times to gain one point on the S point scale. Worth thinking about when you are considering paying a bit more for Grey Box A because it runs 25 watts and the cheaper Grey Box B runs 10 watts . . . no one will probably notice the difference!

QRP operation has the advantage that it is possible to build equipment without having to resort to expensive components or special techniques. Simple and surprisingly effective transmitters and transceivers can be built by the average radio amateur using ordinary hand tools in his own home. This has been an attraction for those who want to reject the concept of radio amateurs as "box users", not to mention those who just cannot afford the prices of commercial equipment. So, if you are fed up with the twinkling lights, the dancing LEDs and the digital readouts on your Japanese Grey Box or perhaps you cannot afford one, then have a go at this simple little project. But be warned! It is addictive. Begin making contacts with the little transmitter described in this article and you may become so amused and enthralled that your commercial equipment could lie gathering dust at the back of the bench. The cost will be well under £20. In fact if you cannot build it for £10 or less, you should be ashamed of yourself!

The circuit diagram for the OX is shown in Fig. 1. It is a two-stage crystal-controlled transmitter with a third transistor acting as a keying switch. Usually equipment for the HF bands is VFO (Variable Frequency Oscillator) controlled and the operator can move around the band at will. Although it may appear restrictive to be crystal controlled, this is less of a problem than many imagine. This circuit is VXO (Variable Crystal Oscillator) controlled. The variable capacitor, C1, in series with the crystal, X, allows the frequency agility. The prototype OX had a tuning range, using C1, of some 10KHz which is quite a useful amount of shift.

Another imagined problem is that crystals for the amateur bands are impossible, or at least very expensive, to obtain. A supplier for an ideal crystal for the OX is given at the end of this feature. Our circuit even includes a cheap way out for the variable



G3RJV's little masterpiece, the OX. Dead easy to build and works like a charm!

capacitor, C1, which could be an expensive item.

The BC107 transistor is a crystal oscillator, controlled by X and C1, with C2 providing the feedback path to maintain oscillation. This is fed into a very simple PA (Power Amplifier) stage which uses the inexpensive 2N3866 transistor. Because the BC107 is both DC and RF coupled to the 2N3866 oscillation will not occur without both transistor stages being built. So the common, and wise, practice of building the circuit a stage at a time and then testing each stage cannot apply here. Both stages have to be completed before the circuit will work. The emitter resistor R5 controls how much current is drawn by the 2N3866. If the resistance of R5 is too low the PA can draw too much current so R5 may need individual adjustment. But more of that later. A homemade Radio Frequency Choke (RFC) provides the collector load for the PA and the output is coupled through C7 into a basic low pass filter made up of C8, L1 and C9.

A better-sounding Morse signal

The circuit is so simple that the third transistor, a 2N3906 PNP type, might even be thought a luxury. It acts as a keying transistor to switch the PA on and off in time with the Morse key. It is added mainly because of the 12 volt power line to the PA is keyed and it enables one side of the Morse key to be connected to the ground (minus 12 volts) of the circuit which is common practice. The circuit could be simplified by leaving out this stage and keying the 12 volt line directly by inserting the key in the position occupied in Fig. 1. by the emitter and collector of the 2N3906. However this stage also provides a little shaping to the keying switch action in that C10, R6 and C11 smooth down the sharp on-off action and produced a better-sounding Morse signal. If a solid state 'bug-key' is used this may have a transistor output in which case the switching stage must be used. The circuitry is so simple it is hardly worth leaving it out anyway!

The OX is built on Veroboard, a common construction method for simple circuits. This is a commercial circuit board with a matrix of holes (0.1" spacing in this case) and a pattern of copper strips. These strips can be broken or bridged to obtain the correct circuit interconnections on the underside of the board. Veroboard is easy to use if a little care is exercised. It requires the use of a soldering iron with a small tip; a common fault is blobs of solder bridging the tracks. The copper tracks should be cleaned prior to soldering with fine abrasive paper. Because the holes are all one size and some leads may be slack the solder joints must be made with care. Push the tip of the soldering

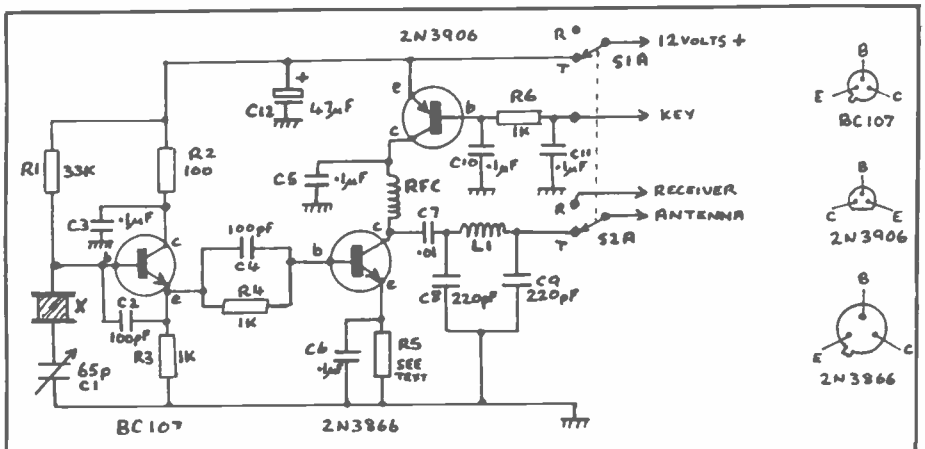


Fig. 1. CIRCUIT DIAGRAM

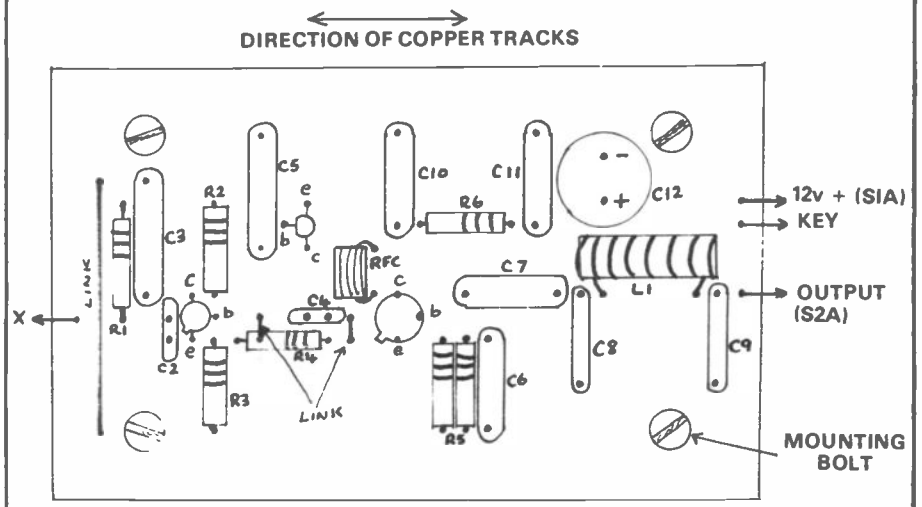
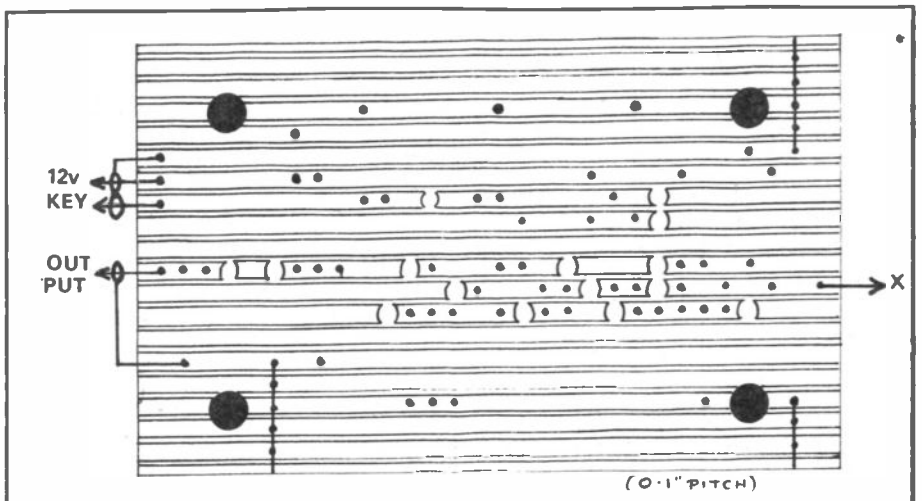


Fig. 2. COMPONENT LAYOUT (TOP SIDE)



VEROBOARD LAYOUT (TRACK SIDE)

= BREAK IN TRACK

= SOLDER CONNECTION

= COPPER LINK WIRE ACROSS TRACKS

iron bit into the corner of the track and the wire and touch the opposite side of the wire/track junction with the solder so it is melted by the wire, not directly by the iron. The solder should flow smoothly to make a small joint – but check for bridges between adjacent tracks.

The layout for the components on top of the board is shown in Fig.2. It is best to solder all the components in place before the breaks in the track are made on the underside. There are three link wires to be added to the top of the board in thin copper wire. The types of component required are given in the component list. The capacitors C2, C4, C8, C9 and C12 really need to be as listed to fit the board but almost any suitable types could be used for the rest including cheap disc ceramics. The RF choke is made by winding seven turns of 32 swg enamelled copper wire through a ferrite bead. This must be done with some care as the edges of the hole can scratch the enamelling off the wire and cause shorted turns. R5 may require adjustment for individual PA transistors but several QX circuits have been tried using two 39ohm resistors in parallel for R5. This should work in most cases but the cautious could try to arrange that R5 allows the PA to draw around 85mA. This can be checked by inserting a meter between RFC and the collector of the switching transistor.

The coil, L1 in the low pass filter is very easy to wind. The former is an Amidon T-50-6 toroid core. This looks like a grey Polo mint with some yellow paint on one side – a stockist is listed later on. The coil requires 14 turns of 22swg enamelled copper wire. Each time the wire passes through the hole counts as one turn. The winding should occupy about two thirds of the circumference of the former.

How about a spot face cutter?

When the components have been soldered into place the breaks in the copper track can be made. There are special tools, spot face cutters, for this job but a 3mm drill used with the hand works well with some care. This pattern for removing the copper track to make the breaks is shown in Fig.3. This diagram also shows that a number of shorting links are added on the copper side of the board. Take care to ensure that only the correct breaks are made and that the cutting does not damage adjacent tracks.

The circuit board is now complete – simple wasn't it? The crystal X is mounted in an HC25U crystal holder on the front panel close to the VXO

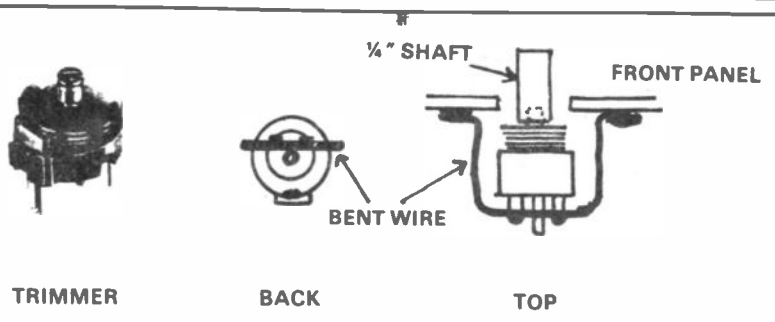


Fig. 4. MAKING VXO CONTROL (CI)

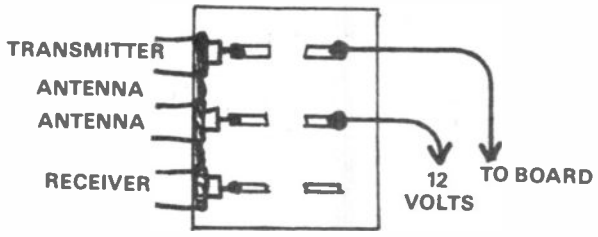


Fig. 5. SWITCH WIRING

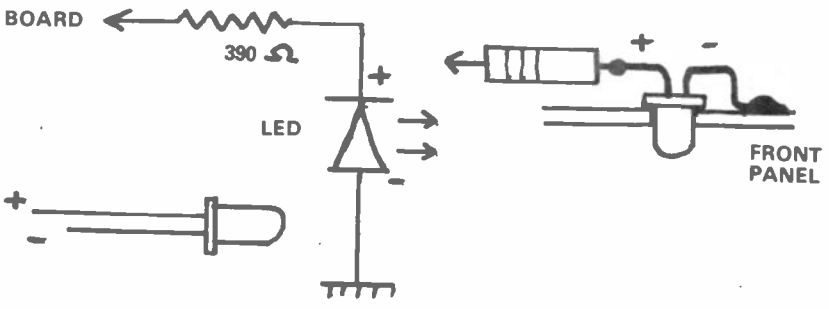


Fig. 6. ADDING AN LED

control C1. It would be possible to use a proper airspace variable capacitor for C1 but these can be very expensive. The prototype used a control fabricated from a semi-airspaced trimmer. The method for doing this is shown in Fig.4. These trimmers have a small shaft which accepts screwdriver control and this is converted into a knob control by adding a ¼" shaft. A piece of ¼" shaft, abut half an inch long, can be culled from a spare potentiometer or wafer switch which usually come complete with a very long shaft.

One end of this is counter-bored to be a tight fit onto the trimmer screwdriver control point and can be secured with Superglue or Araldite. Two of the contacts on the trimmer are close together and these are used, in conjunction with a U-shaped piece of bent stiff copper wire (about 18 gauge), to secure the trimmer to the front of the case and also provide the grounding connection. This is shown in Fig. 4. The third contact provides the connection which goes to X.

The switch, S1 (A and B) provides the circuit change-over functions from transmit to receive and the wiring diagram is shown in Fig.5. Screened lead is required for the inter-connections between the transmitter, receiver and antenna. Small bore coax cable, such as RG174, is ideal although screened microphone lead cable will do for these short runs of cable. The transmitter, antenna and receiver cables must have their screen leads joined as shown. S1A ensures the oscillator is switched off during receive so that the note does not interfere with the received signals. A miniature toggle switch was used but a large one could be just as good. Take care to check which way across the contacts the switching action occurs.

The prototype QX had a little LED added as a refinement. It serves little purpose except to enhance the front of the transmitter. I connected it into the keyed line so that it came on as the transmitter was keyed – neat eh? For this action the circuit for the LED, shown in Fig.6, is connected to the collector output line from the switching transistor. That is the junction of C5 and RFC. The LED could just indicate when the QX is switched to transmit in which

case it is added to the main 12 volt line from S1A. That is the emitter end of the 2N3906. A series resistor controls the current drawn by the LED. I used a miniature red LED which looked cute in operation. Watch out Yaesu Musen!

The whole transmitter was housed on a home-made base panel with front and back plates as shown. These were made from double-sided printed circuit board offcuts. This is quite an easy material to work, especially the fibre glass type. The front and back panels, after being drilled, were seam-soldered to the base plate. The layout for these panels is illustrated. The circuit board is joined to the base plate with small nuts and bolts (6BA) but standoffs must be used to raise the board above the copper of the base plate. Mounting the VXO control and the LED is simple as they are soldered onto the inside of the front panel as shown in Fig.4 and Fig.6.

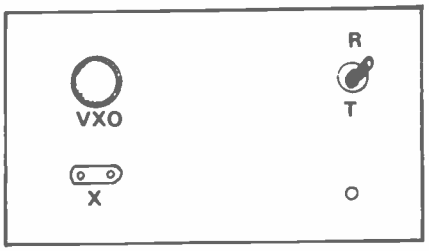
Four sockets are required for the antenna, receiver, key and 12-volt supply. These can be any type of connecting socket available or in common use in the station. I used the inexpensive phono sockets as these are standard in my shack. It may seem a little risky using the same termination for everything including the power input line but they can be clearly labelled.

Making it look pretty

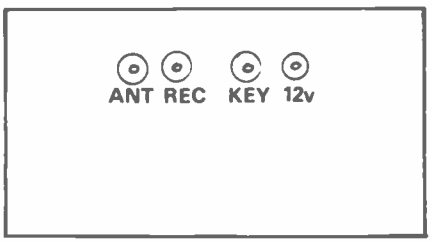
To make the casing look attractive I cleaned the front panel (controls removed) with household scouring powder. Labels were then added using Letraset rub-down letters. A good final finish can be added to the front panel by adding a layer of clear sticky back plastic film of the sort sold to cover books.

The transmitter is now built, but before switching it on for the first time, make a number of careful checks. Check out the wiring against the layout drawings and the circuit diagram. Look for poor joints or bridges between the Veroboard tracks. Simple little PA stages do not like to be used without a proper load so the transmitter should not be keyed or tested without connections to the output. If bench testing is to be attempted connect a couple of 100ohm resistors in parallel across the transmitter output first. The oscillator can be checked by listening for it on a receiver. If no low power wattmeter or SWR bridge (terminate it with a dummy load) is available try a low wattage bulb across the output to check for RF.

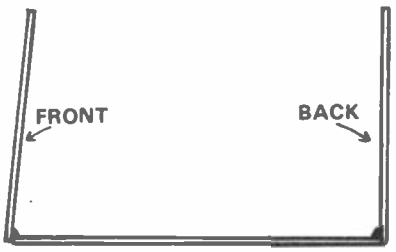
This little circuit is a real 'goer' so if yours does not work I suggest you check the wiring again. The supply is a



FRONT PANEL



BACK PANEL



SIDE VIEW

nominal 12 volts DC, which can come from batteries or from a 12-volt bench supply. The current demand is so low, under 150mA, that almost any well smoothed 12-volt source would serve as a supply. The OX is designed for a 50ohm terminaton, common in amateur radio equipment. So it can feed into any antenna (such as a dipole) with this characteristic impedance. If a long wire or other odd impedance antenna is used then an ATU (Antenna Tunning Unit) will be required to match the transmitter.

There are certain techniques for QRP operation. Because the power is low it requires just that extra bit of skill and cunning. Avoid calling CQ but try calling stations who are making CQ calls. Try tail ending, that is listening to the end of an existing QSO and jumping in with a quick call for one of the stations. Check which stations are calling G stations; if they are getting good reports, then the QRP signal is in with a real chance. Most of all just try it out, be bold, assume you will make lots of contacts and watch out for the praise from the other station when they know you are a low powered and homebuilt. Another tip is not to tell the station your power until after you have received a report – it makes quite a difference!

Many amateurs enjoy QRP operation and building simple equipment. Why not join their group? The G QRP Club specialises in low power operation and home construction and their journal *SPRAT* includes many circuit ideas. For details contact: **The G-QRP Club, c/o Rev. G.C. Dobbs, G3RJV, 17 Aspen Drive, Chelmsley Wood, Birmingham, B37 7QX.**

Component Stockists:
CRYSTAL (X): Miniature HC25U crystals with a frequency of 14.060MHz (the international QRP calling frequency) are available from P.R. Golledge Electronics, Merriott, Somerset, for £3.75 including VAT and postage (£3.00 for GQRP Club members)

TOROID COIL FORMERS: The T-50-6 former is available from TMP Electronic Supplies, Unit 17, Pinfold Land, Buckley, Clwyd, CH7 3PL (data and prices for sae).

COMPONENT LIST:

R1 33K
R2 100
R3 1K
R4 1K
R5 Two 39ohm in parellel
C1 Miniature foil trimmer, 5-60pF (see text)
C2, C4, C3 100pF miniature ceramic plate
C5, C6, C10, C11 0.1uF ceramic or polycarbonate
C7 0.01uF ceramic or polycarbonate
C8, C9 220pF silver mica
C12 47uF. 25v electrolytic. PCB mounting.
S1 (A and B) Double pole, change over miniature toggle switch
RFC See text
L1 14 turns 22 swg on T-50-6 (see text)
X 14MHz band fundamental crystal HC325U Crystal Holder, Veroboard 0.1" pitch (3" + 2.8")
Suitable sockets and hardware.

YAESU FT102 vs. ICOM IC740

In the first of a series of important major test reports; Angus McKenzie MBE, C.Eng., FIERE, G30SS, compares two of the most popular transceivers available today.

The FT102 and IC740 have already established good reputations for themselves, despite the fact that they are both very recent rigs. Whereas the Yaesu FT102 is designed purely for mains operation, the Icom can be worked off 13V DC or mains, the latter being accommodated with an optional AC psu, which can be fitted internally, or an alternative psu can be used externally.

Two photographs show the front fascias from which it will be seen that the Yaesu is larger, measuring 38 × 38 × 14cms whereas the Icom is 29 × 37.5 × 12cms. the IC740 weighs 8kg (without internal mains psu) whilst the Yaesu is 15kg. The most important difference between the rigs is that the Yaesu uses valves for the transmitter output section, and runs much more power that the IC740, which is completely transistorised. The FT102 is not synthesised, whereas the IC740 can be tuned in 1kHz, 100Hz and 10Hz steps, also having an excellent memory facility and two separate VFOs.

Both rigs have digital frequency read out, and can transmit or recieve on all amateur bands (including the new ones), from 160m to 10m, although CB is excluded as normally supplied. Both can be supplied with optional FM or TX and RX, although the Yaesu optional board also accommodates AM. The IC740 was supplied with the normal mic, and with two additional ones, a hand mic type HM11 which has up and down steps and search facilities, and an electret desk microphone with goose neck, type SM5, which only has a lock on ptt switch incorporated. The FT102 cannot be stepped up and down from the mic unless you also install an accessory FV102DM external VFO.

The following facilities are incorporated in both rigs: CW, USB, LSB, FM with option, tunable T notch filter, band pass tuning, switchable RF pream;p on rx, vox control, noise blanker with variable threshold level, switchable compressor with mic gain control (the FT102 also has a compressor gain control), metering selection (FT102 has two meters) rf gain control, tone control, squelch control (operating on FM (SSB/IC-740)), receiver and transmitter independent incremental tuning, optional additional filters for CW, facilities for operation with external transverters and linears, external alc input, phone patching in and out, external ptt, rf output power control, internal speaker, external speaker socket, spare phono socket for any required application, Morse key jack, SO239 antenna socket, headphone jack (1/4), and microphone input.

Above: the Icom HF tranceiver IC740 (left alongside the Yaesu HF all mode transceiver FT102. Both rigs look good and come with myriad facilities.

The IC740 has continuously variable rx agc from short to long, whereas the FT102 is just switchable between two speeds. The 102 has tx treble and bass controls acting in the audio circuits, and adjustments for cw sidetone pitch and level, these being underneath the rig. On the back panel are the vox anti-trip control and power output meter calibration. The band pass tuning control is split between a lever and knob which are friction locked, allowing independent adjustment of the bottom and top parts of the IF pass band. In addition to a 24.5dB tunable T notch facility, a separate knob can be switched to operate a peak sharp band pass for rejecting interference either side of a required CW transmission. Since the 102 has a valve PA driver, and three 6146 PA valves for the transmit power output stage, anode load and tuning controls are complemented by a preselector drive tuning and power variable drive control.

Those not used to tuning up valve PAs may find these awkward to set up initially, but would soon get used to them, as many amateurs have done over the last 50 years or so! A mains switch is complemented by a valve

heater switch, which turns off both driver and PA valve heaters, either if an external transverter is being used or the rig is being used for receive only. An optional filter switch is provided. A monitor switch turns on the loudspeaker with amplifier for checking microphones (also on IC740), but this will howl round if you leave it switched on! The mode switch has a tune position used for transmitter output tuning up, which should be done as rapidly as possible. Sockets on the rear include AF output for tape recorder, ptt line, two separate IF outputs (before and after the IF filter), phone patch input, accessory 1 and 2 multipin sockets, external receiver interconnection socket (multipin) and external VFO interface socket, transverter IF output, receiver input break points (also on IC740), but a shorting switch for internal linking is provided on FT102, and again an SO239 aerial socket for antenna connection. A large earthing wire wing nut and bolt is provided (spring loaded earth clamp on IC740).

FT102 subjective trials

Both rigs were used on the air on several bands with special attention paid to obtaining transmission quality reports, and receiver checks at various times of day to assess overall performance. The transmission quality of the FT102 was generally considered very good, and I suspect it would have been even better with an improved microphone to the rather cheapo hand mic supplied. No spreading was ever reported, and the response balance seemed ideal. The compressor was most effective in increasing readability in difficult conditions.

No drift was noted on transmit or receive after the rig had warmed up for a few minutes. The tuning knob was a pleasure to use, rotation being very smooth and fairly lit, whilst a finger hole allowed rotation (when a finger was pressed in it) without friction. The maximum loudspeaker amplifier output level seemed slightly limited when driving an external speaker, although the internal one was quite sensitive, and reproduced adequate volume before distortion came in.

The RF pre-amplifier, when switched in required the pre-selector to be peaked for optimum performance, and a large shift of frequency, particularly in LF bands, required re-peaking. Slight radio frequency intermodulation products and general mush were added underneath the received signals on 160, 80 and 40 when the pre-amp was selected, but one would not normally use the pre-amp on LF bands, so this is not a problem. No such hash, etc, was noted with pre-amp in on higher bands, the pre-amp noticeably improving input sensitivity. Even in the slow position of AGC, gain was recovered rather too rapidly (our pen chart tests of this showed between one and two secs recovery time for a 40dB signal reduction to come up to fill output level, though much of the gain recovery was within ½ second. This will mean that you will have to back off the RF gain control when you are receiving a strong SSB signal in which you want to relax back and listen to the full transmitted dynamic range.

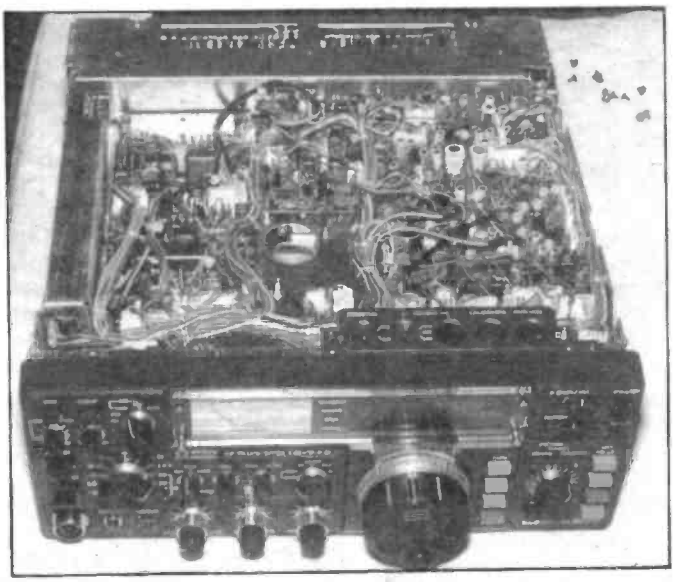
The AGC action would otherwise bring up shack noise much too quickly when the other operator stops talking for a moment. The pass band tuning facility was slightly confusing at first, but I got used to it quite quickly, although I preferred the IC740 here. The T-notch filter gave quite a good notch of annoying CW within an SSB pass band, whilst the CW peaking control was found to be superb. The meter switch selects HT volts, total PA current, power output, and compression, a separate meter indicating received signal strengths or transmitter ALC action. The S-meter, unfortunately as is usual with so many Japanese rigs, had very small dB increments at the low end, but larger increments towards the upper end, S9 to 9 + 20dB representing an RF level change from 23uV to 360uV, approx 24dB, with rf pre-amp in on 10m. The RF pre-amplifier gave 13dB gain, and so S9 without pre-amp

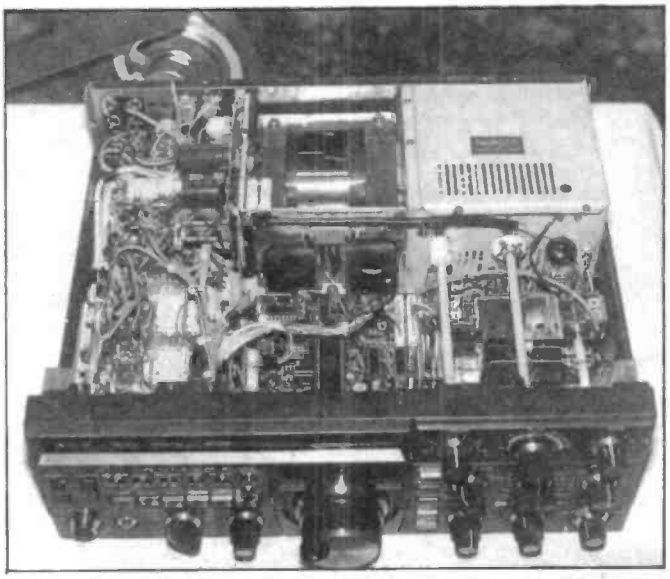
is at 100uV. S3 with RF pre-amp in was 2.4uV thus seven S units represent a change of only 20dB, which is a little ridiculous.

The incremental tuning was useful, allowing one to leave the transmitted frequency constant, whilst following other amateurs in a net who either cannot net properly, or whose rigs are continually drifting! Both the compressor level control and squelch levels were easy to set, The tuning knob rotates approximately 16kHz per revolution, and in tuning over the various bands with a 50ohm dummy load screwed on to the aerial terminal, I noticed weakish spurii at 28.0 and 500kHz points across the 10m band, with a few other spurii at between noise and an audible S3, although the meter did not read any of them above its SO indication, even with pre-amp on. Bands from 1.8 to 24MHz either had no spurii, or ones that could be totally ignored. The FM discriminator and filter were well optimised for 25kHz channel spacing, some interference being noted from 12.5kHz spacing transmissions though.

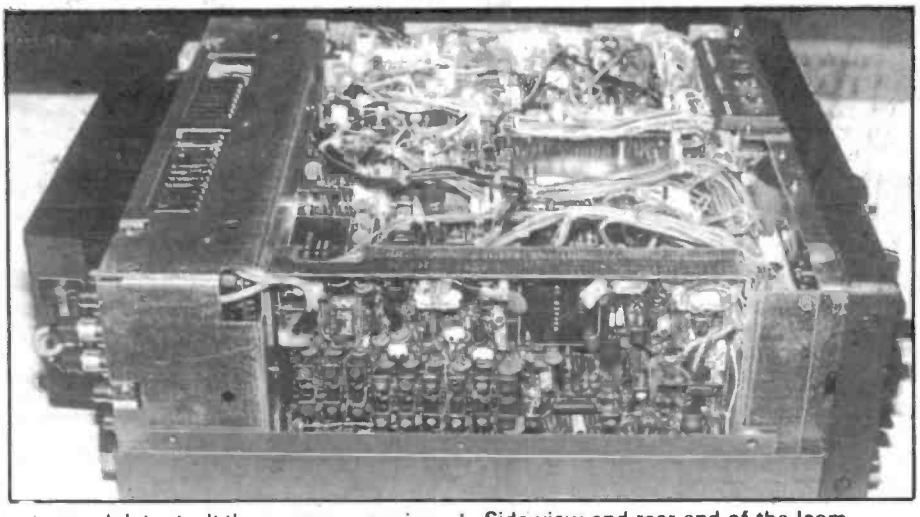
The receive selectivity was considered to be very sharp, and almost ideal, and the reciprocal mixing performance seemed good, extremely strong stations a little off channel only causing a problem it they themselves were spreading. The rfim performance was reasonably good (interference on the

Below left: With the top off, the IC740 looks complicated but isn't once you've sorted the separate sections and components. On the right is the FT102 with boxed-in sections and generally neater-looking layout.





YAESU FT 102 vs. ICOM IC740



Side view and rear end of the Icom IC740.

wanted channel being created within the set from two or more unwanted stations off channel). The sensitivity on 10m with RF pre-amp in was very good, but not outstanding. When used with transverter, and with RF pre-amp off, all received signals seemed reasonably clean, unless they were themselves grotty!

Overall impression of this rig was that I greatly preferred it to many of its predecessors, including the FT101 series, and that it can be recommended for fixed station use both for normal LF and HF band tx and rx, and for driving transverters. The transverter transmit output level though is ridiculously low at around 100mV rf into 50 ohms, so if you are using it with a Microwave Module transverter, you will have to specify maximum sensitivity to obtain a full 10w output from the transverter. MM can modify old transverters for this, or can supply new ones appropriately equipped, but the requirement must be specified special order. The accessory sockets give facilities for external linear or transverter switching, alc input, and many other important facilities. The transverter rf feed is attenuated internally with a series 560ohm resistor, and presumably one could obtain more transverter drive by reducing this value, but take care to avoid loading the 102 too much. The transverter feed is taken from a secondary coil of the driver valve's input transformer.

One local amateur who had purchased an FT102 with almost all mod cons also ordered a 4m transverter from Microwave Modules. At first he found he was hardly getting any output on 4m, but after Microwave Modules modified it he was able to get full output, but he then had a problem with distortion and spreading.

After lengthy trials, in the middle of the night with me, we realised that when the heaters were turned off, there was no ALC action on the transverter drive socket and so the position of the microphone gain control was extremely critical, and only slightly raising his voice flat topping occurred on the drive. When he switched on the heaters, and tuned up the rig on 10m, driving an external dummy load, the resultant ALC action dramatically improved quality on 4m and allowed the MM transverter gain presets to be adjusted just right so that his signal did not spread even when he shouted into the mike from a reasonable distance.

Distortion came up if he spoke close to the mike as would be expected from our own lab tests. It thus seems very important that any external transverters or linears after them should have a modification to give an ALC voltage pre-settable which could drive back to the rig acting as an exciter. The RF power control does not affect the FT102's PA output on SSB when no compression is used, but comes into play when the compressor is switched on, or on CW and FM. It seems very probable that many complaints of spreading on VHF, when transverters are in use, are due to the lack of ALC in the system and so those portables on field days should watch out for this.

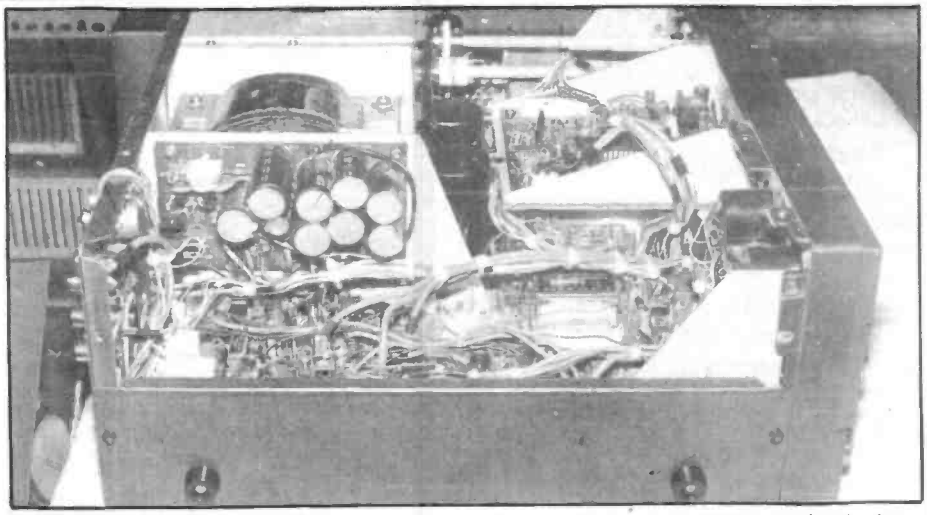
FT102 laboratory tests

The rf input sensitivity measured very well on all bands with the rf pre-amp in, with pre-amp out it fell quite appreciably by an average of around 12dB. The rfim performance, checked with two carriers at +20 and 40kHz respectively, was only fair with RF pre-amp in, but good with pre-amp out, thus confirming the subjective tests. The equivalent to a 12dB sinad input spurius was developed with the two carriers each at 2mV, whilst raising the 1m product level by 28dB approximately, required just over a 9dB increase in the input carrier levels, which is about what one should expect. The rfim intercept point was not directly measured, but approximations of interpolation indicate that it should be between −10 and −5dBm with RF pre-amp in, and quite a bit better with pre-amp out, These figures are good, but not outstanding. The RF pre-amp selectivity was fairly sharp, giving similar figures for rfim at 200/400kHz spacing, but much better at 1 and 2MHz spacing on 40m.

IF selectivity was excellent, a typical pass band, as set, being 2.7kHz wide for −6dB, and 3.8kHz for −60dB, giving a shape factor of 1.4:1 which is excellent. The reciprocal mixing ratio performance at a 20kHz spacing measured approximately 84dB which is good but not excellent. This parameter is extremely important, but exceptionally difficult to measure, and concerns the amount of noise generated within the local oscillators of the rig which causes noise to be added underneath weak signals if very strong signals exist off channel. The signal to noise ratio of a very weak station being received at say 0.3uV would thus be noticeably degraded by a 5mV signal off channel. The T notch filter could notch out by 24.5dB either of two equal carriers spaced 600Hz apart. This performance is very useful, but not good in comparison with the excellent T notch filters that I have met with on a few rigs in the past. One Collins receiver I had notched around 50dB!

The audio distortion, when reproducing a 1kHz tone resulting from an rf carrier, at a strong input level, was 1.8% at an output level of 125mW across 8ohms. 10% distortion was reached at an output level of 1.7w, which is not quite adequate for some speakers. The AGC was checked by pen charting the audio output when suddenly reducing the RF carrier level from 1mV to 10uV, and 100uV to 1uV. Almost complete restoration was reached in just over one second at the higher level, and around two seconds for the lower level tests. Most of the gain though had restored by ½ second too fast. AGC action was rather poor below 1uV, showing that you would have to increse audio gain to increase the apparent volume of weak signals on 10 to 15m for example. The FM input sensitivity was good for 10m, but not good compared with a really hot vhf FM receiver (around 0.25uV for 12dB sinad). We noted that as normally supplied, the CW position used the SSB filter, but with the addition of an extra audio filter. The input noise figure was measured on 10m and was found to be approximately 9dB which is reasonable considering that band noise even on 10m is higher than this until the band dies out. An external pre-amp could help slightly, but would not really be all that worthwhile. This could be easily inserted in the receiver break points.

The transmitted audio pass band had −6dB points at 300Hz and 3.2kHz, and with tone controls set nominally we noted a slight 2.5dB bump at 1.8kHz on USB which was not present on LSB, the two side bands when selected



Side view and rear end of the comparison rig, Yaesu FT102.

otherwise being very similar. 1kHz side band rejection as transmitted was around 36dB, which is quite reasonable, whilst carrier rejection was excellent, reaching 60dB after a few seconds. The audio distortion within the pass band, with compressor switched out, was around 3% typically, although this rose dramatically with higher imput levels, showing that you shouldn't either eat the microphone or shout at it! Power output on CW was between 130w (10m) and a maximum of 180w on 40 and 80m, with SSB PEP measurements between 180 and 240w. Two tone intermodulation tests with audio frequencies spaced well apart, but easily within the filter pass band, showed lower IM products measuring very well, but high order products being adquate, and certainly much better than those which would be measured on many other rigs. No transient problems were noted with ALC action, and IM measurements did not significantly change with up to 10dB or so of indicated ALC, the checks being done on 10m which is the band most likely to show up a problem with a PA, as neutralisation is most critical at high frequencies.

We checked for transmitted spurii and harmonics on all bands, and whilst 10m and 15m showed no serious problems, 20m and lower showed second harmonic outputs which might be slightly troublesome in a few circumstances. the worst harmonic was −40dB on 80m (second), but this harmonic might only stop a neighbour listening to Radio Moscow! Harmonics would be appreciably lower if the internal ALC was increased to reduce the peak output power slightly, and if the rig was used with a good linear with ALC, harmonics would again almost certainly be greatly reduced.

IC740 subjective trials

I used this rig for some days, driving directly into my own Drake 2700 aerial tuning unit, using the same aerials as already used with FT102, namely a High Gain TH6 DXX for 20, 15 and 10cm and a G8KW trapped diapole antenna for 80 and 40m. Brief tests were also carried out on 160m on both rigs. A few days after the IC740 arrived, the Icom AT500 automatic ATU arrived which was interconnected with my normal system. I have tried many auto ATUs before, but the AT500 outshone the remainder in its ergonomics by a very wide margin. The ATU is capable of being used with steady carrier levels up to 500, and with SSB up to 1kW. When the IC740 bandswitch is changed, the AT500 automatically follows, switching both band and pre-determined antenna at the same time. When the AT500 is initially set up, preset ATU positions can be adjusted using two presets for each band for optimum VSWR at the most used frequency in each band.

If you change frequency with the transmitter, and either whistle or hold a morse key down for not more than two seconds, the ATU automatically corrects the VSWR to better than 1.2:1. In practice, it usually fell to 1.1:1, two separate motors adjusting large variable capacitors unbelievably rapidly. I was able to tune all the way from 3.5 to 3.8MHz for example, without any problems, VSWRs of 3.1:1 being corrected a half to one second.

The receiver input's sensitivity was the best I have yet encountered on any receiver provided the pre-amp was switched in. There is no pre-selector tuning for this pre-amp, which again saves time in operation. Although I did not note any problems, on the bands even on 80 or 40cm only with the pre-amp in, very faint IM products were audible. Sensitivity on both these bands was more than adquate with the pre-amp out. On 10m, the pre-amp made a marked difference to extremely weak signals very late at night, when the band was virtually closed down from any skip. The sensitivity was thought excellent throughout all bands, and there would be absolutely no point in even considering extra pre-amplification. The IF selectivity was incredibly sharp with the wide filter, and CW interference at the top or bottom end of the pass band almost completely disappeared with a very small adjustment of the sideways acting, fader type control, used for placing the position of the band pass filter. In the narrow position

of the IF filter, the pass band was subjectively considerably reduced to about the optimum for retaining intelligibility in a very crowded band, and any filter breakthrough noted in the lab did not seem to be of concern subjectively.

The T notch filter facility, switched on with a push button with the notch position, again varied with a sideways acting fader, whilst being useful, did not notch out interference sufficiently, and this was a little disappointing. The reciprocal mixing performance seemed very good even when used with transverters, and no problems were noted on any band. The AGC, continuously variable, was superb, the long AGC characteristics allowing one to relax back and listen to a strong SSB signal without much pumping of hiss unless the transmission ceased for more than seconds. As with the Yaesu, the S meter showed no inclinaton to respond to even fairly weak signals although it was better than the 102 here. However, it seemed accurate on very strong signals.

The IC740 has two separate VFOs, and these were a delight to use, each being controllable in 10Hz or 100Hz or 1000Hz steps allowing one to get from one end to the other of a complete band amazingly rapidly. The RIT and TIT functions worked well, and the built in memory, allowing one to memorise one frequency on each band (four different frequencies on 10m) was excellent. If one selects a memory frequency you can VFO up and down from it, but return to it again when you re-select memory: this will surely be found extremely useful, particularly if you are using the rig with transverters, allowing you to return to the calling frequency, for example. It is possible to use the two VFOs in split mode, but each frequency must be in the same 500kHz segment. A lock button allows any frequency to be locked so that it does not change if you knock the tuning knob.

An FM board is optional, and the mode switch selects FM, normal SSB (USB on hf and LSB on lf) reversed SSB, CW and RTTY. The vox control needs to be set up carefully (switchable in/out and variable threshold, anti-trip and delay) but worked very well. The noise blanker was fabulous, switchable off, normal and wide, as well as having a variable threshold level. The wide position was particularly effective when virtually no other noise blankers

YAESU FT 102 vs. ICOM IC 740

on other receivers would help, although considerable distortion occurred if the threshold was adjusted too far. The built-in compressor was extremely effective, switching in considerable bass cut. The hand mike supplied only had a PTT switch and most listeners felt that it was coloured, and produced rather a hollow sound.

One amateur fitted the mic amp from inside the HM7 into his Shure 444, and the sound quality was incredibly woofy without compression, but superb with the compressor switched in, its combination with IC 740 showing up the mike amp's strange response noted in the lab tests.

Returning to the rig's ergonomics, I found myself using 1kHz steps for quickly scanning the band, 100Hz steps for scanning a small portion and roughly tuning in a station, but 10Hz steps for very precisely tuning an SSB station for the correct pitch. Many users are content with 100Hz steps here, but some people (including myself) are very sensitive to pitch errors. The tuning knob drag can be adjusted with a cross-head screw underneath the chassis, but on the review sample, with this unscrewed quite a way, I could not really make the knob spin as I might have expected it to, although it would be possible to make it feel quite stiff. The finger hole was too small and friction warmed up my finger a bit. When changing to reverse SSB, the rig unfortunately does not hold the same carrier insertion frequency, so it is not possible to check someone's alternative sideband rejection without retuning. This was found slightly annoying but is not really serious.

CW is received well, even without the optional filter, an audio filter being incorporated. CW tone seemed very free of distortion and therefore much purer than usual, and this was delightful. The treble control was found quite useful, particularly on FM which itself was received at far better than average quality, the filter being fairly steep but not quite sharp enough for 12.5kHz spacing. The squelch control worked amazingly well both on FM, and unusually, on SSB, provided in the latter case; the input signal was fairly strong and not subject to interference. The RF power control is most useful, in that it allowed the rig to be run on a lower output power, particularly on FM and CW.

I enjoyed using this rig very much indeed, and after much consideration I feel that it is one of the best rigs in its class available today. Quite frankly I rather envy those who have a complete Icom installation, which can of course include the Icom transistor linear as well as auto ATU. We did find one snag however in that the auxiliary input which the instruction book claims is both microphone amplifier output and direct input to the mike gain control, is absolutely useless as a tape recorder or phone patch input, the input response falling by 6dB per octave above 100Hz (3kHz around −30dB!). On examining the circuit diagram, it is clear that the manufacturers forgot to include a series resistor in the output of the 741 IC acting as input mike pre-amp. As with the FT102, the feed level of a transverter is ridiculously low again at around 100mV but Microwave Modules can accommodate this level to special order.

IC740 laboratory tests

All the tests carried out on the IC740 were done in the same way as had been used for the FT102, test equipment including two Marconi 2019 generators and a 995, an HP8558 and Marconi spectrum analysers, a Racal computerised power meter, a Bird through line/PEP indicating watt meter, and a 30dB Rhode and Schwartz attenuator load. For audio measurements we used an HP8903 audio analyser, a B & K 2010 super heterodyne wave analyser, and a 2307 chart recorder.

The input sensitivity measured 0.14uV on SSB with the wide filter on virtually all bands for 12dB sinad, the sensitivity decreasing to 0.3uV with the preamp out. Sensitivity thus was excellent.

The rfim performance at lower levels was rather better than that of the FT102, but higher levels were fairly similar, indicating that rfim performance was being affected by more than just one mixer. The intercept point will thus be approximately the same as that of the Yaesu, but subjectively the performance would sound better at normal levels. I suggest that just quoting the rfim intercept point is fairly useless in evaluating how a rig will perform in practice under normal operating conditions. The selectivity of the wide filter was incredible, showing 1.3:1 shape factor, the bandwidth for 6dB attenuation being around 3kHz.

The narrow filter gave some strange readings, for the 60dB attenuation point seemed to be as poor as 6.1kHz, slight whistles and noise appearing, and this may be due to some form of synthesiser leakage, or leakage across the narrow filter. The reciprocal mixing ratio in fact measured extremely well, being noticeably superior to that of the Yaesu. The S-meter required 0.47uV for S2 and 4.1uV for S9, S9 + 20 being 44uV − fairly accurate relative to S9. The pre-amp gain we inferred to be 10dB by finding the required level for S3 with and without pre-amp. The AGC on the slowest setting showed the capability of quite gentle audio recovery time of around 2 seconds,, which is about ideal, provided it is properly exponential. Audio distortion at 125mW output was 0.9%, about half of that of the Yaesu and maximum output for 10% THD was 3.1w into 8ohms. The T notch filter only gave a relative attenuation of 16dB, and this is rather poor.

Without the optional CW filter, the SSB filter is used but a 400Hz wide audio filter was incorporated.

When we tried to measure the transmitter equivalent audio pass band using the auxiliary input, it was quite evident that there was a design problem, so we measured it by injecting tones through a 10 micro farad capacitor into the microphone socket. We were surprised to find that with the compressor switched out, the resonse from input socket to RF out was almost flat down to below 25Hz, whilst attenuating incredibly rapidly above 2.7kHz USB & 2.3kHz LSB due to the excellent shape factor of the filter. This would mean that anyone using other than an Icom mike (don't forget that a capacitor is necessary to hold off DC here) would transmit any rumble, hum, linear amplifier blower etc, and I think this is rather ridiculous.

I frankly cannot understand Icom's philosophy here, for it would be easy to insert 6dB per octave bass cut capacitors at say three points to give 18dB per octave cut, below 200Hz, rather than putting perhaps only 6dB per octave in the microphone. I have often noted that many Icom transmissions are rather toppy and this may be because there is just a 6dB cut in some Icom mikes, but cutting from too high an audio frequency. Matters improve greatly though when the compressor is switched in, very steep bass cut only then being incorporated. It is for this reason that I suggest so many people find compressor-in sounding much better than out.

Maximum CW power varied between 110w on 10m down to 80w on 40m, whereas SSB powers were around 15 to 40w greater. PEP measurements were very difficult to tie in between the PEP meter and the spectrum analyser, and I suspect that whilst average PEP measurements were as indicated, some higher readings obtained on a transient after no modulation for a few seconds, were created by the ALC not quite catching the transient quickly enough. Using the spectrum anaylser method, for example, we actually noted 180w PEP on 10m on an isolated middle frequency vocal toneburst! In the review sample, the 10, 18 and 24MHz bands were not enabled for transmit, so when you are purchasing one don't forget to ask the dealer to do this. Also, the marker option including 25 or 100kHz markers with a level potentiometer was not included. The 1kHz SSB rejection on the alternative sideband showed −44dB which is excellent, although lower frequencies showed a far poorer rejection, because

of the mic-amp characteristics. Carrier rejection on switch-on was around −40dB, falling to −65dB extremely rapidly, which is superb. Single tone checks of audio distortion harmonics showed the mic-amplifier to be good, but two tone tests revealed the production of several IM products both inside the filter pass band and up to a few kHz of channel. The rfim of two frequencies just within the audio passband was not too good for third and fifth order products, but attenuated very rapidly indeed at higher orders, ninth order for example being below 70dB the limit of our measurement capability.

At worst then, it can be seen that there might be slightly more distortion than usual close in to an IC740 transmission, but rather less spreading at say 10kHz off channel than is present on many other rigs, which is what really matters. No significant improvement was obtained by reducing the output power from that produced by 10dB ALC to that from below the action of ALC. These tests infer that the rfim would not significantly reduce if ALC was fed back from the linear, so it would be important to use a low distortion linear with the rig to avoid spreading. The Yaesu is clearly better in this area, since all products would be reduced with linear ALC feedback. We checked on a spectrum analyser for harmonics and spurii and were pleased to see that on no band were harmonics in excess of −55dB, spurii always being below −60dB, these performances being thought excellent.

Conclusion

I feel that my colleague Simon (G8UQX) and I have fairly exhaustively tested both these rigs, and I find it difficult to choose between them, for their philosophy of operation is so very different.

The Yaesu's continuous tuning for example, was rather pleasant in use, whereas I had to get used to the Icom's synthesiser steps. After all is considered, and having spent some time with each rig, I must admit to slightly preferring the Icom, particularly because of its compatibility in operation with the automatic ATU. This rig's rather poor T notch filter was unfortunate, and I would have liked a better transmitter rfim performance on lower orders, and I must admit to being irritated by Icom's philosophy in the design of the mic-amp response.

The fixed output impedance of the IC740, together with its SWR protection etc, and the fact that it will withstand CW key down for some down time is a boon, whereas the Yaesu will take a while to tune up, and requires much care in doing this.

The Icom receiver clearly had the edge on the Yaesu in almost all respects, and it is welcome that the rig can be used in the car, its size being quite a lot smaller than the Yaesu. The Yaesu's requirement for careful tuning up should hardly be beyond the capability of a licenced radio amateur, but my preference here for the Icom is that it just requires picking up the mike and talking – provided the aerial is a good match, or you are using the auto ATU and are prepared to whistle for a second or two if you are in a part of the band away from a nominal setting up point.

Some of the controls on the Icom are necessarily slightly cramped because of the smaller fascia size whereas the Yaesu is very well laid out, which might be a consideration. Both rigs are easy to use with transverters, provided they are sensitive enough at 28MHz input. I would describe the Icom manual as rather poor, and they need to improve this, but the Yaesu one was very good indeed and was up to their normal standard.

I must emphasise therefore, finally, that while I prefer the Icom for rather personal reasons, your own choice between the rigs will probably not be simple, for there are so many pros and cons. I consider both to be generally very good indeed, and both outclass many earlier models from their respective stables.

Amateur Radio magazine would like to thank SMC in Southampton, Amcomm in Harrow, and Thanet Electronics for their tremendous co-operation and willingness to answer technical queries, and for loan of the review samples.

Parameter	FT102 Test Result	FT102 Subjective	IC740 Test Result	IC740 Subjective
RF sens 12dB SINAD pre-amp in	0.21uV	Good	0.14uV	V.good
RF sens 12dB SINAD pre-amp out	0.7 to 1.1uV	Good	0.25uV average	V.good
Input noise figure at 28.6MHz	9dB	Good	6.8dB	V.good
Rfim for 12dB SINAC product at 28.6MHz pre-amp in/out	2/12.5mV	Good	3.2/6.3mV	Good
Rfim for 5uV products pre-amp in	5.5mV	Good	8.0mV	V.good
Selectivity: shape factor (6dB/60dB ratio)	1.4	Excellent	1.3	Superb
Bandwidth for -6dB SSB filter	2.7kHz	Ideal and variable	3/1.8kHz	Excellent comprise
Reciprocal mixing ratio (20kHz offset) ref 12dB SINAD point	84.0dB	Good	91.5dB	V.good
Recip. Mix. IP level for 3dB noise increase	3.5mV	Good	5.3mV	V.good
S-meter: S2/S9 pre-amp in	1.7/23uV	Fair	0.47/4.1uV	Fair
Max T notch rejection	24.5dB	Fairly good	16dB	Poor
Audio distortion for 125mW/8 Ohms	1.8%	Fairly good	0.9%	V.good
Max audio out for 10% THD/8 Ohms	1.7w	Fair	3.1w	Good
RF pre-amp gain	13dB	Good	10dB	Good
TX PWR out CW min/max	130/180w		90/110w	
TX PWR out SSB PEP min/max	180/240w		120/150w	
Worst harmonics & spurii	-40/-56dB	Poor	-55/-60dB	V.good
Carrier suppression ref full output	-65dB	Superb	-65dB	Superb
1kHz SSB side-band rejection	-40dB	V.good	-44dB	Excellent
2 tone IMD 3/5 order	-35/-37dB	V.good	-24/-34dB	Fairly good
2 tone IMD 7/9 order	-48/-58dB	Good	-50/-70dB	Excellent
Mic input socket/PWR out response, comp out	300-3200 Hz	Excellent	30-2500Hz	Extra-ordinary

Amateur Radio's propagation wizard analyses how the new bands fit into the great master plan

THE NEW BANDS

You may have heard we've got some new bands since the last issue of this magazine. As we mentioned at the back end of Current Comments last time (we heard the news the morning we were supposed to take all the deathless prose down to the printers, so things were hectic at Bicester while we cut the last story and stuffed the news of the changes in – the printers have only just stopped muttering at us and threatening to cut all our antenna cables) some changes took place as from October 1 and we promised you an analysis in the next issue.

First off, we've lost the segment 431-432MHz in the 70cm band. Or at least, "amateurs are requested to desist voluntarily from using it within 100km of Central London", as the Home Office stately prose puts it. It isn't to be withdrawn at present. Apparently this will go to private mobile radio in the London area. A couple of other magazines went off at half cock over this one (heh heh), claiming that it was all part of a Grand Plot to swipe 70cm from the amateurs and hand it over to MoD – well, we have it on good authority that it isn't. It really is for PMR use, and it has precisely nothing to do with the MoD system we mentioned in the last issue.

Net effect of this? Not a lot, we feel. It's a pity that this part of the band wasn't ever incorporated into the bandplan for the 432MHz band, and we'd guess that the reason was that the power restriction of 10 watts ERP and the rather old geographical restriction around Fylingdales made it a bit of a problem to plan for. In our experience, this part of the 70cm band was almost never used except for lo-power local chatting; we used to have a hand-held natter channel at rallies on 431.5MHz actually – so although any loss of spectrum is sad news for the amateur fraternity, we honestly can't shed too many tears over the demise of this bit. It isn't as if it were slap in the middle of the simplex or the repeater channels (which would make life a hell of a lot more difficult all round), so all in all the loss of 431-432MHz within 100km of Central London doesn't strike us as a great tragedy. As long as it isn't the thin end of a wedge however . . .

The big problem with 432MHz is that in the UK the amateur service is a "shared secondary" user. Which means in practice that the amateurs can be given the big E any time the primary user so desires and there's not a lot that anyone could do. Although we came up against one high brick wall when we tried to clarify the bit about the military having overall control of this part of the spectrum (Current Comments, last issue) we *did* ascertain that although it isn't written down anywhere, the effective "primary user" of the 430-440MHz band is the military. This doesn't affect the amateurs unless MoD suddenly decide they want it – in which case, dear readers, the cold reality is that we will get asked ever so politely to cease using it. End of story.

On a non-interference basis

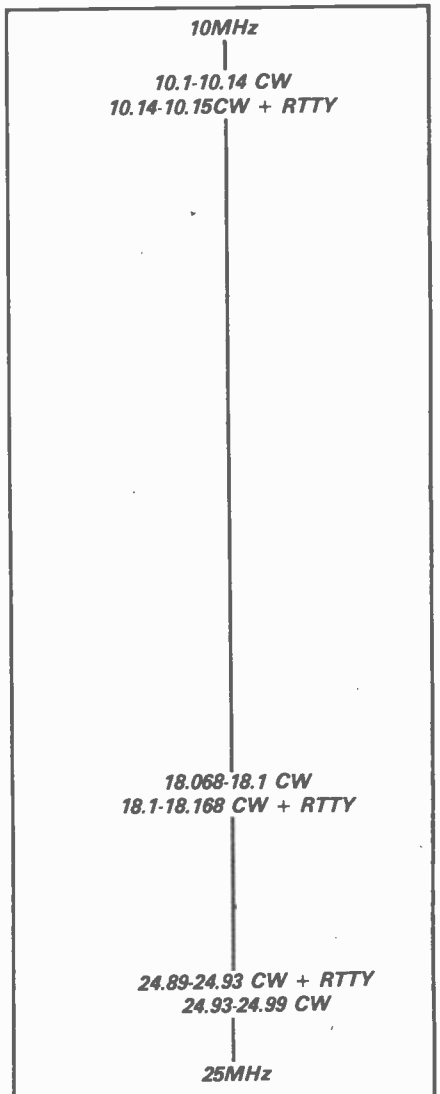
The plain fact is that we haven't any divine right to be there, and if the MoD announces tomorrow that they're having, say, 433-437MHz for something or other, there isn't any right of appeal. Which is a sobering thought. Many people wrote to us after our last issue saying that they'd invested £X,000 in gear for 70cm and how could there be any chance of it being taken away? Well, sorry, but 432MHz isn't like 144MHz (for instance) which is an exclusive amateur band, and it could vanish tomorrow. We don't for a moment think it *will*, mark you, and we've quite an investment in 70cm gear ourselves, but that doesn't alter the fact that it *could*!

Anyhow, enough of 70cm. We've also given it a fair old airing in Current Comments, as you'll have been. What's next? There's a bit of the 10GHz microwave band that's been got at, but we suspect that none of our readers will be avid 10GHz operators so we'll leave that out. Suffice it to say that amateurs will now have to share with some more primary users in the sub-band 10.25 to 10.4GHz. Oh, and while we're on the subject of microwaves, the four new bands which were allocated at WARC have now come on line – so if you're absolutely bursting to go on 47, 75, 142 and/or 248GHz, well, now is your big chance. None of us in the office have the slightest idea how to generate more than about a micro-pica-watt on any of those frequencies, and anyone who designs and writes up a multi-mode 47GHz transceiver for publication in these pages will win a major prize. Mind you, he'll probably win a Chief Designer's job at Marconi as well . . .

Now, about the 18 and 24MHz bands. These were agreed at WARC in 1979 as well. Or at least, it was agreed that they'd become full amateur bands "not later than 1 July 1989". Until then they're used by various other services. It's been agreed that UK amateurs can use them from 1 October, subject to operating on a non-interference basis to all other services and a few other conditions. These are that (a) you can only use CW, ie no SSB or what-have-you (presumably no RTTY either), (b) maximum antenna gain shall not exceed 0dB with respect to a half-wave dipole, (c) said antenna should be horizontally polarised in order to reduce ground wave radiation and (d) the carrier power supplied to the antenna shall be 10dBW, or 10 watts to the likes of you and me.

So, we haven't yet got exclusive use of these new bits of radio space but we have got shared use of them, which is nice. Point here is that the services who presently use these bands, such as embassies, obviously need time to find other parts of the spectrum, which is why the 1989 date was agreed. So we amateurs *must* give priority to those services in the same way as we do on Top Band and 10MHz.

We don't know why 18 and 24MHz are restricted to CW only in the UK but no doubt there are some good reasons connected with who else uses these bands; the horizontally-polarised bit sounds reasonable enough, although we do feel that laying down specifications on what antennas may be used by amateurs is a slightly worrying trend. No doubt the Powers That Be have their reasons in the case of bands we're sharing with other users, but it isn't



The new 18 and 24 MHz bands: *These become full amateur bands not later than July 1st 1989. Until then, amateurs can use them subject to operating on a non-interference basis. See the text for further information.*

something we'd like to see increase and certainly not on amateur-exclusive bands. Same goes for the 0dB figure. It seems pretty clear to us that the horizontally polarised half-wave dipole is going to be the 18 and 24MHz flavour of the month, and there's no harm in that. Certainly if the Home Office feel they ought to restrict the possibility of problems to other users the restrictions seem fair enough.

So all in all, we're delighted to have the use of them – only six other countries in the world have, to our knowledge, and we can't say we've amassed DXCC on either band yet. Our 18MHz dipole came into use at 0001 on 1 October, and we worked a few locals but nowhere farther than Bristol. We found some problems with (a) the 24MHz band on the office rig, (b) one of our sister magazines and (c), the antenna which fell down three times. These have stopped us doing much on 24MHz, although Bicester to Abingdon was something, we suppose. Perhaps it was via the long path . . .

So, that's 18 and 24MHz. The other new band (well, almost) was the announcement that, for research purposes only, a "very limited" (we understand 40) number of Class A licencees would be permitted to operate outside UK broadcasting hours on a non-interference basis on (pause for the roll of drums) 50 to 52MHz. Those interested in taking part were asked to write to the RSGB's VHF manager, Keith Fisher, G3WSN.

Great stuff, we felt, although we don't envy Mr Fisher one little tiny bit. According to the GB2RS bulletin, almost 200 folks had applied by the closing date of 15 October, and apparently a questionnaire was going to all interested parties after that. Hopefully we'll be able to publish a list of the lucky winners in our Current Comments, assuming that the printers will forgive us – ten gets you one that the list will appear the morning we go to press . . .

As we said, God help Keith Fisher. We can't think of a situation likely to stir up as much jealousy, resentment and general aggro as this one. It seems to us that the RSGB didn't have very much time to set it up after the Home Office gave them the go-ahead for 40 licencees, and how the hell do you allocate 40 licences to the ravening hordes of VHF men out there? The questionnaire sounds like a good idea to us, and perhaps it'll get round the old cracks about so-and-so only getting one because he's a friend of a friend who's on the VHF Committee. Either way, we wish we were a fly on the wall at the last committee meeting. We shall certainly publish the list of the people licenced to have a go on 50 to 52MHz, and let's hope there's a good sprinkling of bods geographically.

It's necessary to show what we can do with this band in our opinion – there's no point whatsoever in using what is essentially an experimental allocation yacking across town. There are a load of intriguing propagation modes on 50MHz which could do with some look at, so let's hope the VHF Committee pick people who can make a genuine contribution, as opposed to the people who *think* they can like the UK Six-Metre Group. We heard some of this outfit at a rally recently, and you'd have thought that they were a self-appointed 50MHz police force, demanding this and demanding that. Now, a suggestion: instead of having a VHF ego trip, why not get down to some serious work on the band and leave the negotiations to the national society?

So – we'll publish the list and wait for the fun. The only thing we thought was unreasonable was that it was limited to Class A licencees; we realise it's an experiment but if you're going to have a limited number of licencees, why not include Class B people as well? There's nothing in the Radio Regs to say they can't – 30MHz is the lower limit if you haven't passed a Morse test – and unless we've missed something there aren't any stations on 50MHz who'll need to use Morse to ask amateurs to QSY. Or do they have secret thingies on Band 1 TV transmitters? On the face of it, the restriction to Class A people looks like a form of discrimination to us, and either the RSGB or the Home Office have something to answer for.

It seems the RSGB pressed for Class B people to be allowed to take part in the experiment as well but the Home Office wouldn't have it (if our sources within the Home Office are as reliable as usual), so we don't feel like kicking the RSGB; however, the HO wouldn't answer our letter of 11 October in which we asked them, so we can't tell you the official story.

That, by the way, makes two letters from us they haven't answered. We'll keep a scoreboard perhaps, because our feelings is that they're being a bit *Yes Minister* these days.

So – where from here? The BBC are supposed to be out of this band altogether in the not-too-distant future, and the Merriman Committee advocated an amateur allocation at these frequencies recently, so we'd think that cautious optimism is the order of the day. But surely Class B folk will get a look-in if we do get a 50MHz slice of the cake? We don't think it's the RSGB's fault, and we gather that they've also been asking the Home Office about getting 70MHz opened to Class Bs. Snag here seems to be that the military feel they couldn't cope with any more amateur activity on the band so they wouldn't agree to it. This sounds reasonable to us.

We were talking to an ex-President of the RSGB recently, who gave us the gory details of how we got 70MHz in the first place . . . We seriously thought about having a Christmas competition for you to guess the answer, but the real reason is so incredible that we thought in the end it wouldn't be fair – nobody would ever guess . . .

So that's the story so far. 18 and 24MHz ought to be very good in a month or two, and we promise to let you know who else is on the band for our next issue. We couldn't get the information in time for this one, but the story we have is that six other countries have 18MHz and five have 24MHz. Our tame propagation wizard is also preparing an analysis of what you'll be able to work.

SHOPTALK

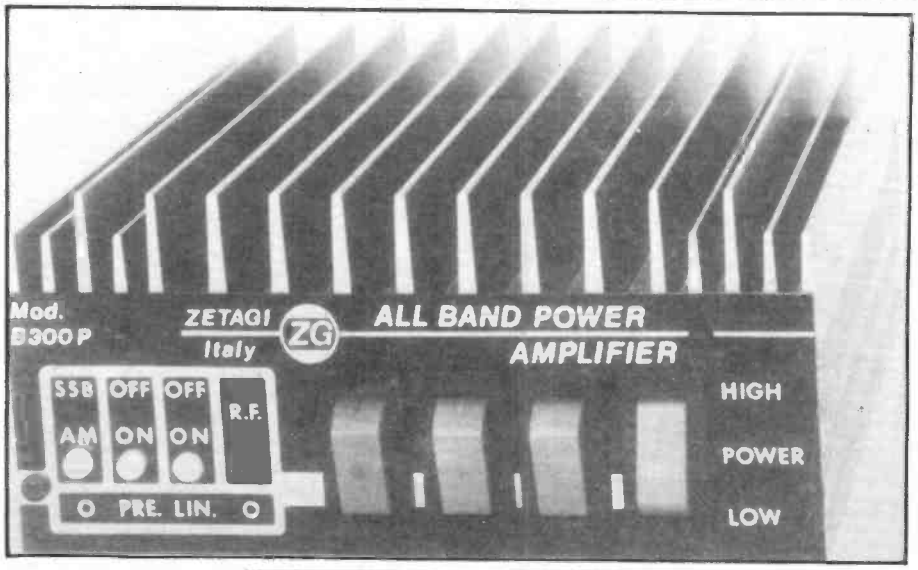
Equipment available today. From hand-held radios to full blown bench equipment, there is enough to suit all tastes and requirements. Here is a selection of things available in the shops currently.

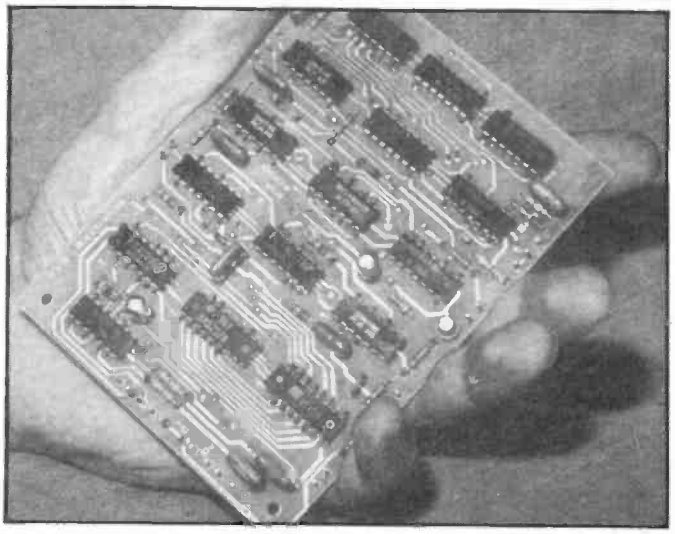
Well, S. Claus is about to make his annual visit to the shack, and we hope he's QSL'd your wishes for Christmas! We've heard of some nice goodies since the last issue, so we thought we'd throw in a few suggestions for what you might like to have in the shack and elsewhere.

The firm of Zetagi is well known in CB circles for all sorts of odds and ends from filters to amplifiers of more or less legality – in the UK, anyway. They've come into the amateur market with a range of three linear amplifiers for mobile use, and they look quite good to us. First off there's the B40 (no connection with the antique communications receiver of the same name made by Murphy for the Admiralty some years ago – nice machines, even though they did weigh about four tons . . .) which is a 30 watt 144MHz linear allegedly for mobile use. It costs £32.07 which is extremely cheap for this class of unit. Its bigger brother is the B100, which is a 100 watt device for 144MHz, and this will set you back £63.00.

The third Zetagi product is the B300P, which, according to their blurb, is "a very high power broadband HF linear covering 3 to 30MHz with a power rating of 140-300 watts PEP on SSB. Output power is switchable between low and high power positions. An input power of approximately 20 watts PEP is required to obtain maximum output power. The unit has a built-in broadband preamp with a 25dB gain if required". Thus endeth the press release, and it'll rush you £119.00 if you want one.

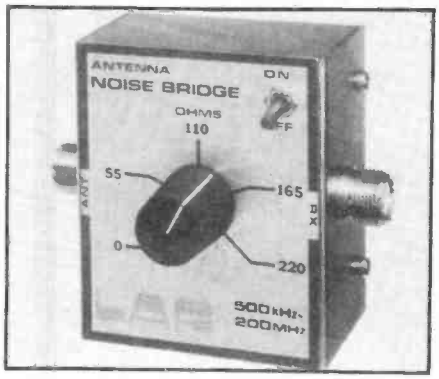
These are very low prices for this sort of amplifier, and we'd be interested to see how they measure up in practice. They don't say whether the figure given for the power ratings represents PEP output or the power input to the amplifier itself, and of course they're not the same thing – not that we're casting aspersions or anything, but we do wish that manufacturers would make clear what it is that their spec refers to. As far as amplifiers are concerned, we'd like to see an RF output figure quoted with respect to a given level of intermodulation performance on a two-tone test; our technical bod suggests a third-order IM figure of −26dB would be about right under those conditions, and that would tell you a lot about how well, or not, the thing meets its spec in ordinary everyday use on the bands.





Above: The Zetagi B300P broadband HF linear amplifier with built-in 25dB preamp – heaven help your front-end! Right: the innards of the KM4000 keyer memory, bristling with what someone once called silicone chips! Complete with added wax polish . . . Below: LAR's cute Antenna Noise Bridge, good even on the 144MHz band.

There seems to be a fashion for amplifiers to have built-in preamps as well, which is all very well if the preamp is properly designed but we still feel that the right place for a preamp (at least on VHF and UHF) is the top of the mast, not in the amp. For HF work it's a different story, and a preamp might be just the thing if you're using a short whip, for example, and your receiver is a little deaf. Having said that, 25dB of gain in front of the receiver might be a bit much for some front-ends, particularly if it's a broadband 25dB with only the selectivity of the receiver's RF amplifier to sort out what you want from what you don't. We'd hope you can turn it down a bit if you need to, because you'll be asking a great deal of your rig unless it's ever so state-of-the-art.



Now for something complete different. Namely, a keyer – you know, one of those things for sending Morse other than with a straight key. The February 1982 edition of the RSGB's magazine *Radio Communication* carried a write-up of the KM4000 keyer-

Left: LAR's Antenna Traps. These weigh in at a measly 50 grammes, and should cause less distress to your dipole than the usual chunky ones encapsulated in Portland cement or something.

memory, and we remember thinking when we saw it that it seemed a nice device. Basically, it's a combination of an electronic keyer and a memory with a high degree of flexibility. We'd suggest you have a glance at the technical information if you'd like the facts and figures, but the good news is that you can buy a printed circuit board for the thing at a very reasonable £9.62 including postage and packing, or if you really hate building things (this sort of thing is an ideal project for those winter evenings when you're bored with gazing at the box and putting the boot in the dog) you can buy the whole thing ready-built and tested with instructions on how to connect it all up and get keying away for £44.95 including post and packing again.

We're thinking of something like this for the meteor-scatter station we're hoping to put together soon, since you need a source of high-speed Morse for things like that. The PCB looks of excellent quality to us, so try it if you're interested in keyers.

Talking about MS reminds us that for good results you really need to be able to run reasonable power, and you'll need some sort of linear amplifier. A popular way of doing this is to use valves in the 4CX250 family, and you'll also need the right bases and chimneys for them. Talking to John Nelson (RSGB) at the Leicester exhibition about these reminds us to mention that a company called Cambrian Electronics is the official Eimac distributor for valves and bases, and so on, in the UK as far as amateurs are concerned and they keep stocks of all sorts of mouthwatering goodies for those who intend to run high power.

He made the point to us that although new valves and bases are expensive, you'll probably only need to buy them once and you'll know that everything is according to spec and should produce the performance the valves are capable of giving. According to John, most amateur linear amplifiers don't give anything like the performance that they're capable of producing. Cambrian are at PO Box 10, Stanmore, Middlesex, and you can ring them on 01-954-1609. That reminds me – we didn't give you the address of GVB Electronics, who do the keyer and its PCB – they're at 95 Old Worthing Road, East Preston, Littlehampton, West Sussex BN16 1DU, and their telephone number is 09062 70260.

Low-cost Noise Bridge

A relatively new company on the scene is LAR Modules Ltd, who (not to be confused with Microwave Modules of Liverpool) come from Leeds, and we spent a very pleasant while with their man at the Leicester show. Their specialities are quite low-cost items for use in the shack, and some of them are really handy. The antenna noise bridge is one – this is a super piece of kit for doing resonance and impedance checks on your latest Monster Megabeam on the chimney, and it'll also tell you things about your feeder that you may wish you'd not known about!

The LAR one includes 144MHz so that should help those stalwarts who make their own antennas on this band and you get some comprehensive application notes with it so you know how to get the best out of it. Another nice LAR product is their antenna traps. The dipole antenna in one form or another is a popular beast of the HF bands, and indeed we have several swaying around on the roof of the office here – actually, we made a classic boob with ours because we saw some nice-looking wire at the Woburn rally and thought it'd be good for dipoles for assorted bands we wanted to play with. The big snag was that said wire was *soft-drawn* copper instead of the hard-drawn stuff you need when there's a lot of weight in the thing, and we wondered why ours never seemed to stay nice and taut – we also wondered why the 18MHz one in particular wouldn't hold resonance from one day to the next. The reason was that, being soft-drawn, the wire was stretching. Not good, Brian. Nil marks for thinking!

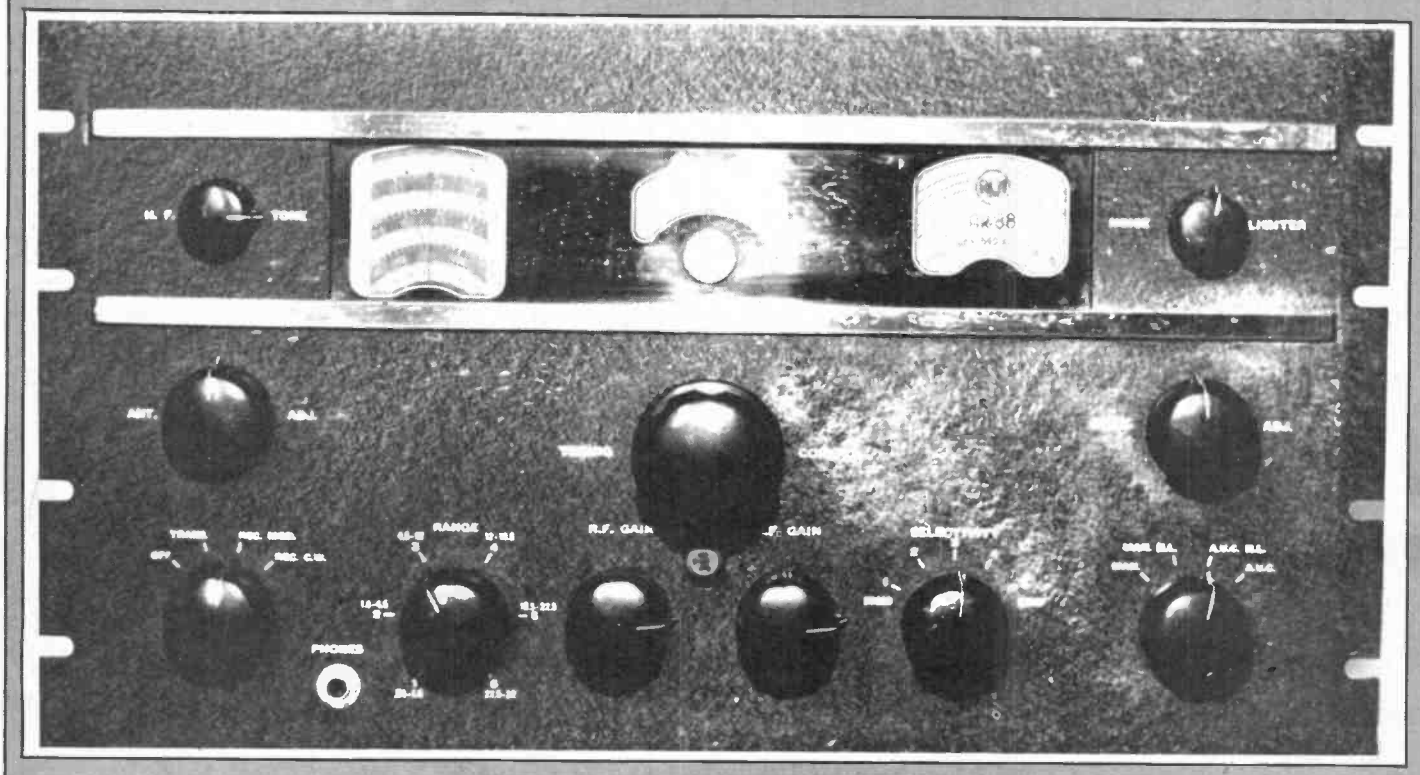
Where were we? Oh yes, traps. Resonant traps are a way of making a dipole resonant on more than one band, and they usually work well. The only problem is that most of them are a bit on the tubby side and the antenna wire gets more strain on it than is a Good Idea. We think it was the weight of the 7MHz traps which did our other antenna in, actually, so LAR have a point when they say they've halved the weight of theirs. Their 7MHz trap weighs 50 grammes, which shouldn't cause anything like the sag our old encapsulated ones do, and the ones we saw on their stand look nice and weatherproof. You can buy sets of 3.5 to 7MHz traps complete with end insulators and a centre T-piece for £17.50, and there's a couple of quid extra for p&p.

If you read the SWL column in the last issue, you'll remember we talked about matching units – well, LAR do those too. Their "HF Omni-Match" will handle all bands from 1.8 to 30MHz and will handle up to 250 watts; they're very well made and cost £69.25, which isn't bad really. They also do similar things for VHF and mobile work, so if you want to get your radiating system working as well as possible (ducky) here's one way of doing it that'll save you trekking round the rallies trying to find the bits. Mind you, there were some superb roller-coaster inductors at Leicester for a tenner and we raided the petty cash and got one – should be just the thing for when we get a really good HF station sorted out! It's just the variable capacitors that tend to cost a small fortune, assuming you can find them in the first place.

Anyway, you can get hold of LAR at 60 Green Road, Meanwood, Leeds LS6 4JP, or ring them on Leeds (0532) 782224. When we get round to it we'll buy a set of their traps and try them on our own antenna (we clean forgot to get them at Leicester, silly boy) and we'll let you know how they do.

Have a good Christmas and New Year; don't blow the linear up and we'll see you in March.

THE AR 88



First produced in the 1930s, the RCA AR88 still commands a big respect from amateurs. Full description by Bob Henly, C.Eng., MIERE, G31HR.

This receiver is still fairly widely available on the secondhand market from near-mint condition to sheer grot – depending upon the previous owner. For a modest sum (about £50) an AR88 can be acquired in excellent condition.

You should aim for one which has not been modified. The construction of the receiver is of a very high standard and unless any modifications have been executed to a similar standard and properly documented they are likely to detract from its performance and reliability. The AR88 is rather like the VW Beetle – it tends to go on for ever!

The AR88 has a long history, starting life in the late 30s as a general coverage receiver but intended also for amateur use (hence the AR). This version is not often seen on the market; it covers the range 550kHz to 32MHz and is fitted with an S meter. However do not confuse it with one which has had an S meter added!

The 1939-45 war and the need for reliable communication receivers resulted in large-scale production of the AR88 in various forms including a CR series (not to be confused with the Marconi CR 100, etc). Two models are generally available now. These are the **AR88LF** and the **AR88D**

The main difference between these two models is that the AR88LF has a lower intermediate frequency and a low frequency tuning range 75 to 150kHz. The AR88D is better suited to amateur use and this article will therefore concentrate on that model.

First, let us see what it is. The AR88 is a single-conversion super-het with a total complement of 14 valves (those ancient glass things referred to in a recent article). The receiver is shown in block-schematic form in fig. 1. It comprises two tuned RF stages and 3 IF stages. The two tuned RF stages are essential in view of the relatively low intermediate frequency of 455kHz in order to reduce its response to second-channel interference. The coverage is continuous from 530kHz to 32MHz in six over-lapping ranges.

The two RF amplifier stages use 6SG7 valves and are designed to provide only sufficient gain ahead of mixer to give the required signal-to-noise ratio. The principle purpose of the RF stages is to provide selectivity ahead of the mixer in order to reduce second-channel responses. This is its main weakness; image rejection of 500kHz is about 120dB but at 30MHz it falls to about 40dB. Fig. 2 shows the manufacturer's performance figures for sensitivity and image rejection. Although current practice would probably use much less gain ahead of the mixer in the interest of cross-modulation performance the AR88 in fact acquits itself very well when compared with many modern equipments on this score.

The mixer is a 6SA7 and the local oscillator is a 6J5. The supply to the local oscillator and the BFO is stabilised at 150 volts by a VR150/30. The Intermediate Frequency (IF) stages comprise a single crystal bridge filter followed by a three-stage tuned amplifier using 6SG7s. The inter-stage coupling circuits between first and second, and between second and third stages, each use four tuned circuits. These have variable coupling links which together with similar links in the crystal filter circuit enable IF bandwidths between 400Hz and 6kHz to be switch-selected. In addition, two further positions of the selectivity switch give 'fidelity' bandwidths. The IF bandwidths are summarised in fig. 3.

The second detector is of the diode envelope type using half of a 6H6. The second half of this valve provides carrier-derived AVC which is applied to the RF stages and the first and second IF stages. AVC is selected by a front-panel switch and a novel feature is that the RF gain control which also operates on the RF stages and the first two IF stages alters the AVC delay.

A 6J5 is used as a Beat-Frequency Oscillator (BFO) for the reception of CW. The anode supply is stablished at 150 volts. The frequency is adjustable from the front panel over a range of approximately +/– 3kHz about the IF. Output from the BFO is injected at the grid of the third IF amplifier ensuring a good injection level. A second 6H6 is used as a peak noise limiter with the clipping level adjustable from the front panel.

Audio output is provided by a two-stage amplifier comprising a 6SJ7 followed by a 6K6 output stage which is designed to deliver 2.5 watts into either a 2.5 ohm or 600 ohm load. The front panel jack provides approximately 10mW into 20,000 ohms from an additional winding on the output transformer. The integral power supply – which contributes a large part of the weight – operates from either 110 or 230 volt AC and uses a 5Y3 rectifier. A socket on the rear apron is provided for operation from external power supplies.

Both rack and table mounted versions can be found. It is built like the proverbial battle ship; overall dimensions are 19.25in × 11.0in × 19.25in deep and it weighs about 80 lb. Both mechanically and electronically it is very stable and although its physical size may be rather daunting it represents a very good buy.

The panel layout and location of the controls is shown in fig. 4. The central feature is the tuning control and the two tuning dials. The main dial on the left comprises seven concentric scales: one for each range and an inner logging scale. Calibration is in MHz except on range 1 where it is in kHz. The logging scale comprises a number of numbered segments each representing one revolution of the vernier scale. The vernier dial occupies the centre of the panel and has a single scale graduated from 0 to 100. The two dials are coupled together, to the tuning control and to the main tuning capacitor by a train of split gears which result in a very smooth 'feel' with zero discernible 'backlash'. This is probably one of the most attractive features of this receiver and is one item which requires careful inspection before purchase – of which more anon.

How well does it perform under today's conditions? The answer (in the author's opinion) is: quite well. As a CW receiver it is superb and the crystal filter is quite adequate for most situations. The addition of an audio filter such as Datong FL1 or FL2 more than compensates for any inadequacy. Its performance in the presence of strong adjacent-channel signals is very good – 7MHz is a good test of any receiver and the AR88 can certainly hold its own. Its main weakness is on SSB. This weakness is due to three main things. Firstly the tuning rate on all amateur bands is a little too high to make the initial acquisition of a SSB signal easy. Secondly the IF selectivity curve is not sufficiently steep-sided to resolve SSB to its best advantage. Thirdly the BFO is not preset for upper and lower side-band. The first is overcome to a great extent by practice and some owners have fitted an additional, out-board epicyclic drive to the main tuning control to slow it down. The IF response can be modified a little by careful alignment (of which more later) or the filter can be replaced by a more suitable type, but this is major surgery. As far as the BFO is concerned a variable control is invaluable for CW and therefore it is necessary to determine the two settings for upper and lower sideband respectively with a little patience and record them for future use by two discrete marks on the front panel.

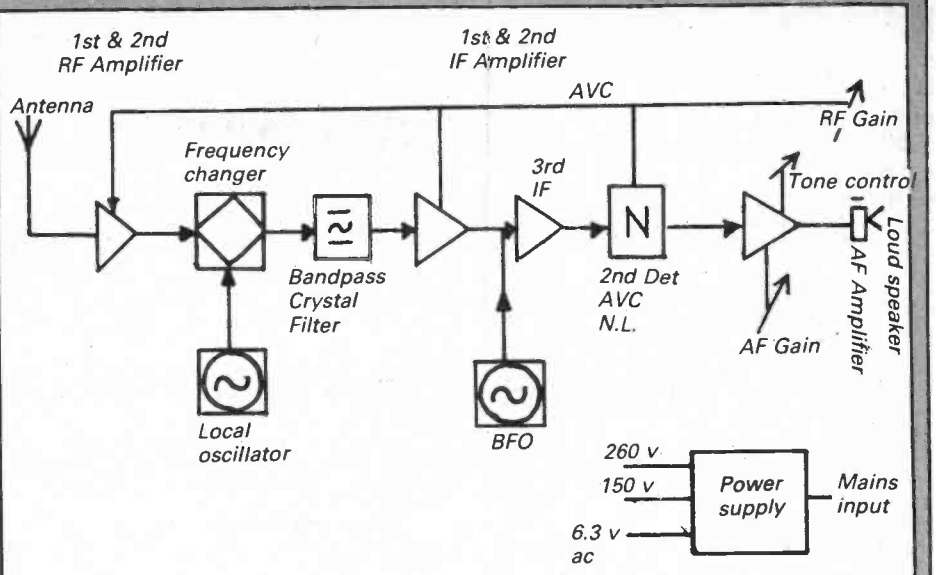


Fig. 1 Receiver diagram

Band No.	Megacycles	Sensitivity in Microvolts for 0.5 watt	Antenna Input in Microvolts for 6 DB Signal-Noise Ratio	Antenna Input in Microvolts for 20 DB Signal-Noise Ratio	Image Rate
1	.6 1.0 1.5	.5 .9 1.0	.9 1.4 2.2	4.6 8.0 12.0	$>10^6$ 10^6
2	1.7 3.0 4.3	.6 .6 .6	1.0 .95 .9	5.0 4.8 4.5	$2.4x10^5$ $14.5x10^3$
3	4.6 8.0 11.5	.8 .8 .7	1.3 1.2 1.1	8.0 6.8 6.0	$6x10^4$ $2x10^3$
4	12.1 16.4	1.2 .7	1.3 1.2	6.6 7.0	$4x10^3$ $1.5x10^3$
5	16.4 22.5	1.3 .8	1.3 1.4	7.0 8.0	10^3 400
6	22.5 28.0	2.5 1.2	1.5 1.3	8.0 7.0	400 200

I-F rejection at 600 kc is 100,000.

Fig. 2 Performance data

THE AR 88

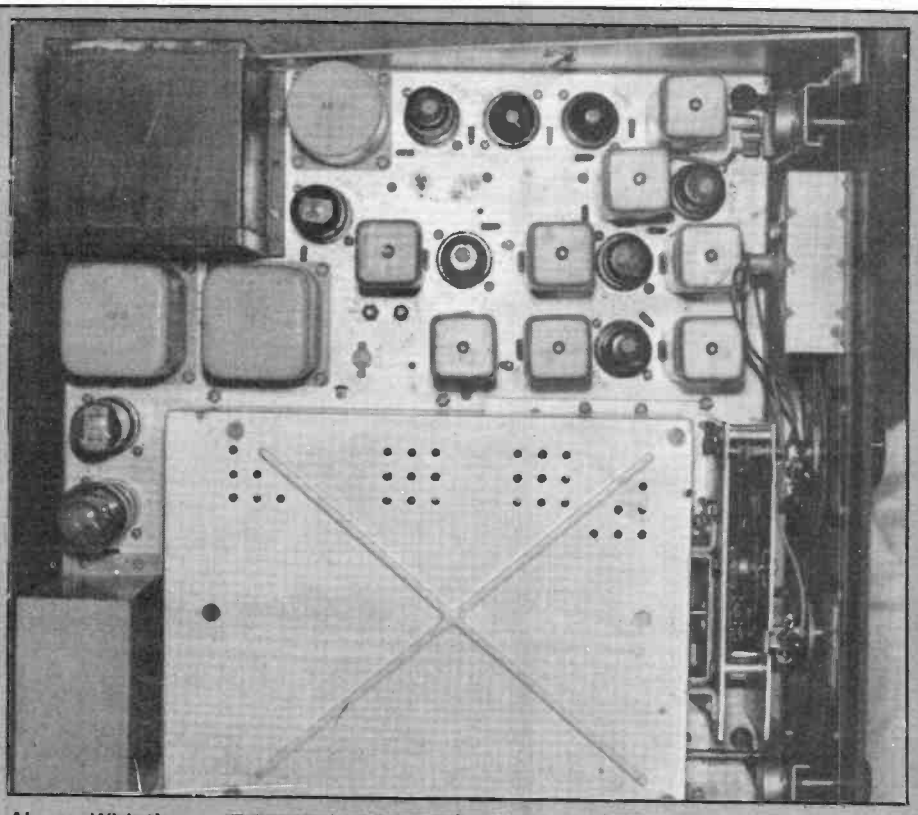
In general, sensitivity is adequate but the signal-to-noise ratio on the HF bands, ie, above 15MHz could be better. This is generally improved by the use of a low-noise pre-amplifier ahead of the receiver. A tuned pre-amplifier or even an antenna tuning unit will improve image rejection above 15MHz.

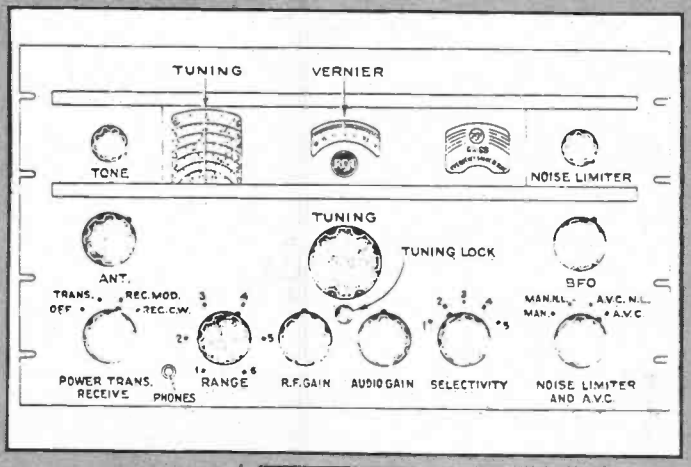
Although the electrical and mechanical design is inherently stable there is often a problem with frequency stability and re-setability above 15MHz. This derives from several causes – mainly a direct result of the age of the specimens available. Firstly some 6J5s tend to be microphonic and careful selection is necessary. Thumping the front panel is a good test and tapping the valve envelope. On a secondhand receiver of this vintage there are often bandswitch problems. Generally this is not due to wear or damage but simply dirt and grease which has accumulated over the years. It can be solved by the careful application of switch cleaner. This involves the removal of the coil-pack covers and a large number of nuts. Do make sure that you replace every one and when you gaze on the beautifully constructed coil do resist the temptation to touch it any more than is necessary!

Finally there is instability caused by ageing of components which can cause both frequency instability and gain instability. The worst offenders are capacitors used for decoupling. The capacitors used in the AR88 for this purpose are either moulded mica for small values or oil-filled paper for the larger values and both have a very good reliability record so approach this problem with care! If it proves necessary to replace any moulded mica capacitors in the RF, LO or IF sections then use only polystyrene of a suitable value and working voltage. The author discovered in his receiver that a previous owner had replaced all RF and IF coupling capacitors with Hi-K Disc ceramics; this included decoupling capacitors in the Local Oscillator and the BFO. Their replacement with polystyrene capacitors made a dramatic improvement to Local Oscillator drift.

So far no open-circuit resistors have been found but if gain or signal-to-noise ratio is thought to be below par then it pays to check screen-grid decoupling resistors/capacitors – assuming that the valve concerned has first been tested. Design of the RF and IF amplifiers is very conservative and results in stable performance. If instability is experienced when aligning the receiver then the relevant circuit components should be carefully checked.

Finally, in purchasing an AR88D, examine carefully the physical state of the equipment. In the upper end of the price range the appearance should be clean and unscratched with no sign of modification. Check that the tuning drive gears are not worn or the assembly distorted. There should be evidence of grease on the gears and the drive should be smooth and positive with no 'slop' or backlash. Ideally it should come complete with a handbook, two trimming tools and an Allen key clipped inside the cabinet. In many cases it may have the original packing crate and a spare set of valves.





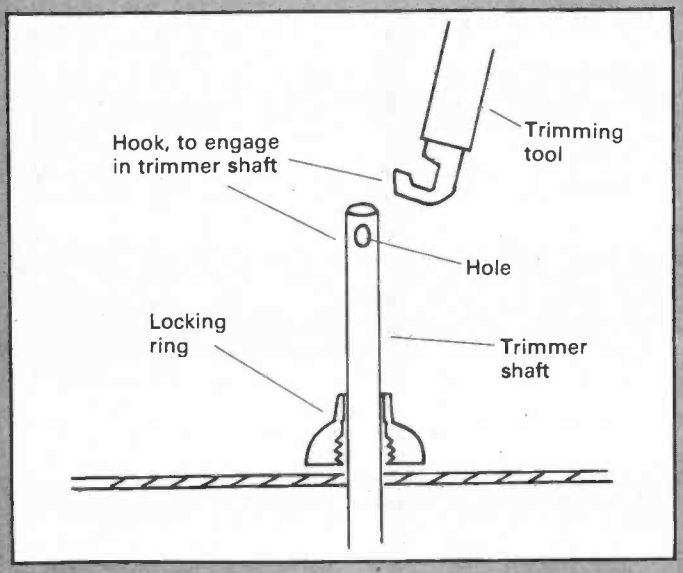
Above: With the top casing removed, this is what you see. Right: Diagrammatic version of the front panel, showing all controls, what they do. The panel should be unscratched and clean if the price is around the upper limit. Make sure the tuning drive gears are not worn or distorted. Below: IF bandwidths for all switch positions.

SELECTIVITY SWITCH POSITION	BANDWIDTH KHz	
	3dB	60dB
1	14	22
2	7.0	16
3	3.0	11
4	1.5	10.4
5	0.4	8.4

We shall now look at the alignment of the AR88. In my experience recalibration is necessary from time to time but the IF alignment deteriorates very slowly. Do not undertake realignment unless you have the time and patience to do a complete and careful job; tweaking up is not recommended!

Ideally an oscilloscope and a sweep generator is required to achieve the very best results. However, with a little care it is possible to

SIGNAL TYPE	MODE SWITCH	AVC SWITCH	RF GAIN	AF GAIN
AM	REC. MOD	AVC OR AVC-NL	CLOCKWISE	AS REQUIRED
CW	REC. CW	MANUAL OR MANUAL-NL	AS REQUIRED	CLOCKWISE
SSB	–AS FOR CW SELECTIVITY POSITION 3–			
FM	REC. MOD	MANUAL OR MANUAL-NL	AS REQUIRED	C/W
	USE SELECTIVITY POSITION 3 OR 4			



Above: This is a general guide to the control settings on AM, CW, SSB, and FM signals. There is, naturally, more information in the original manual – if you can obtain one. They are almost as valuable and rare as the equipment itself! Left: Details of the trimmer and the tool with which it can be adjusted. A well-kept AR88 should come supplied with two trimmer tools and an Allen key inside the cabinet.

achieve very good results using a high impedance voltmeter and a stable signal source – I use my BC221 frequency meter. A signal generator is preferable however for the RF alignment, provided that its calibration is reasonably accurate and it is stable. Beg or borrow one if necessary! Beware though some of the cheaper signal generators on the market have inaccurate calibration and are unstable even at 455kHz! It is essential that, with the signal source used for the IF amplifier alignment, one can estimate +/– 7kHz from the central Intermediate Frequency.

Alignment must commence with the IF amplifier. Although the handbook gives the intermediate frequency as 455kHz this is the nominal value. The value which we shall use is the actual value of the receiver's crystal filter which will probably differ from the nominal value by a small amount.

Connect a high impendance voltmeter of the analogue type (eg: AVO8 or similar 20000 ohms/volt) on its 5 volt range to terminal 5 on the rear terminal strip which carries the loudspeaker connections; the positive lead of the meter being connected to chassis. Connect the signal generator via a 0.01μF capacitor to the frequency changer signal grid (6SA7 pin). Select Selectivity switch position 5, mode switch 'REC MOD' and AVC switch to AVC (fully clockwise). Sweep the signal generator either side of 455kHz looking for maximum reading on the voltmeter. The signal generator (un-modulated) level should be reduced if necessary to keep the volt meter reading around quarter-scale and to avoid overloading the receiver. The frequency at which the maximum voltmeter reading is obtained should be noted; it should be within a kHz of the nominal IF.

In the extreme case, where no output at all can be detected, it will be necessary to roughly align all the IF transformers to the nominal 455kHz by injecting a signal at each IF grid starting with the third and working back towards the mixer grid with the selectivity switch in position 2. At each stage the IF transformers are adjusted for maximum reading on the voltmeter. However this is an extremely unlikely circumstance and one should look for faulty valves or components before making any adjustments.

To proceed with the alignment assuming that all is well and we have the signal generator set to the frequency of the crystal filter as above. Set the selectivity switch to position 2 and the crystal phasing (C75) to its mid-way position. Now adjust all IF transformers for maximum reading on the voltmeter working from the detector back towards the frequency changer; reducing the signal generator level where necessary to avoid overload. Now select selectivity switch position 3; set to the signal generator frequency 7kHz above the crystal frequency and adjust the crystal phasing (C75) for minimum meter reading. All that now remains to be done is the adjustment of the crystal load circuit. The purpose of this adjustment is adjust the symmetry of the IF response about the centre frequency nd it is very difficult to carry out with the equipment we are using here. Ideally we need a sweep generator and an oscilloscope. The following procedure can be used only with patience, otherwise leave the adjustments as they are. First tune the signal generator to approx 1.2MHz; set the receiver band-switch to band 1 and tune for maximum deflection on the voltmeter, reducing the generator output as necessary to avoid overload. Select position 3 on the selectivity switch and note the two vernier logging scale readings for which the voltmeter reading falls to half the maximum value. Adjust L34 to obtain as near equal distances on the logging scale for these two readings either side of the setting which gives maximum reading. This procedure is repeated for selectivity switch positions 4 and 5 adjusting L81 and C80 respectively. Note that the dial readings and the adjustments will become progressively smaller and more critical.

All that now remains is to set up the BFO. Using the above set-up, tune the receiver for maximum reading on the voltmeter. Set the BFO pitch control so that the pointer is at the 12 o'clock position (check that the variable capacitor coupled to this knob is at half-mesh – if not then slacken the knob and adjust it). Set the mode switch to 'REC CW' and adjust L22 until the whistle that is heard falls to zero-beat. The BFO should now give approximately 3kHz variation in pitch either side of zero-beat. Return the mode switch to 'REC MOD'.

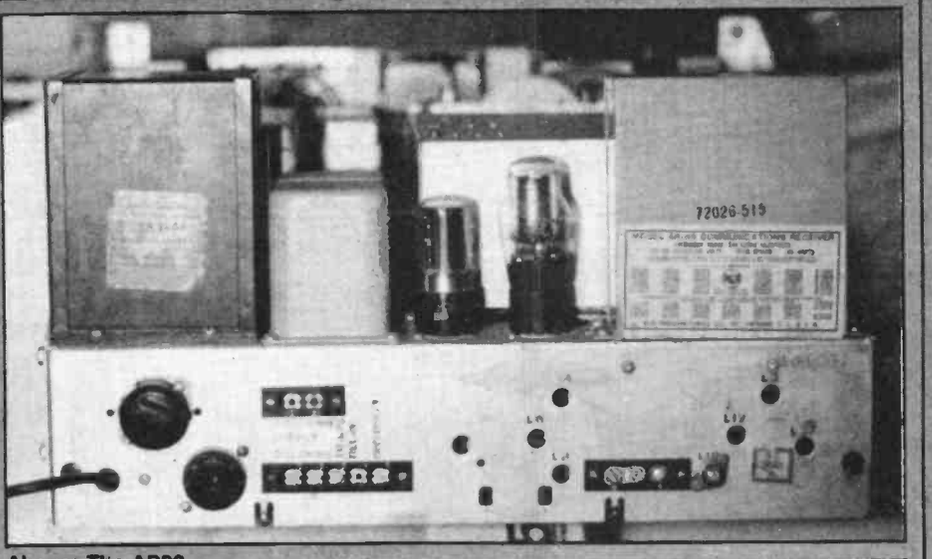
Alignment and calibration of the RF section is quite straightforward but requires even more patience! It is possible to achieve very close agreement with the dial calibration over the whole of each range even though only a two-point tracking

system is used (this is due to the design of the ganged tuning capacitor). The accuracy to which the dial can be set is only about +/– 5kHz but this is probably superior to most signal generators with an analogue readout. If a frequency meter of the BC221 class is available – or even a 100/1000kHz crystal calibrator then this can be used to put the finishing touches to the calibration but the initial calibration and alignment should be done with a signal generator. The reason for this is the poor image rejection at frequencies above 10MHz – particularly when the receiver is not correctly aligned – which could lead to the receiver being aligned to the wrong signal.

It will be found necessary to repeat each sequence several times before optimum calibration or performance is obtained. The procedure is as follows:-

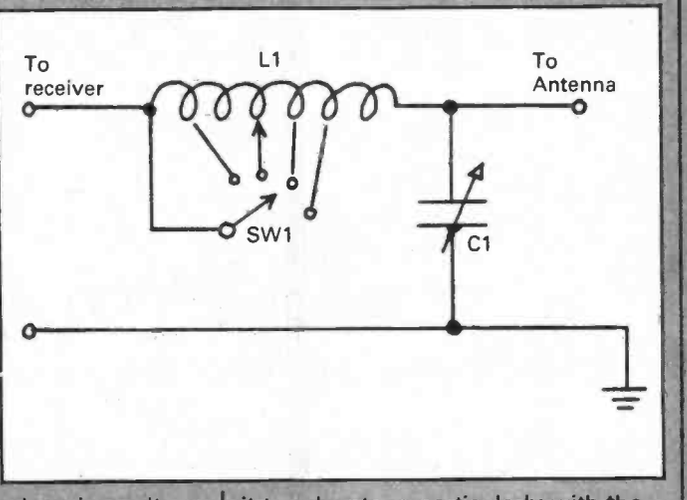
In all cases use the signal generator with modulated output since this makes it easier to identify. The output level should be set to produce a one or two-volt reading on the voltmeter and should be reduced where necessary to avoid overloading. Set the generator frequency to the high frequency for the band concerned and tune the receiver to find it. Adjust the appropriate trimmer to bring the signal near to the correct dial reading. Now set the generator to the low frequency and adjust the appropriate trimmer to correct the calibration. Repeat this procedure until the two signals appear at their correct dial readings. The trimmers concerned should be adjusted using the tools provided with the receiver. At the low frequency end this involves the core of an inductor and an insulated screwdriver blade is suitable. At the high frequency end, trimmer capacitors are involved which are of an unusual tubular construction. The AR88 tool provided for this has a box-spanner at one end to release the friction lock and at the other end there is a hook. After releasing the locking nut so that the central part of the capacitor will just move this central part is adjusted by sliding it in or out by engaging the hook on the tool in the shaft end – see fig. 8. Remember to lock the trimmer when adjustment is complete.

The RF amplifier is adjusted in a similar way. The antenna trimmer on the front panel should be initially set to the 12 o'clock position. With each adjustment tune for maximum voltmeter reading repeating the adjustments until no further improvement is obtained. As each stage comes into alignment the generator output should be reduced to avoid overload; the final output level should be around a microvolt or less.



Above: The AR88 with its rear panel removed. Right: A simple antenna tuning unit for the frequency range 1.5MHz to 30MHz.

C1 500pt variable capacitor.
L1 35 turns 18 SWG enamelled copper wire on 2 inch former (eg a length of plastic drain pipe) tapped at every 3 turns.
SW1 12 way rotary switch eg R.S. heavy duty.



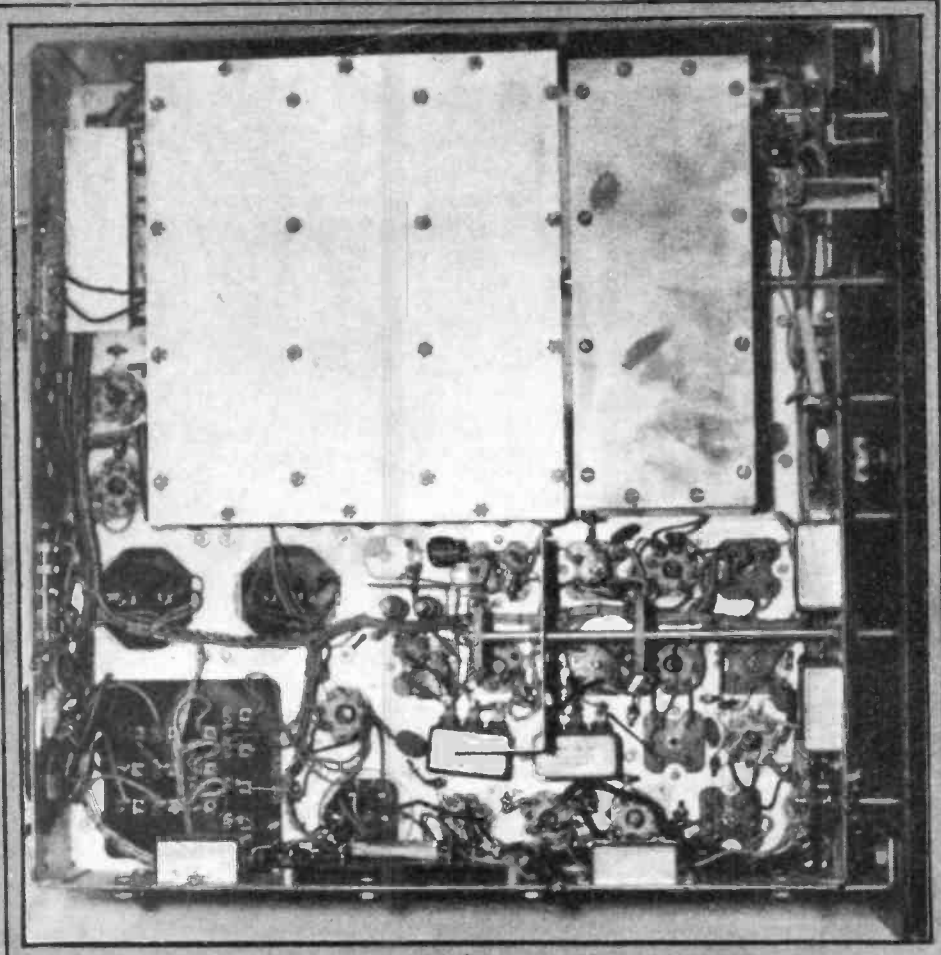
A final check should be made by setting the signal generator to a frequency in the middle of each band and checking that it appears in the right place on the dial. Adjust the antenna trimmer for maximum output and check the level of the image signal by tuning the generator to a frequency which is 910kHz (ie, 2 × IF) above the frequency to which the receiver is tuned. If the generator has a calibrated attenuator you can estimate the image rejection ratio by adjusting the generator output until you obtain the same reading on the voltmeter as you had at the correct response frequency. The ratio of the two readings is the image rejection ratio.

The receiver is now aligned and ready for general use. One final touch whilst we have the test gear to hand is to note the logging scale readings for each of the amateur bands – including the three new ones – using a crystal calibrator if you have one.

Finally let us look at the operation of this receiver. It is not intended to give a blow-by-blow description but rather to concentrate on how to use it to advantage particularly with the two modes for which it was not specifically designed. It was originally designed for reception of telegraphy (CW) and amplitude modulated telephony. With a little understanding it can be used effectively for SSB and narrow-band FM also.

The mode switch in the bottom left-hand corner of the front panel has four positions; 'OFF' removes the mains supply completely. In 'TRANS' the HT supply is removed putting the receiver in a standby mode. In this position terminals 3 and 4 on the loudspeaker terminal strip are shorted together and can be used to energise an external relay for transmitter operation. In 'REC MOD' the receiver will receive modulated transmission whilst in 'REC CW' the BFO is energised for CW reception.

The switch in the corresponding right-hand position controls the AVC and Noise-Limiter and is self-explanatory. The noise limiter threshold is set by the control above the BFO pitch control. There is a combination of these controls which should be used as a general guide for reception of the various modes but which may well be modified by conditions prevalent at the time. Let us now look at some of these in



This is the view you get if you removed the bottom housing from the AR88. The inner casing on the right houses the oscillator coil pack, by the way.

more detail:-

First the reception of CW, ie, telegraphy. Here we have in effect a single frequency and all we have to do if there is no interference is to tune for maximum signal and set the BFO pitch control to give the required beat-note in the headphones or loudspeaker. In general the receiver is used with the AVC off so that the BFO injection does not reduce the receiver sensitivity. The AF gain is set fairly high and the receiver gain is controlled by the RF gain control. Of course this ideal situation rarely exists; there is usually an abundance of adjacent-channel interference and this is where we learn to 'drive' the receiver. Clearly we have a case for using the crystal filter and the technique is best practiced on a strong signal such as one of the broad-cast stations in the 7MHz amateur band. Switch the selectivity switch to position 3 and the BFO pitch to one side of the zero position – say to 1 o'clock.

As you tune through the signal note how the strength of the beat-note is much stronger on one side of zero-beat than on the other. Shift the BFO pitch control to say 11 o'clock and note how the position is reversed. Put the BFO in the zero position and the beat-note strength is the same on both sides of the zero-beat position. Repeat the exercise with the selectivity switch in positions 4 and 5 and note how very much more pronounced the effect is.

We make use of this effect in receiving CW in two ways . Firstly, if possible we tune the wanted signal so that it sits at the top of the IF response curve – with the BFO on one side or the other of zero – and unwanted signals down the side of the response and therefore attenuated. If the unwanted signals are very close to the wanted signal then we can do one or two things; both using maximum selectivity. We can adjust the BFO to the other side of zero-beat so as to make the interfering signal differ more greatly in beatnote, or adjust the BFO pitch to reduce it to zero-beat. Alternative we can adjust the receiver tuning to place the offending signal further down the side of the IF response at some sacrifice in the strength of the wanted signal. All this may sound difficult but it becomes quite easy with practice.

Now let us look at SSB. In selectivity position 4 it is possible to select each sideband of an amplitude modulated signal – and again there are an abundance of broadcast intruders in the 7MHz amateur band on whom to practice. If we tune carefully across an AM signal with the BFO and AVC off, two points, one on either side, should be found where the signal becomes unintelligible. At these points we are receiving a single sideband only and the carrier is positioned down one side of the IF response curve. Now switch on the BFO; a beat note will be heard. As the beat-note is adjusted for zero-beat the signal should become increasingly more intelligible. Note the position of the BFO pitch control and repeat with the other sideband. The two positions of the pitch control will be roughly correct for receiving amateur SSB and can be 'refined' by first tuning AM SSB signal for maximum signal, then adjusting the pitch control to make the signal intelligible.

The reception of narrow-band FM, which is becoming quite popular at the HF end of the 28MHz amateur band, is also quite simple – and there are always plenty of CB stations on 27MHz to practice on! The technique, known as slope detection, uses the IF response curve to convert the frequency modulated signal into an amplitude modulated signal and in doing so there is a loss in signal strength, but this is rarely appreciable. The FM signal is tuned using selectivity position 3 or 4 so that the centre of the signal lies down one side of the IF response curve. Frequency modulation produces variations about this central frequency which in turn move the signal up and down the 'slope' of the IF response resulting in an AM signal to the detector. The above techniques are shown graphically in fig. 10.

Well, that was a much-abbreviated run through on how to drive the AR88; the key-word here is practice. The receiver will acquit itself well, even with a piece of wire on the floor for an aerial – but of course it deserves better. The aerial input circuit is designed to match into an impedance of 200 ohms but I have found it will work very well with a 70 ohm coax feeder. A random wire antenna coupled via a tuning unit (for example fig. 11) will give very good results and the tuning unit will help also to reduce image interference on the 21 and 28MHz bands.

Being a general coverage receiver it comes ready equipped for the three new amateur bands of course. Buy an AR88 and enjoy a real receiver.

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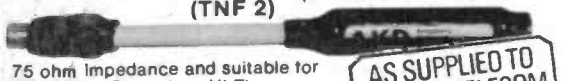

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A PUT UP JOB

Buying and erecting your aerial is simple, but an important part of the shack, says Peter Dodson

Just about everybody from the smallest teeny-bopper breaker to Terry Wogan's friend the DG *must* know by now that a radio transmitter or receiver is only as good as the antenna to which it is attached. They may not know this is so, but at least they appreciate that antenna effeciency is not a matter of sticking a bit of wire on the end and hoping for the best.

To some extent, the quality of antenna fitted to an amateur rig is dependant upon the price he is prepared to pay for it. But inasmuch as the enthusiast of today does not have the time, or possibly the inclination to actually build his aerial, there are many firms who are only too willing to relieve him of this chore. And apart from anything else, the construction of an accurately balanced antenna is a lot more difficult than many imagine. Not so systems-orientated as CB enthusiasts, the expertise in choosing the correct gauge of metal with which to build an antenna does not exactly fall within the skills of an amateur radio type anyway.

Taken at face value, providing this service for amateurs is good for the enthusiasts, in that healthy competition will provide him with best gear at an acceptable price, and it is good for industry in that it provides employment in these difficult times. On the other hand, it has led to the mushrooming of many firms whose products are not "of merchantable quality" and whose specification claims are not only false but technically impossible! So, in an attempt to sort out the wheat from the chaff, *Amateur Radio* invited itself along to the Northampton firm of Jaybeam to see how their products are made, how they can justify their claims of high-accuracy systems and exactly what was down to the amateur once he opened the neat box his antenna system arrived in.

And with 30 years of experience in the field, a healthy export trade and contacts with government departments concerned with communications to back their integrity, Jaybeam qualify as one of the 'goodies' in the business. On the

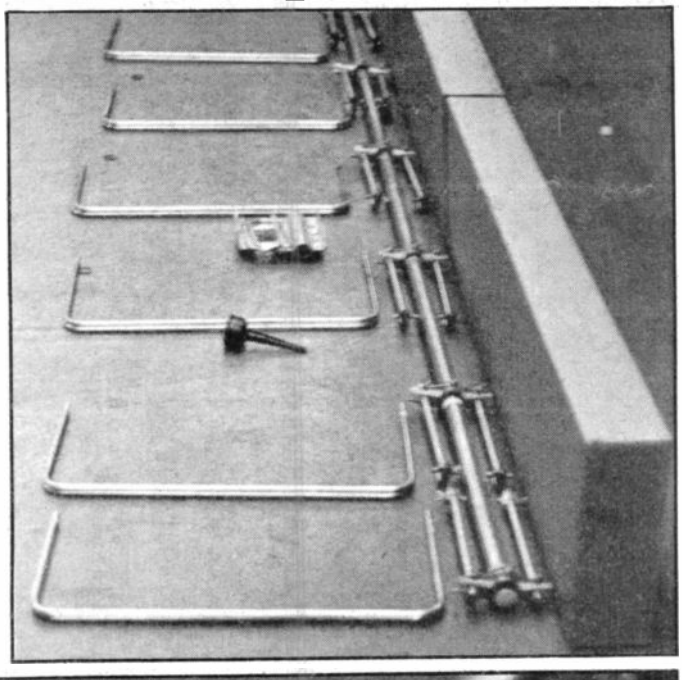
Perhaps the ultimate in two metre antenna systems – the Q62M, soon we hear, to be superceded by the Q82M. Even more ultimate? The antenna pictured costs £34 and weighs only 3.5kg. Jaybeam say it requires an approximate turning radius of 1.28 metres.

home market, they are enjoying something of a boom brought about to some extent by the dissidents from the world of citizens band radio having been disillusioned by the limited scope in that area and who want something better. From 27,000 licences, the number of amateurs has risen to an estimated 40,000. At the same time, the feed back from commerce, besetted with advanced electronics has meant that the use of such items as slant and circular polarisation and inverse baluns, hitherto the tools of telecommunications, are now freely available to the amateur. To quote another couple of examples, where additive gain is required, stacking or baying two identical antennae at a spacing greater than one wavelength offers a further 3dB gain – although this distance is not critical and 1½ wavelengths seem to be about the norm. Furthermore, modern amateur antennae can be mounted for horizontal or vertical polarisation and by phasing cross yagis correctly, it is possible to obtain circular polarisation and so vastly reduce signal fluctuation due to tropospheric conditions. So, provided that the now standard 50 ohm impedance is used throughout the system, many of the QSB problems of the past have been eliminated.

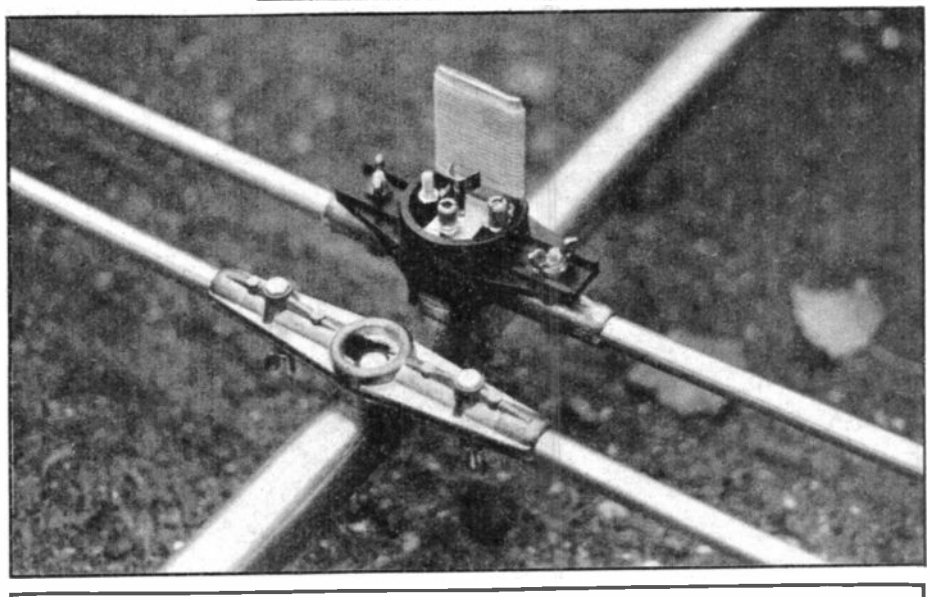
A means of rotating the beam

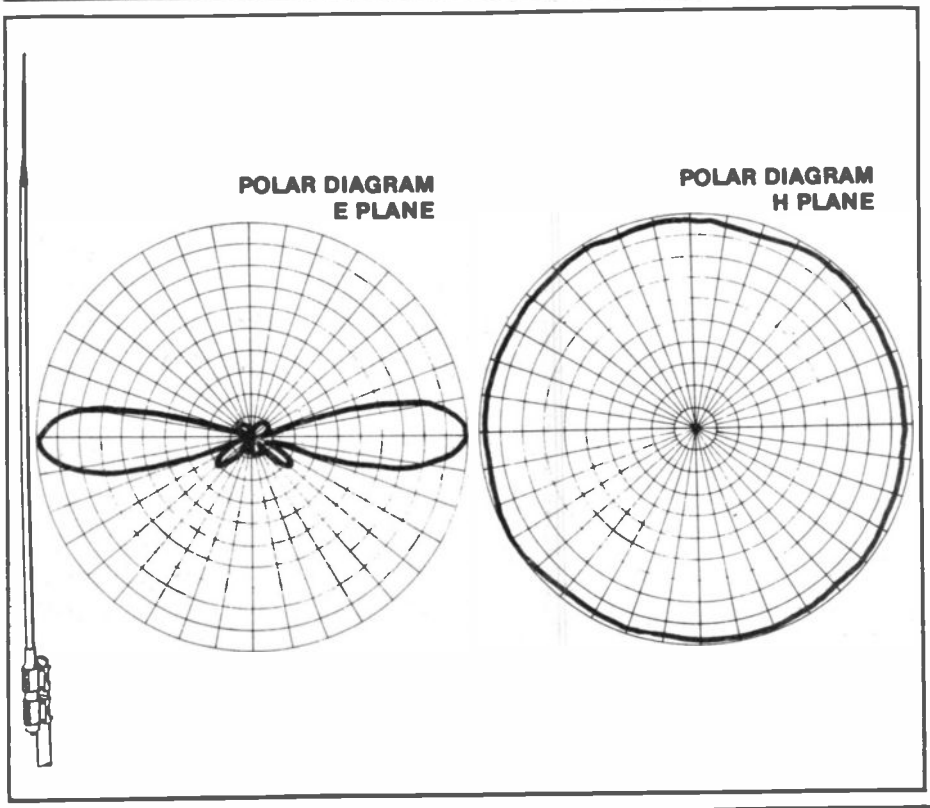
Jaybeam currently market some 29 different types of amateur antennae. These vary from a simple dipole with director and reflector to their sophisticated Q6/2M 'Qued' – claimed to be one of the most advanced of beams which, incidentally, will shortly be replaced by a veritable monster with no fewer than eight elements. The range of available antennae are, for the most part, directional units based, of course, on the dipole and varying from a boom length of 420cm to nearly six metres with multiple directer units. There are other types available including bi-directional dipole derivatives and rods for omni-directional operation.

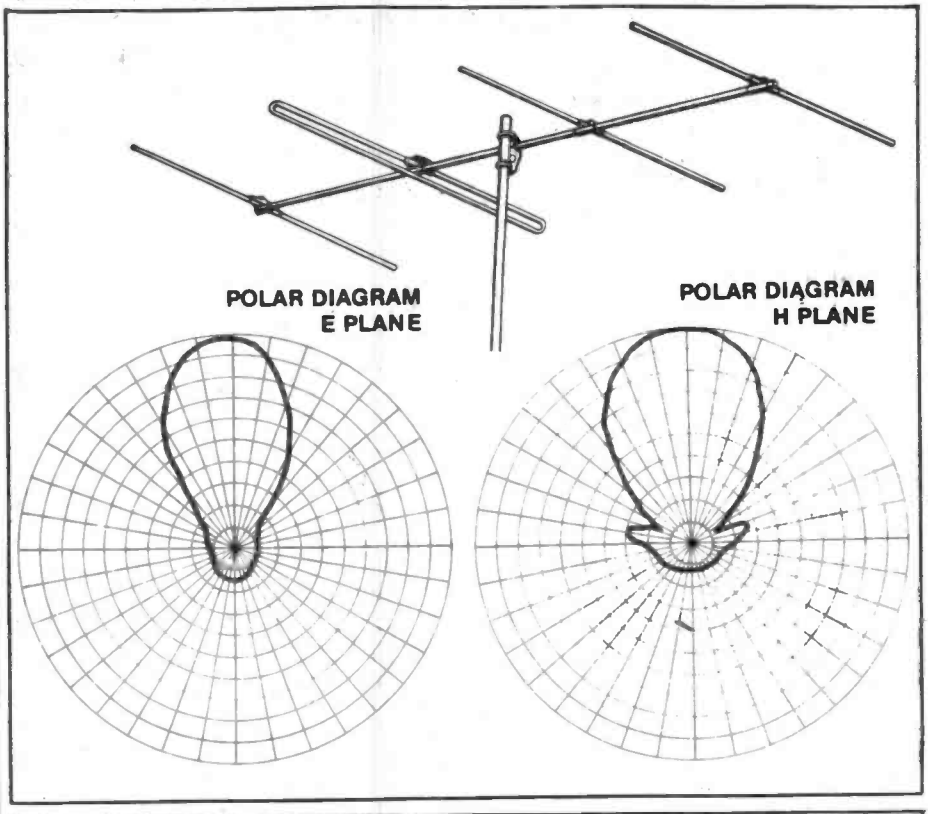
But whereas the customer who wants an omni-directional rod has only the problem of getting it aloft to worry him, those requiring uni-directional beans have two unless they are prepared to face the same

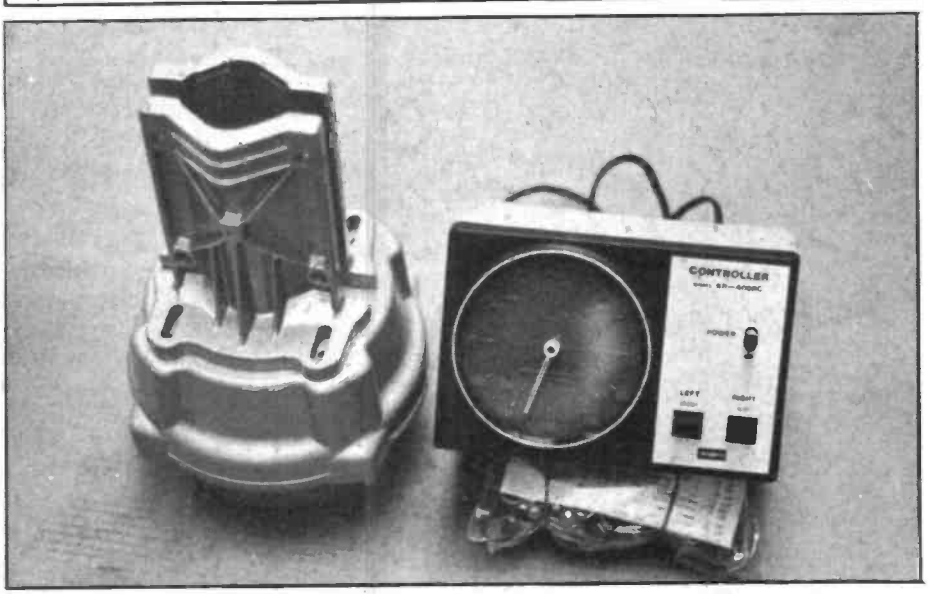


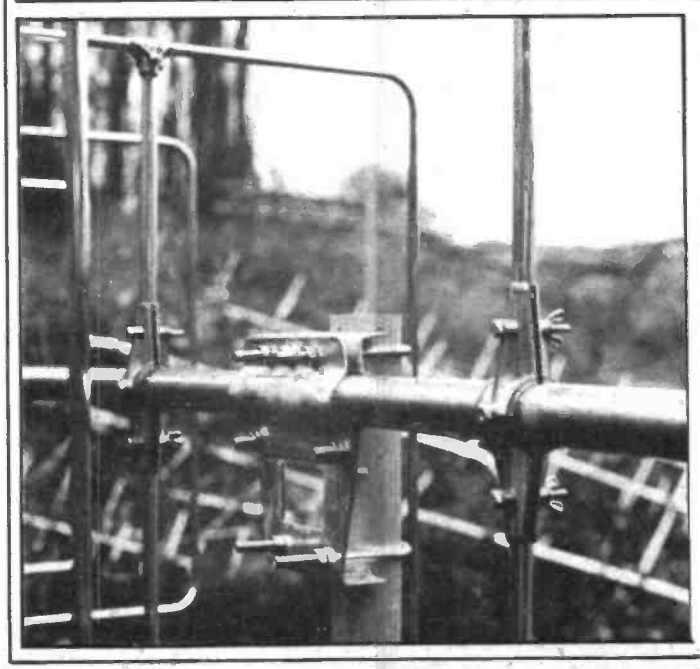
Right: This is what you'd get if you bought a Jaybeam antenna. Well packed with all the bits and pieces for assembly. Below. With the top housing off, the inverse balun, patented by Jaybeam and ensures correct balance of the whole system. Bottom: The C5/2m Colinear omni-directional pole, suitable for use on the 144-146MHz band. Cost is £47.50.











Top: Cheapest of the best selling uni-directional beams is this £26 4Y/4m, a folded dipole yagi for the 69-71MHz range. Above: Rotor and rotor alignment bearing. Speed is one rpm, it is permanently lubricated and the bracket can cope with masts of more than 2in. Beats doing it by hand . . . Left: Antenna-to-pole clamp. Most, if not all, parts are rust-proof, although we would recommend a coat of paint on the hard metal areas and threads to help protect against corrosion.

way and talk to the same people every day which is tantamount to getting married! No, they must provide themselves with a means of rotating their beam – and the means to attain this will cost more than the average antenna! Nevertheless, attaining maximum elevation of antenna, in a safe and secure manner is the problem for all amateurs. Over 90% of them mount their antennae on towers or poles supported by ropes or hausers. Usually, the masts are hinged a couple of feet above ground level to a base deeply embedded in the earth or preferably sunk in concrete like the wife's whirligig. This, incidentally does not constitute an intention to get her one, any more than she has licence to run her smalls up your mast! And having made the hinge from the thickest nut and bolt available, the mast can be lowered and raised to facilitate mounting and subsequent alterations to the beam.

Those who live in high-rise flats have a problem

Conversely, for those whose domestic situations do not include a garden of sufficient dimension to allow for the lowering of the mast on its hinge (or for those who have no garden at all) some other system is necessary – and this must include brackets to attach the mast to the side, or the corner of, a building. Those who live in high-rise flats now have *another* problem! But although good amateur antennae are made to withstand gale force winds of up to 80 mph, a few Rawlplugs and handful of screws are not! The strain on the mounting points of even the smallest of beams is considerable and it follows that the attachment of brackets is a through-the-wall job with some pretty hefty nuts and bolts. This may well cause domestic complications should you inadvertently drill into the back of the freezer! As an alternative, it is possible to 'band' brackets to chimney stacks which gives the added advantage of a little more height and reduces potential damage to the loss of chimney in the event of a tornado instead of tearing out the side of the house!

Jaybeam antennae are supplied in kit form to be assembled at home, packed in such an expert manner

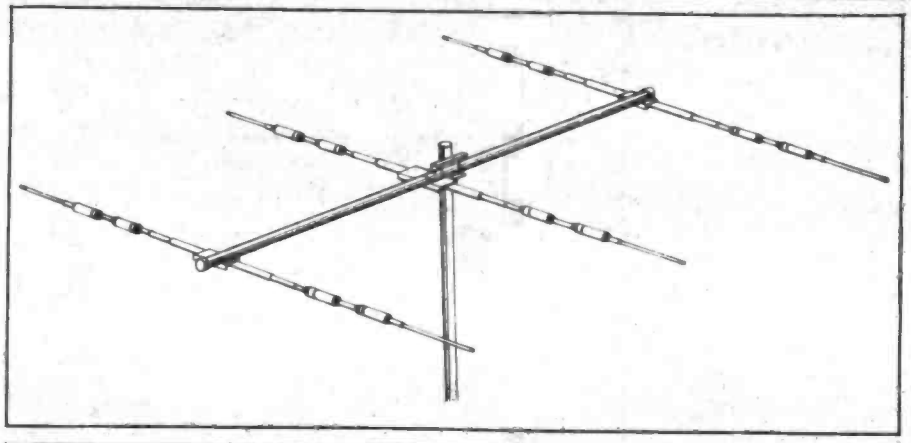
that, should the customer change his mind after unpacking, no way will he get it back in the box! This is known in the trade as 'customer captivation'. They arrive, complete with fitting directions and taped colour coding to ensure that the right elements are attached in the correct position. All the units can be put together with nothing more sophisticated in the way of equipment than a spanner and everything necessary, down to the fixing clamps, is provided. The only other necessity is a little patience, and if all else fails, read the instructions!

Everything necessary is provided

By way of providing a comparison to others, Jaybeam prices range from around £10 up to £165. Where applicable, their beams are fitted with patented 14° slot dipole (and slot reflector), are equipped with inverse baluns and have specially strengthened element securing devices. The five most popular antenna systems includes their C5/2m Colinear omni-directional pole antenna, which retails at £47.50. Suitable for use on the 144-146Mhz band, this system has a gain of 4.8dbd (all measurements are taken against a half wave dipole) with a peak power rating of 250 watts. It has a verticle beam width of 24° and most of its four metres length is shrouded in fibre glass.

However, the cheapest of the four best-selling uni-directional beams comes at £26.00 being the 4Y4M, a folded dipole yagi for the 69-71Mhz range. Claiming a 7dbd gain and rated at 1Kw P.E.P., this unit has a 3dB beam width, horizontally, of 58° and a boom length of 2.3 metres. On the other hand, for the 430-440Mhz enthusiast, there is the PBM18/70CM, consisting of 16 directing elements, a slot dipole and reflector for as little as £28. With a boomlength of 2.8 metres, the antenna is getting on the long side, but it does boast a 3dB beamwidth of 25°, or horizontally, 28°.

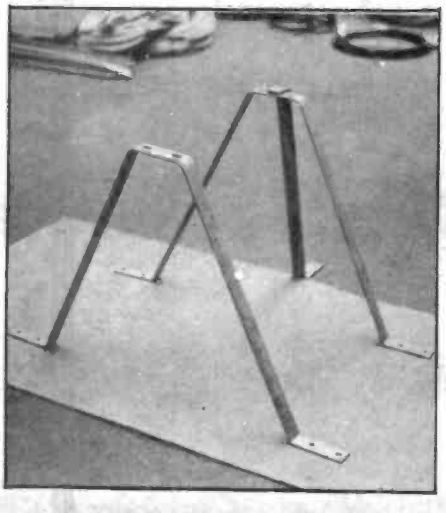
Up now to the ultimate in two-metre systems with the Q6 2M, soon to be superceded by the Q8 2M. For £34, this beam offers a 10.9dbd gain with a front to back ratio of 22dB. It does, however, require an approximate turning radius of 1.28 meters and is power rated at 1Kw P.E.P. Surprisingly, as with all these antennae, it is very light, weighing only 3.5kg. Finally,



Top: Jaybeam's TB3 is a Tribander measuring 51mm boom diameter, and 420cm boom length. This one costs £165 but retains a peak gain of 8db and maximum intput power of 2kw PEP. Above: The PBM14/2m is a panabeam yagi with a length of nearly six metres.

but still with the two metre enthusiast, is the longest system of all, the PBM 14/2M a panabeam yagi with a beam length of 5.95 metres which takes three people to assemble and mount. It can, however, provide a peak gain of 13.7dbd and has a front-to-back ratio of only 18dB.

It is perhaps significant that one of the smallest arrays in the Jaybeam range, measuring only 51mm in boom diameter, costs £165. It is, however, a Tribander containing all the convenience and band versitality that its name implies, yet retaining a peak gain of 8db and a maximum input power of 2Kw P.E.P. Big, as they say, is not necessarily beautiful!



Above: All Jaybeam antennas will mount to walls and poles. Corners of houses a speciality! These two brackets are for the bottom of the wall support, and part way up the pole.

Supplying the POWER

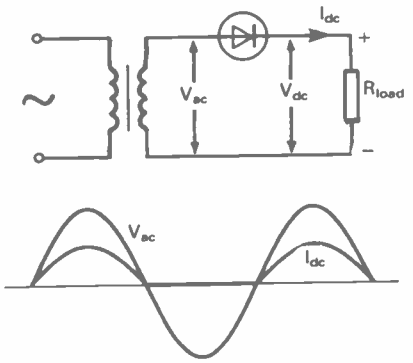
. . . the right amount of power, that is. Power supplies should transform, rectify, and smooth the public 240 volts 50Hz down to the necessary level. Nigel Gresley tells us all about it.

What's a power supply? Well, it's what supplies power to your wireless set – or, to be more precise, the bit of gubbins that takes the volts and amps from the mains and converts them into the sort of volts and amps that your wireless needs in order to do its things.

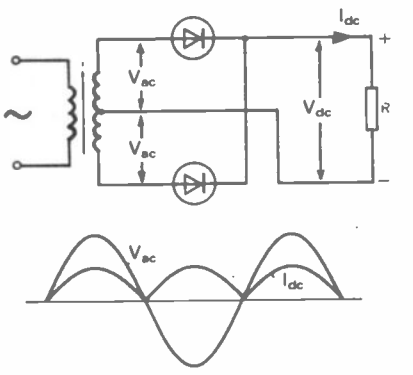
A battery could be classed as a power supply, actually, but it wouldn't be much good for something full of valves, so if we say "power supply" we mean something that gets plugged into the socket on your wall and converts the urge therefrom into something palatable to your electronic whatsit.

Obviously, if you simply plugged your little transistor radio into the wall, there'd probably be a loud bang and a nasty smell; it'd upset the shack moggie as well as rendering the trannie rather useless for anything ever again. This is because it's likely to need about 9 volts (from a battery or something) to work, whereas there are 240 volts available at the wall. 240 volts applied to something that needs 9 is likely to cause something extremely unpleasant to happen in about two-millionths of a second. So how do we convert 240 volt mains supplies to 9 volts, or 500 volts or 5 volts or whatever it might be?

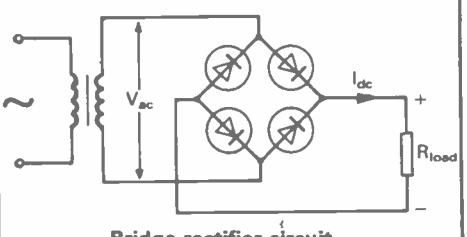
This is the job of the power supply in one form or another. Before we kick off, though, there's one other thing we ought to mention. Electronic things usually need what is known as **direct current** in order to function; DC is what a battery provides, for instance, and it's just current that flows in one direction only. Electric current is conventionally assumed to flow from the positive terminal of a supply to the negative one, so if you connect a piece of wire to the positive terminal of a battery and then tap it on the negative terminal, you can imagine the current galloping down the wire from the positive to the negative terminal. Actually, if you did that with a battery of any reasonable capacity, there'd be so much current that the wire would get rather hot, and the battery wouldn't be much good for anything afterwards; so I wouldn't try it if I were you!



Half-wave rectifier and waveforms



Full-wave rectifier and waveforms



Bridge rectifier circuit

Leaving out the esoteric scientific experiments, then, current flows from positive to negative, and direct current just does that – nice and easy to understand. The other sort of current, which is what emerges from the natty 13amp socket on your wall, is known as **alternating current** – yes, Mavis, that's right, because it alternates. "Alternates between what and what?" I hear you ask, Well, it alternates between a positive and a negative value with respect to a fixed point which can be earth or, as in the case of a mains supply, something called **neutral** which is nearly the same as earth only not quite – don't worry about it, it's all those nasty electricians trying to make life difficult. The mains does this fifty times a second – in other words, you could say that every fiftieth of a second it starts from a value of zero, goes up to its maximum value, comes back down through zero, goes to its maximum negative value and returns to zero. If that makes you dizzy, don't worry about it.

Now you might ask yourself, why the hell go to the trouble of generating alternating current? What's wrong with something nice and simple like DC? Well, the great thing about AC is that it's ever so easy to use a thing called a **transformer** to raise and lower the voltage to whatever you want. A transformer is just some coils wound on a core of some sort, and we're emphatically not going to go into transformer theory here because it's enough to rot your socks; all you need to know is that you can use it to change the value of an AC voltage with great ease. Practically every mains-type power supply for amateur work has a

Supplying the POWER

transformer or two somewhere within its bowels, and if it's a big one such as you might use for a valve linear amplifier, it's what gives you instant hernia when you try to lift up the power supply.

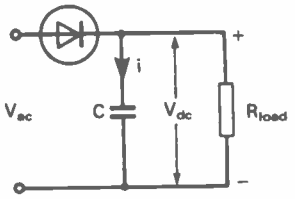
Transformers can either step up or step down. If you're into transistor circuitry, you might need a transformer with the ability to change 240 volts AC from the mains into, say, 12 volts for the power supply for said transistory. A couple of names for you, by the way; the transformer is likely to have two windings, if not more, and the winding you connect to the mains, the 240 volt winding, is called the **primary**. The "output" windings, if you like, are the **secondary** windings. So a transformer for use in a power supply, or a mains transformer as you'll sometimes find it called, will usually have one primary winding and anything up to seven or eight secondaries of various voltages.

To get back to our example, the transformer primary winding, which you'll often hear shortened to just "primary" by the way, would be wound for 240 volts and the secondary for 12 volts. Transformers are usually clearly marked as to which winding is which, and for God's sake don't use them the wrong way round or there are likely to be all sorts of smelly things taking place. Be warned: the smell of burnt transformer windings lasts for days and the family dog won't come anywhere near you.

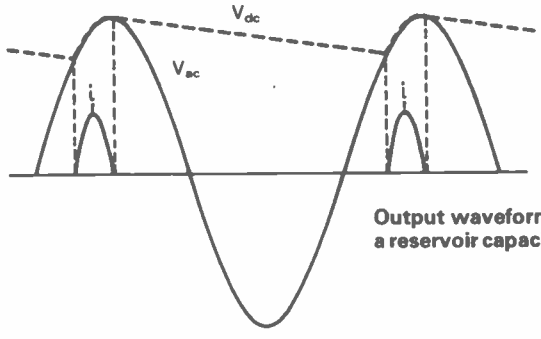
OK, we've got our 240 volt mains down to 12 volts, which sounds a bit more reasonable if we're into transistor circuits. So can we just connect the transformer secondary to our transistorised widget and blaze away?

Well, no. You'll remember that the mains is AC and the transformers will only work on AC – so what comes out of the secondary is 12 volts alternating current, not the direct current we require for our electronics. It all depends on the circuitry, but most electronics would take to having 12 volts AC supplied to their power supply inputs about as much as I'd take to eating Ex-Lax instead of After Eights . . . so the next job is to suss out how to convert AC into DC.

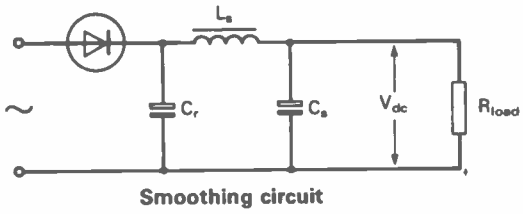
It isn't all that difficult actually. The first essential is something to chop off the half of the alternating waveform we don't need, so that instead of getting true AC which goes positive and negative, we get pulses of volts



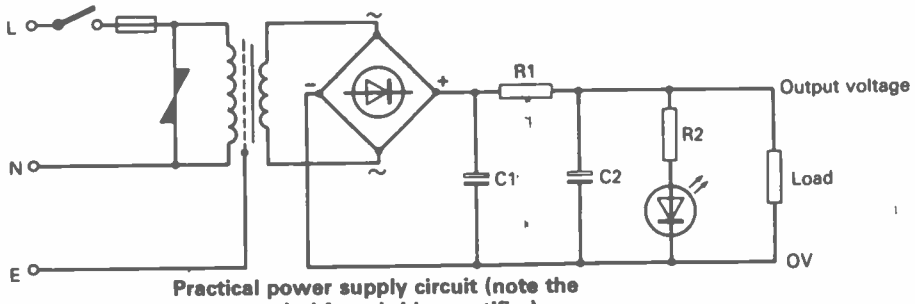
The reservoir capacitor



Output waveforms of rectifier circuit using a reservoir capacitor



Smoothing circuit



Practical power supply circuit (note the symbol for a bridge rectifier)

which go the way we want them to – see the diagram. This little something is called a **rectifier** – don't ask me why, it sounds positively naughty to me – and you buy them in the shops according to what voltage and current you want them to handle. We'll get to the details later on, but the usual rectifier these days is a **semiconductor diode**. Here again, don't worry a bit about the fancy words, just bear in mind that the general idea of the things is to lop off the half of the mains cycle, or in fact the cycle coming out of the transformer secondary, that we don't need.

Now there are various ways of attaching rectifiers to transformers, and the two chief ways are called **half-wave** and **full-wave**. The half-wave is the simplest but it isn't very good for anything at all so we'll ignore it for now and concentrate on the full-wave variety. As you can see from our pretty diagrams, it comes in two basic sorts as far as we're concerned. These are the **bridge** and the **biphase half-wave**. Sorry about this – it gets better in a bit. You'll sometimes hear people refer to the biphase half-wave as a full-wave, but the first is more correct so we'll stick with it even though it's a mouthful. Mind you, think of how you'll impress the lads at the club when you discourse learnedly about your biphase half-wave rectifier. But just mind you don't get arrested . . .

They both do the same job, more or less. The thing is that the secondary of the transformer needs something called a **centre tap** if you're going to use a biphase with it. Many transformers do, especially older ones, and it just makes life slightly easier.

The thing about the full-wave rectifier in either form is that it makes more efficient use of the

Supplying the POWER

transformer because it doesn't just chop off the half-cycle but sticks it in between the others, if you see what I mean. On second thoughts, don't worry about it, just have a gander at the diagram.

So – when we've transformed and rectified the voltage coming out of the mains, can we connect up and switch on? In actual fact, we *could*, although the results still wouldn't be real DC because the voltage coming out of the rectifier is pulsating instead of steady and your electronic thingy will probably throw its hands up in horror and sulk in the corner if you ask it to put up with the rectified output on its own. We now need to find some way of smoothing out the peaks and valleys so we end up with a nice steady direct current such as you get from a battery. And the name of the other component on our shopping list is a **capacitor**.

Old textbooks refer to it as a condenser, but a capacitor is what you ask for nowadays. For a low-voltage supply it's probably going to be a plastic tube with a couple of terminals and some weird letters and figures stamped on it. The idea of a capacitor (this is where we condense pages and pages of textbooks into three sentences) is to store electrical energy and release it as and when we ask for it, and the general idea in our power supply is to stick a suitable capacitor across the rectified output terminals in order to smooth the supply – a capacitor doing this sort of job is known as a **smoothing capacitor**, (surprise surprise) and the size and value of it depend on what the power supply is supposed to do for its living. Capacitors have values measured in units called **microfarads**, or at least smoothing-type capacitors do, and you choose the value according to how much current you want the supply to deliver. We'll get to that in a minute.

You could say that the capacitor delivers energy in between the times that the rectifier can't, and it gets recharged when the rectifier is actually delivering something. Here again that's condensing whole chapters into a sentence, and if you'd like an explanation of it in detail try the RSGB's *Radio Communication Handbook*. It has a good chapter on power supplies and there are all sorts of graphs and charts which show you how to calculate how much smoothing you'll need and clever things like that. You'll find that after a while you get a feel for it and you'll be able to decide whether that nice capacitor at the rally for 60 pence will do the job you have in mind.

Skipping rapidly on, there are a few other important points about capacitors before we plug in and fire up. The vast majority of smoothing capacitors you'll encounter in your amateur career are of a type known as **electrolytic**, which is another big word which describes how they're constructed. For our purposes, this implies a few points. First, they have to be connected the right way round, in other words the positive terminal has to go to the positive side of the rectifier and vice-versa. If you don't, there's likely to be a loud bang and a truly revolting smell, which as well as offending your sensitive nose will put the mockers on the capacitor in a big way. You'll probably zap the rectifiers unless you've been a good boy and put some fuses somewhere in the circuit – so do watch that. Another point is that electrolytic capacitors actually need volts on them to "form" the capacitance and if you don't use an electrolytic for a year or two it'll deteriorate and lose its capacitance. It'll also get slightly "leaky" which means that a fair amount of current will flow straight through it and do nothing useful other than to heat it up. Heating it up is the worst treatment for it because the hotter it gets the leakier it'll get until eventually something has to give and either the fuses will blow (if you're lucky) or the capacitor (if you're not). Result? A smelly mess. Why is it, by the way, that whenever things go wrong with a power supply there's generally an awful smell?

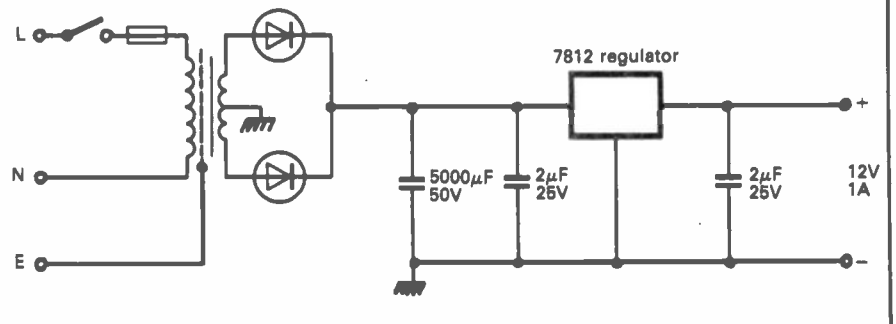
Don't use a 100 volt working capacitor with the 100 volt secondary

The way to treat the nice electrolytic you found at the rally and whose age is a bit uncertain is to connect it up to a source of its normal working voltage (oh yes, I should have said – all electrolytics have a rated working voltage which you musn't exceed or there'll be the usual consequences) via a nice high-value resistor to limit the current to something safe and leave it for an hour or two. I generally aim for a resistor value which will allow only about one milliamp to flow – Ohm's Law rides again – with a multimeter in series so as to monitor the current flowing and leave it for an hour or so and see what happens. Most electrolytics which are going to be any good at all end up with a lot less than one milliamp of "leakage current" flowing in them after this sort of period, and I'd then feel happy about putting the capacitor into service.

This process is called "re-forming", by the way, and I'd recommend it for use with all electrolytics of unknown vintage. It's an especially good idea if you're interested in a high-voltage power supply for anything with valves in it like linear amplifiers, and it's a good idea to do it for every capacitor in a "bank" of them which you're going to use for the EHT supply of a big linear. That way you'll avoid expensive problems later on.

You might see a legend such as "1000 μF 100V" on a capacitor which you might use for a small transistor-type power supply. These mean that the thing has a working voltage of 100 and a value of 1000 microfarads. Remember that a transformer secondary of 100 volts means in the real world that you'll see about 141 volts across the smoothing capacitor associated with any power supply you build using that transformer, because for a full-wave rectifier you have to multiply the transformer secondary voltage by 1.41 to get the peak voltage which will appear on the capacitor. So don't use a 100 volt working capacitor with the 100 volt secondary of a transformer because you'll get the usual smelly problem again. In this case I'd use a 160 volt unit, which are quite common.

You also have to think about rectifiers before you buy them, both because of the current you want them to supply and the fact that they're rated for a certain voltage which you musn't exceed. The thing



Practical power supply unit using ic regulator. The 2μF capacitors should have short connections to the ic to prevent any unwanted oscillation.

Supplying the POWER

to remember here is to allow for the fact that something like 1.41 times the secondary voltage appears across each rectifier of a biphase system and 0.707 times in the case of a bridge – so it's worth allowing a generous margin for surges and other odds and ends which can mean the kiss of death to rectifier diodes because they're very sensitive to too many volts. If I was using a 100 volt secondary and a biphase rectifier I'd probably use diodes with a rating of at least 400 volts just to be on the safe side – they don't cost any more than lower-voltage components and you tend to feel happier about things that way. The rating you're interested in will be written in the catalogue or wherever as PIV or V_{RRM} and you MUST stay within it because if you don't you'll do the things in.

We've arrived at a nice steady DC voltage, have we? Yes, and we could use a basic power supply like this for all sorts of odd jobs. However, one point is that the voltage you get out of it would depend on the amount of current you wanted it to supply, and some circuits don't take too kindly to their supply voltages waving about – so you have to think about **stabilising** them. This is dead easy these days.

You can buy integrated circuit stabilisers in current ratings of up to several amps, and you just connect them across the supply, more or less, and take the stabilised volts out of the other side. The integrated circuits themselves are quite complicated but you can consider them as "things" into which you put your ordinary volts and take out your stabilised volts for whatever nefarious purpose you had in mind.

That's the very bare bones of power supplies – you could write a whole book about the fine details of them and how they work but hopefully we've given you a bit of insight into the very basics. One last word of warning though. Messing about with power supplies is great fun but, like anything else connected to the mains, you MUST be careful. Both the mains and anything over about 50 volts can kill you if you get across them in the wrong way, and even if it doesn't there's nothing quite so unpleasant as an electric shock of any sort. So by all means play around with power supplies to your heart's content but use a bit of common sense about touching things when you're plugged in. Never believe in switches – always SWITCH OFF before you do ANY work on power supplies and PULL THE PLUG OUT. It's also a good plan to fit some sort of indicator across the primary of a mains transformer (a little neon will do if it's rated for mains voltage) and put it somewhere where you can see it.

Some circuits don't take too kindly to their supply voltages waving about . . .

The other thing we ought to mention is fuses. It's a good idea ALWAYS to fit a fuse of some sensible rating to any transformer primary; don't just rely on the 13 amp fuse in the plug. It won't hurt a bit to stick a fuse between the transformer and the rectifiers either. If you have a transformer which you got at a rally and it's irreplacable, it makes special sense because you can always change rectifier diodes but transformers can't be fixed if you burn them out unless you get them rewound, and that can cost an arm and a leg. Make with the fuses, and sleep well at night!

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ALTERNATIVELY SPEAKING...

AC is simply current which changes its direction of flow, instead of going straight from positive to negative (DC). Chris Drake explains.

One of the things you'll have to get a grip on for the RAE is how AC (alternating current) circuits work. Or, to put it another way, what properties some components possess when you apply alternating current of certain frequencies to them. In this section we'll take a look at some very fundamental points from the ground up, which might help make sense of some of the big words.

It's a pretty important part of radio and electronics we'll be dealing with, so it helps to have some idea about what it's about when some Clever Dick at the club starts using words like resonance and impedance and whatnot.

To kick off then, what's alternating current? As we've seen in the section on power supplies it's just current which, instead of just flowing from positive to negative, changes its direction of flow at anything from a few times a second to many millions. The domestic AC mains changes its direction fifty times a second, which is why we say its "frequency" is 50 cycles per second, or 50 hertz. Hertz was the name of an early German radio engineer who sussed out some of the basics of radio waves, and he's commemorated by using his name to mean how often an AC wave changes its direction of flow. They used to be called cycles (which is logical enough) and you'll still come across books and magazines that use abbreviations like kc/s, meaning kilocycles per second. Since "kilo" is a prefix meaning one thousand, one kilocycle is the same as 1,000 cycles per second and in the old books it's written 1kc/s. Nowadays it's written as 1kHz, and in fact if you dial up 1kHz on an audio generator you'll hear a pure tone – well, you will if you connect an amplifier and a speaker of some sort to it anyhow!

To put us in the picture, the human ear can hear a range of between about 20HZ, or 20 cycles per second, and anywhere between 10kHz and 20kHz depending on how old you are and how good your hearing is – like many other things in life, your hearing ability as far as high frequencies are concerned gets worse with age. Since the mains has a frequency of 50Hz, which is at the low end of what people can hear, you'll sometimes hear a faint hum from electronic things when they're connected to the mains. If your hearing is good enough, you'll notice that you can hear a very high-pitched whistle from your TV set when it's switched on; that has a frequency of 15.625kHz would you believe, and it comes from the line scanning circuits in the TV set. If you can hear that, your hearing isn't at all bad.

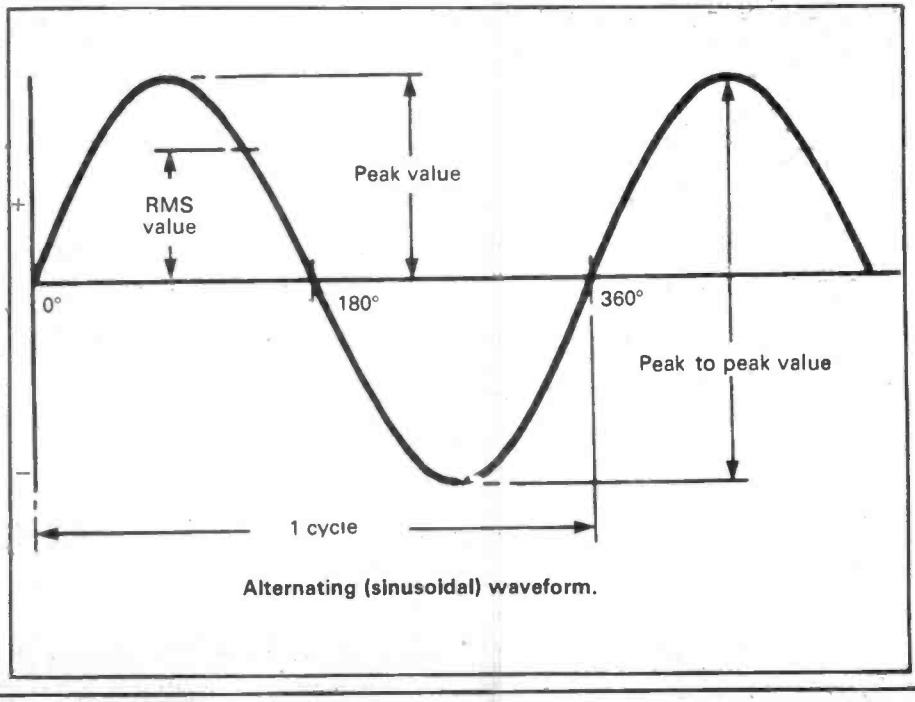
So we humans can hear AC waves of a range of frequencies between about 20 and 20,000Hz – provided, that is, they're converted into sound waves. If you just switched on your signal generator and tuned it to, say, 1kHz, you wouldn't hear a thing because although it's generating AC waves you can't detect them directly – equally, if you stood under the masts at the Rugby very-low-frequency station GBR on 16kHz, you wouldn't hear a thing either. So don't confuse sound waves with AC – if the AC has a frequency within the audible range you can convert it to sound with an amplifier and speaker, but sound waves are quite different from simple AC and it's easy to confuse them if you're a beginner.

Okay – you can produce alternating current of any frequency you like between small fractions of a Hz and many millions of Hz relatively easily, and as we'll see it's crucial to radio to be able to generate AC which has a frequency between about 100kHz and, for the same of argument, 1,000MHz. A MHz, by the way, is just one million cycles per second, so you'll note that a radio wave with a frequency of 1,000MHz implies AC that's changing its direction one thousand million times a second. There's an old saying that a week is a long time in politics – well, a second is a long time in electronics. It can be quite mind-boggling at first, but stay with us.

Have you spotted the link between AC and radio waves yet? Well done, I knew you would. If you're talking to your mate on 144MHz, this implies AC with a frequency of 144 million times per second flowing in your antenna and producing radio waves of that frequency. Clever, eh?

So that's a quick look at AC. Now let's have a look at two electronic components which are incredibly important as far as generating and handling alternating currents are concerned and see how they work.

The two components we need to think about are blessed with the names of **inductor** and **capacitor** – in fact, **inductance** and **capacitance** are two very important properties in electronics, and you could say that a capacitor is anything which displays



Alternating (sinusoidal) waveform.

STARTING FROM SCRATCH

capacitance. That isn't trivial hair-splitting either, as we'll see shortly.

Let's take inductors. If you take an ordinary bog-standard straight piece of wire and connect a battery to it so that a reasonable amount of current flows in it, you'll find that, if you borrow your little son's toy compass and bring it near said wire, the needle will be deflected somewhat. In other words, whenever an electric current flows in a wire, there's a magnetic field formed in the vicinity of the wire itself. Magnetism and electricity are intimately related, and it's this fact that makes things like generators and electric motors and wirelesses possible. As a matter of fact, if you've read the power supply article elsewhere in this magazine, you might like to note that transformers rely on the magnetic field associated with a wire in which an electric current is flowing in order to work at all.

So there's always a magnetic field wherever there's a current – I'd like to call it Drake's Law but it was expressed rather more elegantly about a hundred years ago by A. N. Other. . . .

Now the interesting thing is that the magnetic field formed when you switch on the power tends to oppose the electric current. Does that make sense? I thought not. I forgot to tell you that whenever you change the value of an electric current flowing in a wire or wherever, the magnetic field also changes and any change in the strength of a magnetic field induces an electric current in any handy nearby conductor. Which, incidentally, is how a transformer works. The alternating current in the primary sets up a varying magnetic field; the varying magnetic field aforesaid **induces** (you'll see where the word inductor comes from in a sec) a current in the secondary of the transformer.

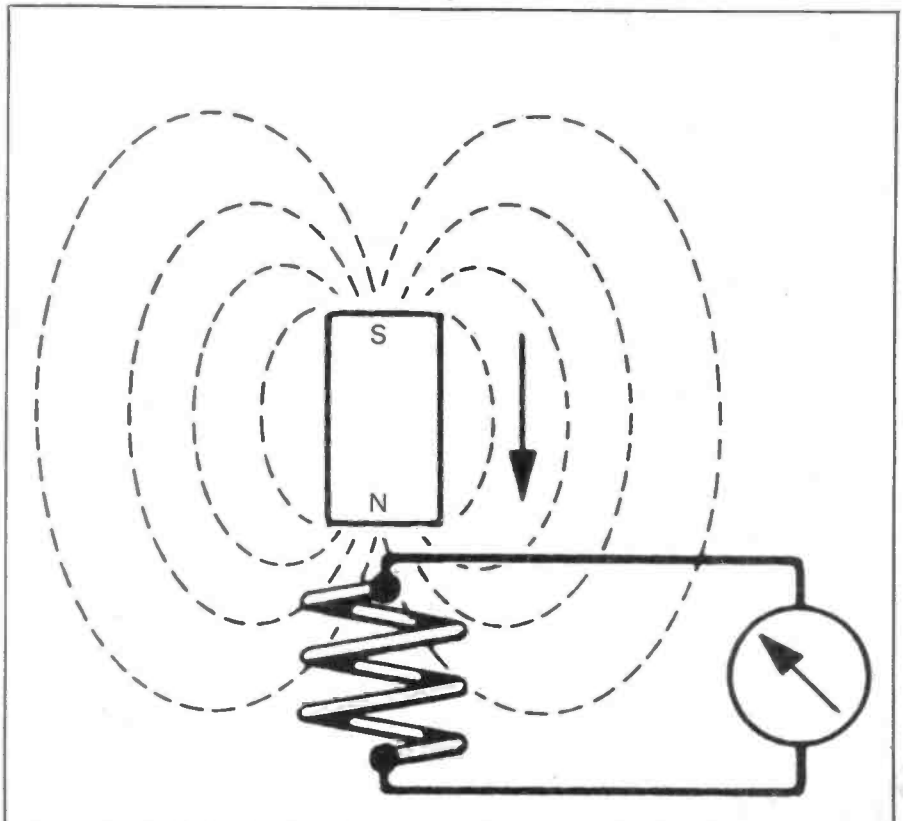
Note solemnly here that it's the fact that it varies that's of great importance. If you stick a source of DC, such as a battery, across the primary of a transformer, you'd get an output from the secondary only at the instant you connected the battery and again only at the instant you disconnected it – in other words, when you change something. Leaving the battery across the transformer primary will flatten it in short order, if indeed you don't burn out the winding while you're about it. . . .

The point is the magnetic field that builds up tends to oppose the electric current – in other words, the polarity of the electric current induced in the wire carrying the current opposes the polarity of the current with which the magnetic field is associated. I'd suggest grabbing a coffee and a fag at this stage and reading that again until you get the idea – it hurts me to think it up and type it, so God knows what it's doing to you trying to follow it!

A Henry: something the size of a small smoothing choke

Inductance is simply defined as the property of a circuit or whatever which tends to oppose any change in the value of current flowing in it, and that can be very handy. Any piece of wire is an inductor of sorts, although the usual form of inductor is a coil of wire wound on something like ferrite which tends to increase its inductance. It can also be wound on heaps of other things, by the way, or in a VHF radio it can be a couple of turns of thick wire wound on nothing but fresh air – self-supporting in other words.

Why is it handy? Well, if you remember the last issue of this magazine, we were looking at the concept of **reactance** – we defined it as the apparent resistance of something or other (usually an inductor or capacitor) as far as AC was concerned. Now the thing about an inductor (of whatever type) is that its reactance increases with frequency in a very predictable way. There's even a nice formula for it – the reactance of an inductor is defined as the square root of 2π times the frequency involved times the value of inductance in henries. Henries? Oh yes, I forgot – just as we commemorate Mr Hertz by making his name the unit of frequency, Mr Henry gets the kudos for discovering all sorts of clever things to do with coils of wire and things by getting his name used as the unit of inductance. So if you talk about an inductance of 1 Henry, you mean something the size of a small smoothing choke or something of that sort. For average radio use, we tend to use millihenries and



Electromagnetic induction (a) relative movement of magnet and coil induces a voltage in the coil; without this, there wouldn't be any wireless!

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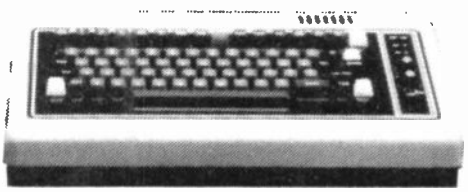

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microhenries rather more because they're handier. The symbol for Henrys is H, so milli and micro become mH and μH in the usual way.

Still with me? Remember that any piece of wire possesses inductance, although you have to do things like wind the wire into a coil of something if you want lots of it for some purpose – as indeed you usually will. If you remember from last month, we said that the DC resistance of the primary winding of a transformer might be of the order of 100 ohms, and you might think that if Ohm's Law is to be believed, there'd be 24 amps flowing in it if you plugged it into the 240 volt mains supply. Because the primary of a transformer consists of a lot of wire wound into a fairly large coil, it possesses a lot of inductance – the magnetic field which is induced in the primary opposes the current coming in from the mains, to put it crudely, and at 50Hz the current might well be limited to 2.4 amps instead of 24 because it is being limited by the magnetic field associated with the current flowing in the primary in the first place. It's sort of self-limiting. Like drinking too much beer, there comes a point when you're too drunk to lift the glass any more. . . .

Let's pass hastily on from inductors and have a look at their other half, capacitors. Inductors and capacitors are a bit like man and wife or Morecambe and Wise or bacon and eggs – their properties are similar but different and they go well with each other in some ways.

So what's a capacitor? Well, it's anything which displays something called capacitance, which is rather difficult to define in less than about 70,000 words but we'll have a valiant bash. There isn't really an easy example, as there is in the case of inductors with pieces of wire and compass needles and so on because capacitors rely on things like charge and dielectrics and the Lord knows what and it can all get a bit heavy. Let's just say for now that a capacitor is an electronic component that won't allow DC to flow at all but it will let AC through. How well it lets it through depends on the frequency of the AC involved, or, in other words, the reactance of a capacitor (remember? that's the resistance as far as AC is concerned) is very high at low frequencies and very low when you wind the frequency up. You measure the value of a capacitor in units called **farads** (here again, we're commemorating the early pioneers – Michael Faraday was a whizzkid at things like this about 100 years ago, and it's a version of his name that forms the unit of capacitance). Actually, the farad is a very large unit, and you're going to be dealing with micro farads most of the time – they're millionths of a farad – and even pico farads if you're into VHF. A picofarad is a millionth of a microfarad, and to give you an idea the capacitance between the top of your head and the floor is about 100 picofarads, or pF.

Any piece of wire possesses inductance but . . .

As in the case of the inductor, there's a formula which gives the reactance of a capacitor of a given value at a given frequency. It looks like this:

$$\frac{1}{\sqrt{2\pi fC}}$$

"f" is the frequency of Hertz and C is the capacitance in farads. If you care to work out some examples, and also compare this with the formula for the reactance of an inductor at a few different frequencies, you'll find that the reactance of the capacitor gets less with frequency increases, whereas the inductor works the other way round.

So that's an ever-so-quick look at the two main elements of AC circuits. "But" says an office colleague "what's the use of all these clever things? Why on earth would I want to know what the resistance is at such-and-such a frequency? Bo-ooo-ooo-ring!"

Well, hang in there because by-and-by we'll see where it all comes together – well, some of it, anyway. We'd need all of the magazine to get it all sussed and anyway there are whole learned tomes on AC circuits so we can't do it all at once! We'll carry on with some of the good bits in our next issue, but to whet your appetite, let's think about what happens if you connect an inductor in parallel with a capacitor and apply AC of a particular frequency to the combination. The particular frequency I have in mind is that at which the reactance of the inductor and that of the capacitor happen to be the same.

What you then get is something very fundamental to wireless which is called **resonance** – it's fundamental because the whole subject of the transmission and reception of radio waves depends on it. Watch this space and we'll delve into it next time. . . .

Reproduced from the Old Timers' Bulletin. American humour, fairly obviously . . .

ANTIQUES, OR RUBBISH ?

Have we lessons to learn from the US when it comes to valuing our radio equipment? David Lazell points us in the right direction.

ANTIQUES, OR RUBBISH ?

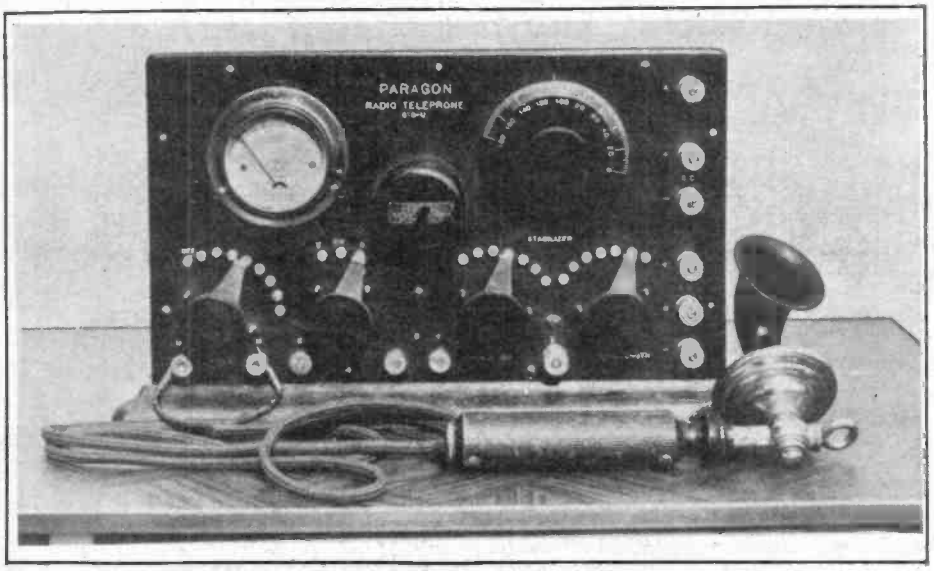
The rumour that hams never leave their equipment is probably put about by aggrieved girl friends who want a night on the town, not on the air.

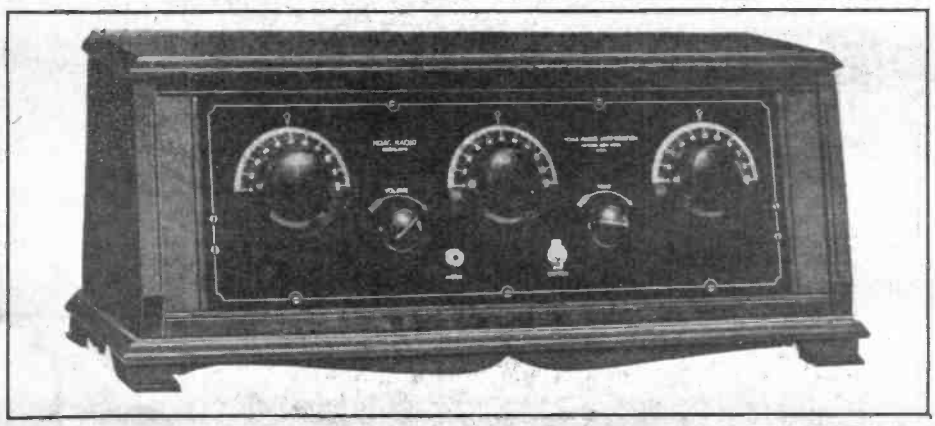
The impact of the feminist movement is being observed in the USA where, happily, more ladies are taking an interest in the hobby. But perhaps the most interesting phenomenon from that great electronic wonderland is the pursuit of historic equipment from previous decades of radio communication.

Local museums, shortwave clubs and other bodies are checking the attics, radio stations and old-timers' collections in search of these 'ham antiques' and it is a little exaggeration to describe it as a new gold rush. For much early radio equipment is proving to be very valuable. You will find, on any visit to the USA, that local museums often have a keen interest in radio history, and have special displays of equipment from the 1930s and 1940s.

To date, however, the same interest has not been observed in Britain, but it is certainly on the way. Even with that much-abused medium CB radio, there has been a keen interest in the 'collectables', the original equipment from manufacturers who, in some cases, saw CB as additional business to other radio products. *S9 Hobby Magazine* ran a very attractive feature by a short-waver, Judy, on the 'antiques' of short-wave communication, and it appeared regularly over some years.

Below: the 1921 Paragon 2-5-U, introduced by the American firm of Adams-Morgan. QSL cards in those days quite often referred to radiation levels of so many thermo-couple Amperes . . .
Bottom: Typical of many early radio telephones is the coachbuilt cabinet. A rare find nowadays.





The really interesting initiatives (for UK readers) are seen from a nationally-known group of radio enthusiasts, in the Antique Wireless Association Inc. of Holcomb, New York. Most members of the AWA are radio hams, and, in many cases, have been professional and employed in radio. The monthly *Old Timers Bulletin* is a well illustrated, and very lively well researched publication, and includes potted histories of radio manufacturers, past and present, photographs of old equipment, and notes of projects in hand. For example, a DX competition some time ago involved the use of old-time all-valve equipment, this being a great opportunity to show off the carefully preserved (and repaired) transceivers of yesteryear. Articles on the restoration of old equipment have long been published in *The Old Timers Bulletin*, and the AWA has obviously helped local museums to develop their own collections.

The association was founded in 1952. From its ten original members, the AWA had become internationally known by its twenty-fifth anniversary with some two thousand members (many of them in European countries including Britain, as well as Australia, New Zealand, Japan and other nations). Not that the AWA has ever had any kind of membership drive. As with many other worthwhile organisations, it worked on the basis of mutual attraction. If you were *really* interested in the historical background of amateur radio, you would certainly find out about the AWA, sooner or later. *The Old Timers Bulletin* was launched just over twenty years ago to meet the needs of effective communication between members who, by that time, could be found in some twenty states. From the outset, it has effectively developed as a medium for creative writing and reporting on radio (and television) history and equipment. From this research sprang the concept of an AWA Museum. This opened in 1974 at East Bloomfield, New York, and it is now highly regarded as a centre for electronic communication history studies. It had, in the late 1970s, more than 25,000 items, and must now have rather more.

The race for this kind of equipment has accelerated in the past five or six years, so that car museums in the States, for example, have opened adjacent radio history displays. Among the treasures at the museum one can find a tape library which has

recordings of great pioneers, including Marconi, Edwin Armstrong (the inventor of FM radio), De Forest, Sarnoff and Hugo Gernsback, who might aptly be called the prophet of radio. Hugo Gernsback, it may be recalled, founded the great grand-daddy of amateur radio magazines in 1908, *Modern Electrics*, and a year or two later produced a science fiction story, which in effect described the electronic communications explosion of the 1970s and 1980s.

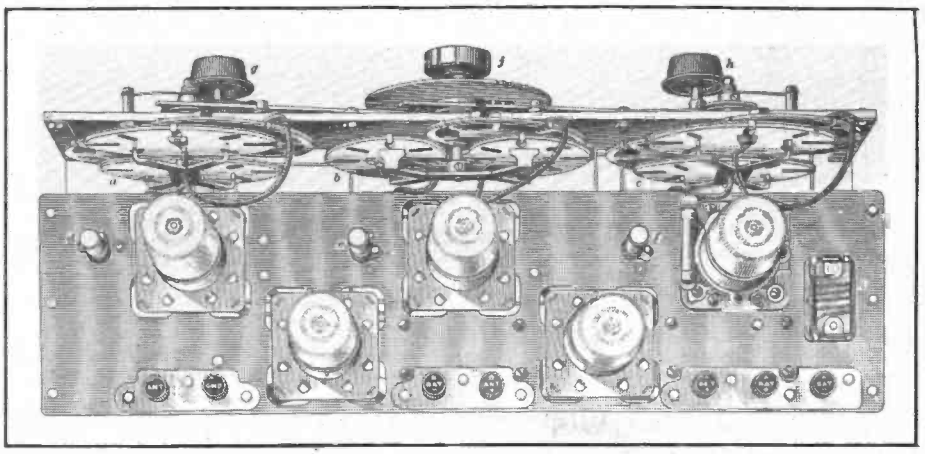
The main room of the AWA Museum is known as the Armstrong Hall, to commemorate the fine work of (Major) Edwin Armstrong, whose fight against the entrenched defenders of AM communication was long and often bitter. A large oil painting of this FM pioneer was presented to the museum by Dr Leonard Wade some years ago, and has pride of place. However, whilst the museum has a 1925 radio store – absolutely authentic but with nothing for sale *there* – amateur radio has always been shown, and used. Not for the AWA enthusiasts mere equipment stuck under a glass case. For example, when the museum was opened in May 1975 it had a very attractive ceremony. "George Batterson, a veteran radio ham, W2GB, commenced proceedings by using a vintage 1kw. rotary spark transmitter," announced the *Old Timers Bulletin* that year.

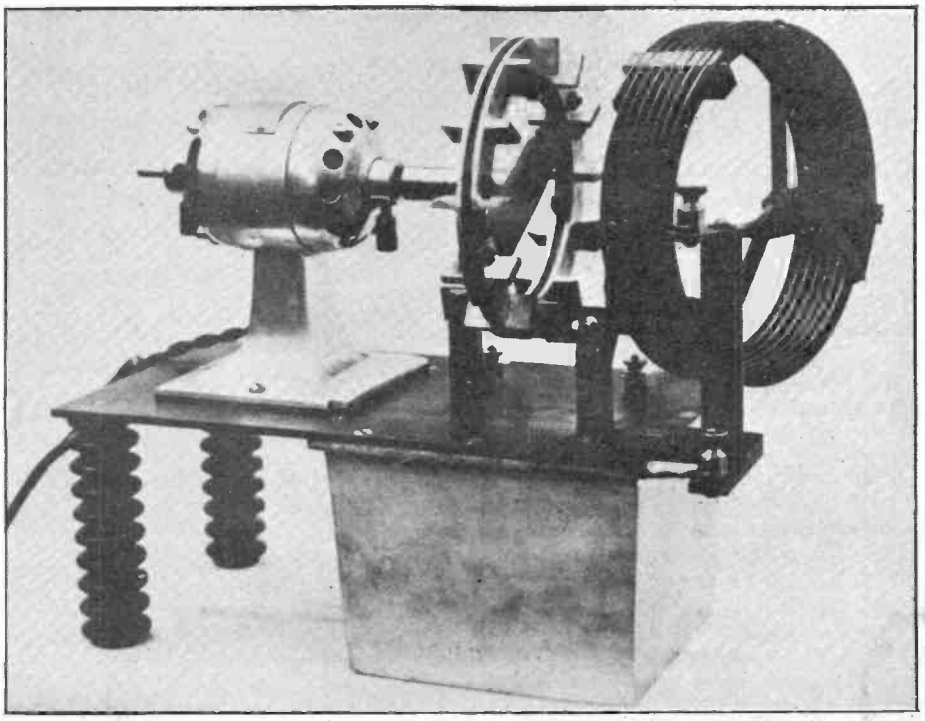
Auctions of old gear

Although you cannot get your hands permanently on the best historic equipment (ie to take home to your own radio shack) there are annual auctions of old gear. Usually, this is an informal affair, with the items brought in no particular sequence. As 10% of the proceeds are donated voluntarily to the museum, the auction is very useful given the high costs of running the place. And the Bulletin reports a run down of the equipment that was sold, usually with illustrations, and the prices reached. Could this be a first 'blue book' for vintage ham equipment?

Although the AWA has always been primarily interested in radio communication, it has also developed other collections eg in television and home entertainment. Sometimes, radio studios, manufacturers or veteran collectors have offered special items to the museum, seeing the East Bloomfield Collection as a worthy resting place for rare and redundant items. Thus, 'The Golden Age of Entertaiment' Display includes vintage phonographs, early AC mains receivers, and even old TV sets Still in working order. Broadcasting equipment, no longer wanted by local stations, has also been eagerly acquired, as well as the telegraph equipment which, as Edison might say, really started everything else going. The high esteem of the museum is reflected by the way that other institutions help, or use it. When, in 1976, there was a special display to commemorate the centenary of Bell's invention of the telephone, the museum was permitted to show two extremely rare Bell telephones, by courtesy of the Smithsonian Institution of Washington DC. At that same exhibition, guests at the museum were invited to use the 1905 telephone circuit installed for the event.

As the AWA celebrates its thirtieth birthday year, we may properly salute these keen radio hams, who dedicate their time, resources and no doubt cash to keeping the traditions of ham radio alive. Of course, they started at the right time. The USA, though it suffered grievious losses of manpower in World War Two, did not go through the blitz which, in Britain, destroyed so much archive material. Any researcher here knows that it is often impossible to get records referring to the 1930s. And, one regrets to say, some researchers

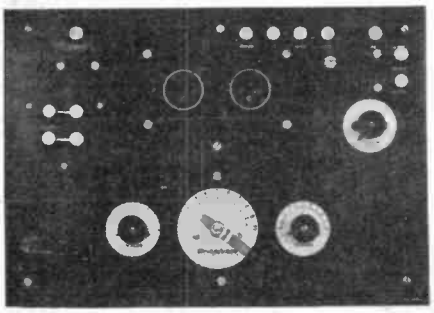




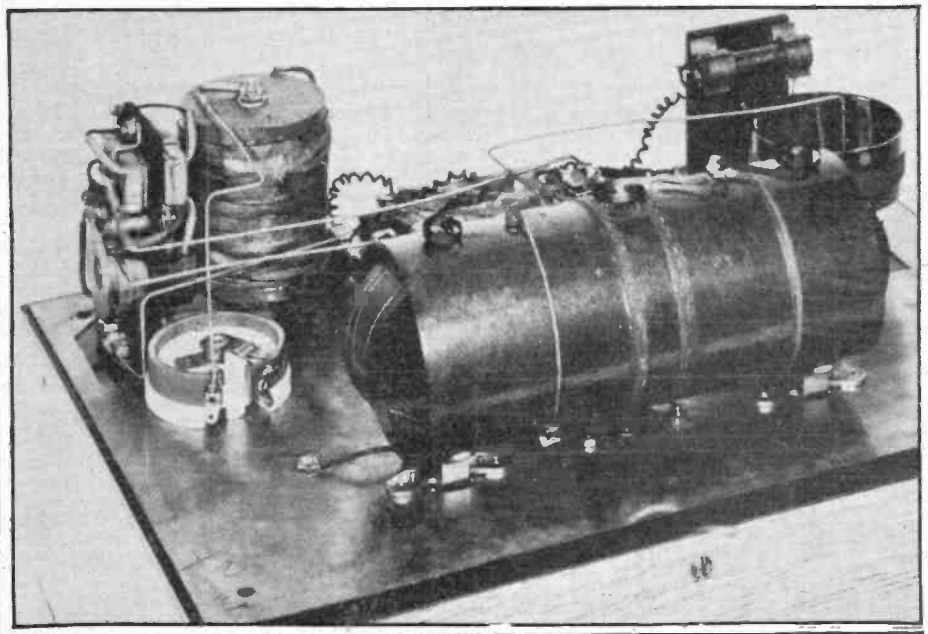
Below: Unusual view of the internals of an early transmitter.
Bottom: The AWA Museum in Washington was opened by W2GB using a 1Kw rotary spark transmitter like this one. It's 56 years old, and is a 60 metre shortwave unit. Does any reader have more information about this (must be) unique device?

find a less than careful attitude to the preserving of historic documents, directories and other material here. In the USA, this kind of radio/ telecommunications history documentation would be afforded far higher importance. But the AWA has undoubtedly helped to 'educate' the public in this direction. At the right time, when so much radio communication equipment was becoming redundant, the AWA was around to pick up the pieces (sometimes, almost complete studios, too).

In Britain, the BVWS (British Vintage Wireless Society) has less bias towards ham radio equipment, though is certainly interested in it as part of the complete picture of electronics communication. Whilst the AWA has a high percentage of membership from hams, and broadcasting veterans, the BVWS. has a far wider representation from all kinds of hobbyists. However, the BVWS is highly regarded by AWA old-timers and Anthony Constable, a leading member of the BVWS has visited the museum – and presented it with a handsomely mounted transformer from the old BBC station at Brookmans Park, Surrey. Constable, a medical physicist, founded the society in 1976, so the yanks have an almost quarter century start in this field. His book, *Early Wireless* published by Midas Books of Tunbridge Wells (£8.95, ISBN O 85936 125 X) is well known to US enthusiasts, as well as to British collectors.



Left: The receiver section of a 1923 Westinghouse Shortwave set. All the knobs are gold-plated!
Below: A view of the insides of the Westinghouse receiver. They were originally production units but coils were removed in order to raise the frequency to 3200KHz.
Bottom: A receiver, about little of which is known by the staff of *Amateur Radio* – can anybody help?

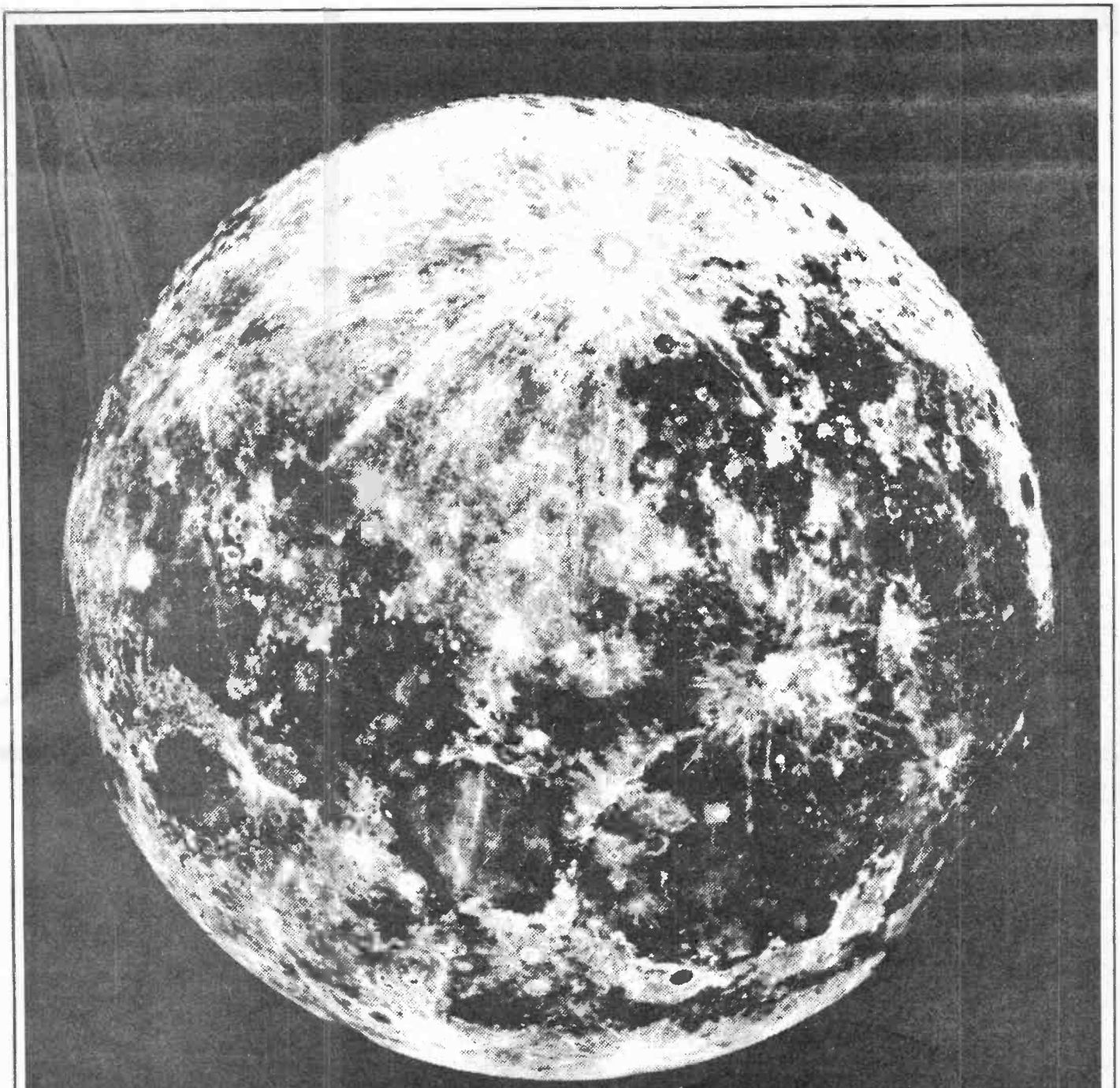


It is never too late to start collecting

Today, radio museums are opening across the USA to an increasing number of enthusiasts, and proving to be effective in showing that shortwave radio communication has been a valuable tool over many years. The AWA Museum at East Bloomfield is almost certainly the best known of them all, even though some museums are associated with major car companies or radio organisations. So it may prove the truth of the old saying: if you want a job well done, ask a dedicated radio amateur, assuming you can get him away from the equipment. But that is where we came in.

Last comment – it is possible to collect back copies of the *Old Timers Bulletin*, though they are becoming quite rare. They cost about £1 each (the back issues, I mean) though naturally UK members get the current monthly issues in the usual way. Details are available from Dexter Deeley, AWA, 8 Briar Circle, Rochester, New York 14618, USA.

Looking through my stack of *Old Timers Bulletin*, I realise that while I may be an old timer, I certainly overlooked the potential of ham radio history. But it is never too late to start collecting. The AWA, like the BVWS here in Britain, could help you in that direction. There are plenty of members' classified adverts relating to eqipment wanted or on offer in the *Old Timers Bulletin*, too. Could it be that we in Britain are losing out on this valuable aspect of ham radio? Are we leaving it too late to build a collection of radio historical importance in the nation that started so much of the art?



EARTH -MOON- EARTH

The theory is easy. But it's probably the most demanding and difficult contact to make. Nigel Gresley explains.

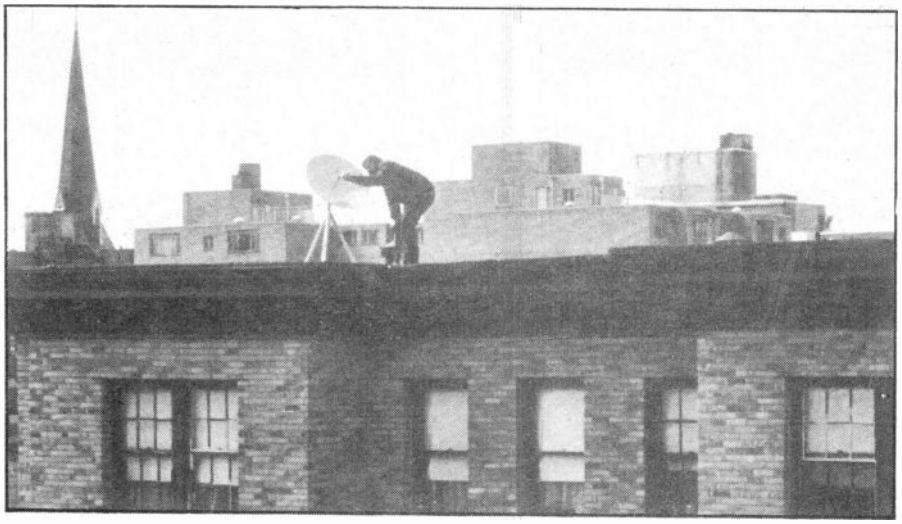
EARTH-MOON-EARTH

The subtitle should read: how to bounce your wireless waves off the nearest handy lunar object. Moonbounce, or EME (which is short for Earth-Moon-Earth) is possibly the most demanding mode of amateur operation of all of them, although the diehard MS addicts would claim that *theirs* was the most difficult. Our feeling is that they're both tricky to do and that you need a good station for both modes.

The basic idea of EME sounds simple enough – the theory is that you take signals on 144MHz or 432MHz or even higher bands if you've really got hairs on your chest and, instead of beaming them in the general direction of another station over the horizon, you wind the antennas upwards and aim at the moon. The idea is that the moon acts as a reflector of the signals and beams them back towards Earth, so that some well-equipped station somewhere can receive them.

Put like that it doesn't sound too difficult. But there are a few things you need to know before dashing out to the backyard and pointing your beam towards the moon. First off, there's the little matter of power. Although it's a bit beyond the scope of this article to go into the nuts and bolts of it, it's possible to calculate the exact amount of effective radiated power necessary in order to produce a given amount of signal in the receiver at the distant end, and in a word it's marginal under the conditions of the UK licence.

Without going into all the facts and figures, you'll need the full legal limit and at least 15dB gain at the antenna to stand any chance at all on 144MHz – in other words, you'll only be able to work very well-equipped stations with such a set-up – and you really need to think in terms of a very out-of-the-ordinary antenna system if you're going to have a go at EME. If you can't run the full legal limit, forget it. The main problem is that the moon isn't exactly a good reflector of radio signals at the best of times, so you'll need all the help you can get insofar as generating power right up to the licence limit and getting a really good antenna up is concerned. The same applies in the other direction. Signals that are going to be coming your way aren't exactly going to end-stop the S-meter, and in fact there are going to be many times – maybe most of the time – when the signal you're after is about as strong as the receiver noise. So in other words you need not only the largest antenna you can get (and in any event something like 20dB gain won't hurt a bit), but you need a very good preamp and the best feeder you can beg, borrow or swipe.



You might be able to use a dish of this size for the higher-frequency microwave bands and bounce them off the moon.

What does this mean in principle? Let's take the antenna first. No single commercial device will have anything like enough gain for this job, so you're down to stacking or baying several multi-element beams or, if you're affluent or persistent enough and you want to use the higher bands, using a dish antenna of some sort. Big dishes tend to take up a hell of a lot of the back garden, and so do antennas of the calibre required for EME work, so you'd better have tolerant neighbours. The most minimal EME array we know of is four 16-element Tonna antennas on 144MHz – we don't know of anyone who has had any success with anything smaller, although if anyone can tell us something different we'd love to hear about it!

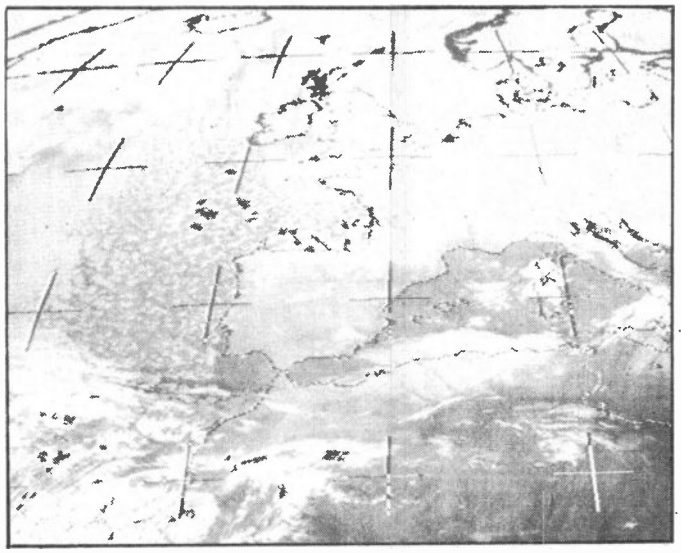
So, that's the antenna side of it. The next thing to worry about is the preamp, and to some extent we've discussed the pros and cons of VHF and UHF preamps elsewhere in this noble publication. Just to recap, you need some gain but you also need quietness, ie a very low noise figure for whatever exotic device you choose to use in said preamp. Gasfets are probably the best for 432MHz and above and they're OK for 144MHz if either you or the manufacturer knows what he's doing; not all gasfets by any means like frequencies as low(!) as 144MHz and you shouldn't think that just because a preamp contains a gasfet that it's going to be the best thing for the job. Some of the consumer-type ones aren't worth the exorbitant amounts people ask for them, so do watch out for "specmanship" in this area. *Radio Communication* did a very good comparative look at some preamplifiers last year, and it's well worth having a good look at that article if you're contemplating low-noise amplifiers of one sort or another for EME or MS work.

There's a case for saying that a low noise factor is more important than sheer signal-handling ability if you're into EME, and we sort of agree with this; it's nice to have both but it isn't always easy. On 144MHz, the only time to worry about the noise figure of your preamp is if you're into EME work, because the residual noise of the sky is much lower than you'll get from a decent antenna pointing somewhere in a terrestrial direction, and EME signals aren't exactly going to overload your front-end when you do receive them, as we've seen. The only time to worry is if four of your local mates are going to be active at the same time as you're spraying your signals in the general direction of the moon, because if your preamp's got too much gain it'll give your receiver a hard time and bang goes your DX for the evening.

As we've said, you need enough gain to overcome losses in the feeder and to bring the system noise figure down to the lowest possible level. Take a look at a book called *Solid State Design for the Radio Amateur* which is published by the ARRL and available from the RSGB. It tells you in simple terms exactly what's important (and what isn't) about things like noise figure and signal-handling, and you can learn a lot from this book about all sort of other things to do with transistors and such.

The feeder is the other thing to worry about. You need the best you can possibly lay hands on. "Best", in this context, means having as little loss as possible because any loss is just going to convert your transmitter power into heat to warm the worms with, so don't mess about with the usual things. If you can get it, you'll need something like Heliax or LDF-4 and the connectors to go with it, and they can cost a fortune.

How about the transmitter side of things? Well, as we've said, you're



Left: A moon's eye view of the earth. Remember that a basic problem with EME work is keeping your antenna pointing at the moon while it moves.
Below: This TV picture is coming from a satellite, but one day maybe amateurs will be able to bounce TV pictures off the moon to each other. Watch this space . . .!

going to need maximum legal power on whatever band you fancy, and this is going to need a decent amplifier. Many designs have appeared in the literature, some which are better than others, but either way you'll need all the power you can get short of going outside the terms of your licence and we don't advocate that for one millisecond. From what we hear, 96 per cent of all EME contacts are done on CW, with the rest being SSB, so if you're a Class B man wondering what the point of Morse is, now you know. CW is superior to SSB under weak-signal conditions if you've got the right sort of receiver with decent narrow CW filters – actually, CW is superior to practically everything else unless you're the Diplomatic Wireless Service and you have a few Piccolo terminals lying around, which is why there isn't anything better than CW for working the weak ones on *any* band. So a good, stable receiver with proper CW-type filtering is required for EME work – you need all the help it'll give you, so a bit of spit and polish isn't a bad idea.

What about the operational side of things now we've had a look at the hardware? EME operation isn't too difficult provided that you've done a few things before you start. Firstly, you'll need to be able to find the moon, which may sound silly but if it's cloudy what are you going to do when it's sked time? You also need to know when the moon is in the right place for what you have in mind, and this is quite a tall order for which we haven't really got the space; have a look at the *Amateur Radio Operating Manual* for all the details of how to go about it. It all depends on who you want to work, assuming you're not just firing random CQ calls at the moon (which some do, by the way – but you need a good station and some knowledge of the geometry of the moon and whether it's in a good position for working anyone) instead of making skeds just as you'd do on MS. The usual thing is to make a sked with another interested party, and it either will work or it won't.

One problem you'll come across is something called fading – you wouldn't expect it, would you, but the polarisation of the signals can change periodically as they get reflected from the moon and you'll sometimes find that the signals drift slowly in and out of the noise. It goes without saying that there isn't any easy way of getting round this, short of using something called circular polarisation on your antennas, and that makes life even more complicated!

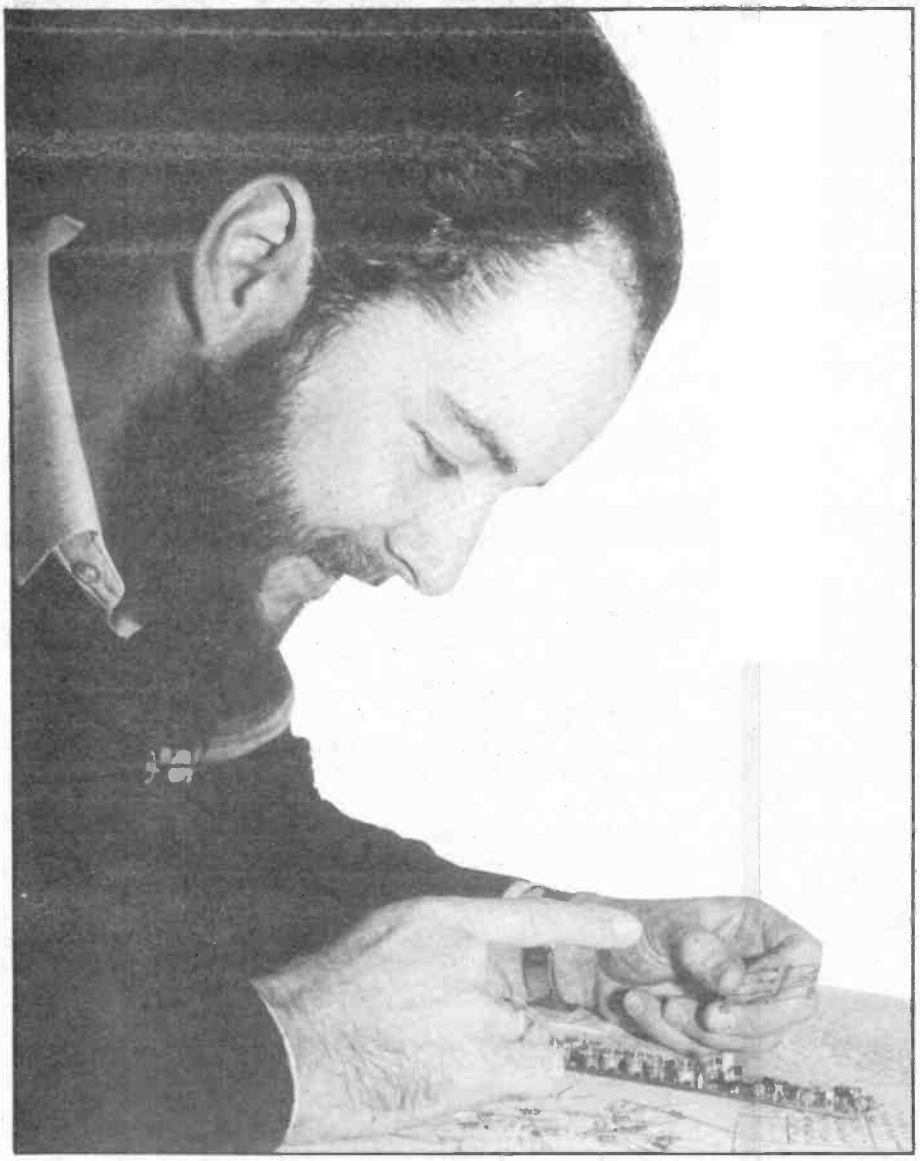
The other snag is that the moon isn't standing still obligingly whilst you bounce your signals off it. It's moving actually, as you'll know if you've ever tried something we had to do for one of our sister magazines a few years ago and take a photograph of the thing, it moves pretty fast and time exposures with a telephoto lens well stopped down aren't really on. So you need to be able to move your antennas to keep the moon in their sights, as it were, and this can be tiresome because as far as we earthlings are concerned the moon is moving in two dimensions at once and you need some way of moving your beam in what the textbooks grandly refer to as "elevation" and "azimuth".

Some exotic EME stations do it with a microcomputer programmed with details of the motion of the moon and linked up to suitable motors and gears to wave the beam about and keep it fixed on the moon but you need to be a bit clever for that – many EME folk do it by hand. The big snag is, what the hell do you do if it's a cloudy night and you can't see the blessed thing at all, let alone see it to track it? Ah. Yes, that is a problem. Actually, our technical maniac swears blind he's going to think up a way of doing it with infrared sensors and the Lord knows what but every time we ask him how he's doing he mutters and mumbles and fiddles with his moustache so we deduce he hasn't got it sussed yet. It ought to be possible, and if anyone has any bright (sorry) ideas we'd love to hear them.

Anyway, you'll be glad to know that if you've solved those problems, the actual mechanics of working stations are pretty simple! You can have skeds rather like you do in MS working, but it's a much more relaxed affair. The only thing is that, as in the case of MS, your transmitter and receiver need to be spot on the frequency you've agreed on with the man at the other end so you'll need some pretty good frequency checking arrangements. It isn't the slightest use having everything else off to a T if you're a KHz out of your partner's passband because all the megawatts in the world ain't going to get into his wireless – so it's always a good plan to switch everything on an hour or two before the sked starts so's you can do some last minute checks with a rig that's well warmed-up and that much more likely to stay on whatever frequency you put it without creeping off somewhere else.

There's one simple test you can do, just to finish with, that will show you whether your station is good enough for EME work and whether you've got the antennas pointing in the right place. Just aim at the moon and press the key (or say a word or two) and then listen. Because of the distance between the moon and earth, there's a fair old delay on the signal and by the time you go back to "receive" and wait a second or so, you should hear your own echo coming back from the moon.

I guarantee the first time you achieve that, all the hairs on the back of your neck will practically catch fire – it's one of the biggest thrills in the whole world of radio, and it's a sure sign that your station is pretty damned good. When you've done that, read *Dubus,* get on the 14.34MHz VHF net and set up some skeds – maybe we'll see you there one of these days!



At one stage, it was two in the morning, and we began to run out of film, and brains. Mike tries to decide whether it really is a 47K or whether he needs more coffee.

PARTWORK

How to build a transceiver from a kit – by Chris Drake and friend

Considering that we're jolly keen on the home-brew side of amateur radio here at *Amateur Radio*, we're always keen to have a go at anything that looks as though it's likely to make life easier for the home builder. One company, Wood and Douglas, who advertise in this magazine, do a very interesting range of kits for amateur projects of various sorts and we thought we'd have a look at a typical make-it-yourself job they do in the shape of the 70FM05 UHF receiver and its companion transmitter, the 70FM05 T4.

These are intended for the amateur 432MHz band, and the basic idea is that you can start out with the receiver, the 70FM05 R5 and get that going first; it's crystal controlled, using standard Pye PF1-type crystals which are as common as the proverbial. What you get in the kit is the PCB and the bits to make the heart of the receiver – you put it in whatever case you like, together with things like the S-meter and all the "front panel furniture" (see Shoptalk last issue) you want for your particular application. We reckon this is a great idea because you can make it as fancy or as simple as you like and you'll learn an enormous amount about basic FM receivers as you go.

When you've got the basic board sussed, you can add several things to it. For a start, there's the 70MC06R 6-channel scanner board, so you can scan between channels; we didn't test this but we know a couple of people who use them and like them. Then you can add the 70SY25B synthesiser if you're feeling top of the class with the soldering iron – we'd very much like to test this device since we don't know any other manufacturer who does a DIY synthesiser and if it's as nice as we found the transmitter and receiver to be we reckon it's well worth having.

When you've got the receiver side sorted out to your requirements, you can add the transmitter. We tried the basic 70FM05 T4 for size, although here again you can add the synthesiser if you want to. Having done that you'll end up with a good 70cm FM system that you can honestly say you built yourself – and that can't be bad, can it?

So, what we did was to hand the kit over to the same bod who did the Heathkit test for us, and then the Editor took time out from fretting about getting the magazine together and would-he-get-all-the-copy-in-time to break out the soldering iron.

Here's Mick to tell us what he made of the receiver.

'When the postman dropped a little packet through the door on a recent Saturday morning I was just thinking about getting up and going on the radio, since it was rumoured that there was going to be the aurora to end all auroras.

In fact it didn't happen, so after some tuning around and listening to all the locals being despondent about the lack of DX I decided to have a look at the Wood & Douglas receiver kit. The basic components and a very well made double-sided board fell out of the polythene bag together with an instruction sheet and lots of circuitry and layout drawings. It took a little time before I got the idea but it all looked reasonably straightforward. The PCB is tiny – more like the kind of thing you find in a commercial rig – and the first thing I did was to hunt out my magnifying glass, thinking that I was going to need it before I was through. I did!

"Take care in the actual soldering"

First job was to have a look at the circuitry and get the idea of what was what. It's a single-conversion UHF receiver of more or less conventional design with a nice eight-pole crystal filter and about a watt of audio out. Basically, it was all the electronic gubbins without any cabinet, case or what-have-you, which I thought was nice for those who knew a little bit about how electronic things go together and weren't afraid of chopping holes in diecast boxes and whatnot.

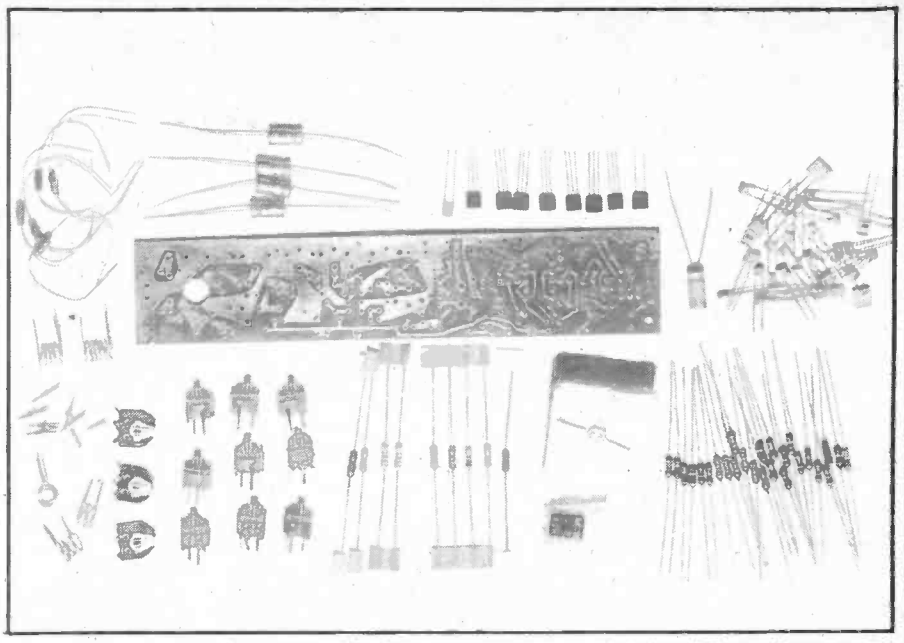
So it was a matter of clearing the kitchen table of the thing I'd been playing with the night before (which was some 10GHz gear which didn't seem to want to work at all well) and lay out all the bits and pieces. Everything was there, and they'd even wound the little coils for you – as far as I could see there was nothing missing and I set to work building.

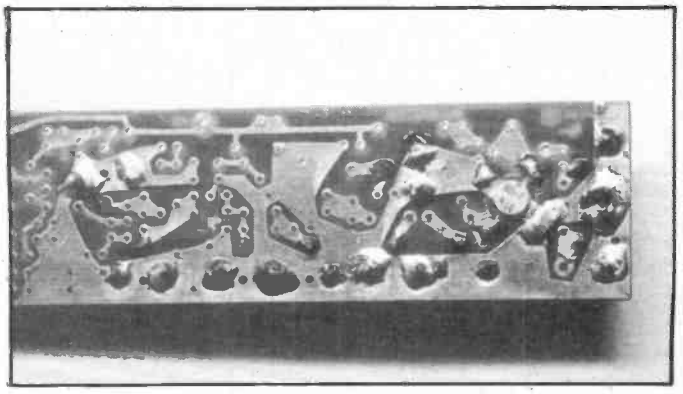
As Wood and Douglas say, this is quite an advanced project for those with little constructional experience, and they're very fair in saying that if you felt you couldn't do justice to the potential quality of the finished product, you could return it to them with the extra cost of a ready-built-and-tested version and they'd supply you with that. Which is nice to know. This kit doesn't strike me as at all tricky provided you take your time and don't guess at things like the colour code for resistors if you're not absolutely sure of what's what.

It's important to take care in the actual soldering as well because, compared with the PCB in the Heathkit meter I built for the last issue, the component density on the board is much higher and it's also double sided – this means that there are connections you need to make and components you need to mount on both sides of the PCB, not just one. So you have to double check that the right bit is going into the right holes in the board, and you'll have to be prepared to keep a close watch on the layout diagrams in order to make sure where you're up to. The board isn't marked with component identification either (unlike the Heathkit), so you need to do that much more work to keep ahead of what you're doing – that isn't a criticism, by the way, because it must cost a fortune to get PCBs silk-screened with component details and it's no more difficult to look after it yourself really.

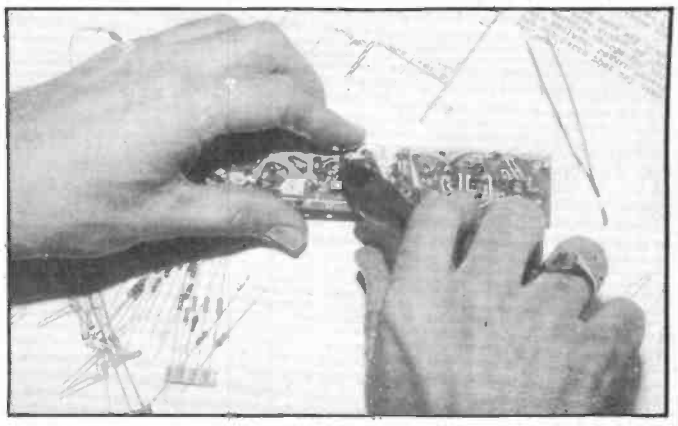
Wood & Douglas provide good instructions for assembly, although they do assume that you know more than the basics – you might not know that "SOT" stands for "select on test" which is what you do when you're not quite sure which component value is going to give you the best results, and so you suck it and see. It's common procedure in the professional world when you're after the best performance from a circuit, and in the case of this receiver it was to do with the type of filter specified.

So it was a matter of blazing away slowly with the soldering iron, stopping for the odd break to give my eyes a rest and to make sure I'd





All the transmitter components laid out – the calm before the storm! Some nice high-quality trimmers were supplied and little ceramic capacitors as well. We suggest you nick the XYL's tweezers before you kick off.



Close-up of the PA transistor soldered on to the PCB. Note the wide leads on the emitter of the transistor to keep the series inductance low.

After the soldering, the cutting. Carefully, so they remain flush with the glass fibre PCB.

got the right transistor or whatever it happened to be. I was impressed with the quality of the components they supplied – they obviously came from reputable sources, and indeed the BFR 91 front-end RF amplifier came from the supplier who's reputed to make the best samples of this device. I got the feeling that whoever designed this receiver had thought about little things like that.

In fact, it was Tuesday evening before I finished it all off, having spent just over 22 hours on it. I'm

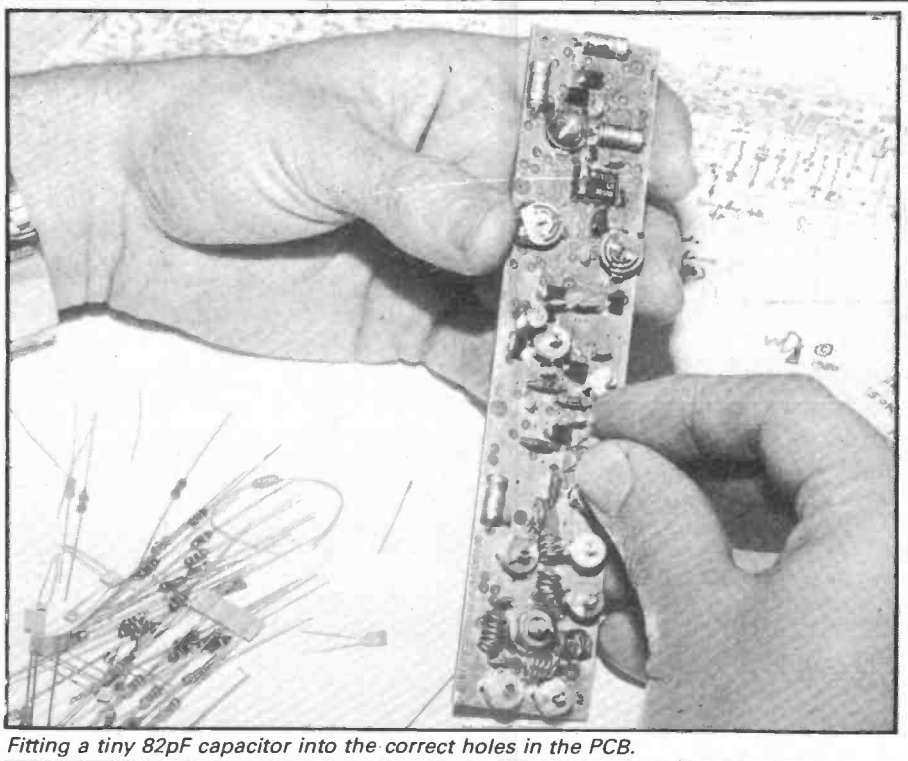
Nice healthy sharsh from the speaker

used to assembling things so I'd imagine that wouldn't be an untypical figure, and I wouldn't be at all surprised if it took many folks a bit longer. Having said that, my eyes aren't what they were 20 years ago, so maybe that slowed me up a bit. Either way, I felt jolly pleased with it when it was done. I didn't have a suitable meter movent handy for the S-meter so I had to improvise with a 60-microamp movement and made a hash of remembering how to calculate the right values to make it into a 200-microamp meter, which slowed me down a bit. However, I did manage to remember the Gospel According to Mr Ohm after some head-scratching and prepared to switch on the 12-volt supply that the thing required. I did remember to bring home from work a couple of suitable crystals, which helped, and I got together all the usual bits of wire and so on that you need to get the thing working.

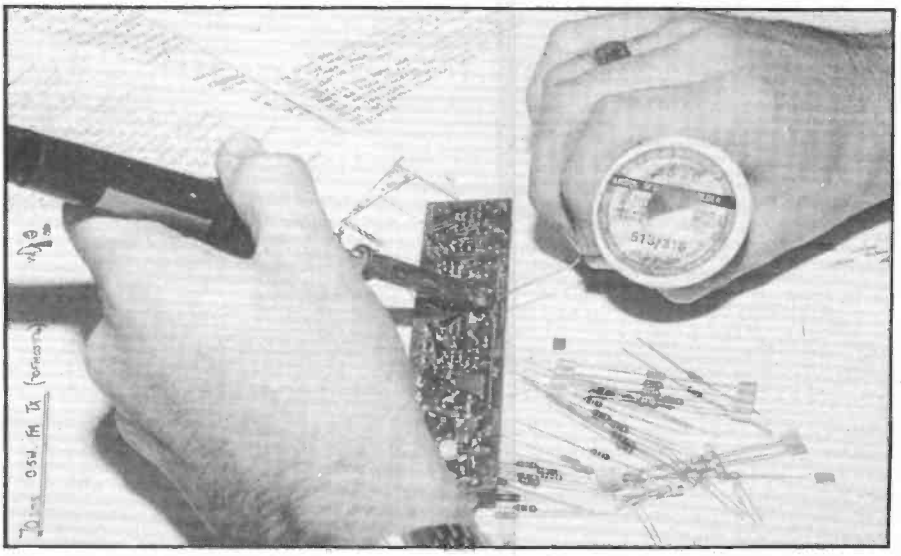
I switched on and – imagine my surprise – it worked. At least, it seemed to be working – all the right currents were where they ought to have been and there was a nice healthy "sharsh" coming out of the speaker I'd hooked up for the occasion. The only snag was that I couldn't hear the signal generator! The crystals I had came out on rather useless frequencies in my area and I didn't have any others, so I was stuck with the generator for the first tests, but when I got the generator delivering its full whack into the front-end of the receiver and I still couldn't hear a tweet, I began to get the message. I'd got something wrong.

Ah well, back to first principles. I applied the genny output to the gate of the mixer MOSFET and wallop! There was the signal, knocking the S-meter needle for six – and what you might call fully quieting and then some. I turned the output down a bit sharpish and wonder what I'd done wrong.

H'mmm – let's have a look at that BFR 91. Surely I couldn't have put it in the wrong way round. Damn it all, I must have used hundreds of the



Fitting a tiny 82pF capacitor into the correct holes in the PCB.



Soldering a component into position. Note the fine gauge solder and miniature iron – essential for a build of this sort. It's a good idea to clean the PCB before you begin the job, and to deflux it with propyl alcohol.

things in my time, and I know perfectly well that they go like this. Er.

Well, we all have our off days. I'd put the thing in the wrong way round. At least I had some solder wick, because desoldering double-sided PCB of this size just isn't funny, but I had my doubts as to whether I had another BFR 91 and surely I'd done this one in?

Actually I hadn't, although I certainly deserved to have. More in hope than anything else, I put it in the right way round and bingo! Everything on line and running, *and* I could hear the generator; even at my age, I still feel like Marconi the first time I get something I've made to work.

Flushed with success, it was time for some measurements. They had to wait until next day because we have a thing called a Sinadder at work and they're just the job for testing FM receivers if you want the best signal-to-noise ratio. In the meantime I sat there with another coffee listening to the generator and feeling like a clever chap.

Along came lunch hour and it was out with the measuring things. Wood and Douglas specify a sensitivity of better than 0.3 microvolts for 12dB SINAD, but my version was 0.16 microvolts for 12dB, which was good and much better than spec. The next step was to take a look at the noise figure, which came out as a whiff over 3dB. This is good, and is about what I'd expect from a good specimen of a BFR 91 on 432MHz. The squelch worked well, and the squelch tail was about right for an FM receiver – the squelch hysteresis was about 5dB, which seemed good to me although some people might find it a bit high for mobile use when there's a lot of fading – in that case, you can

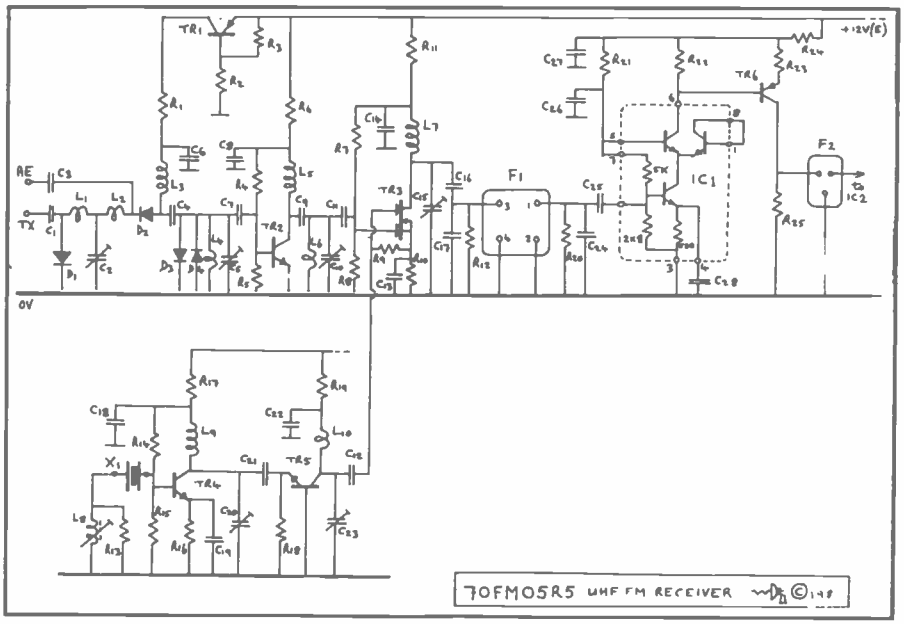


Diagram 70FM05R5 for the UHF FM receiver.

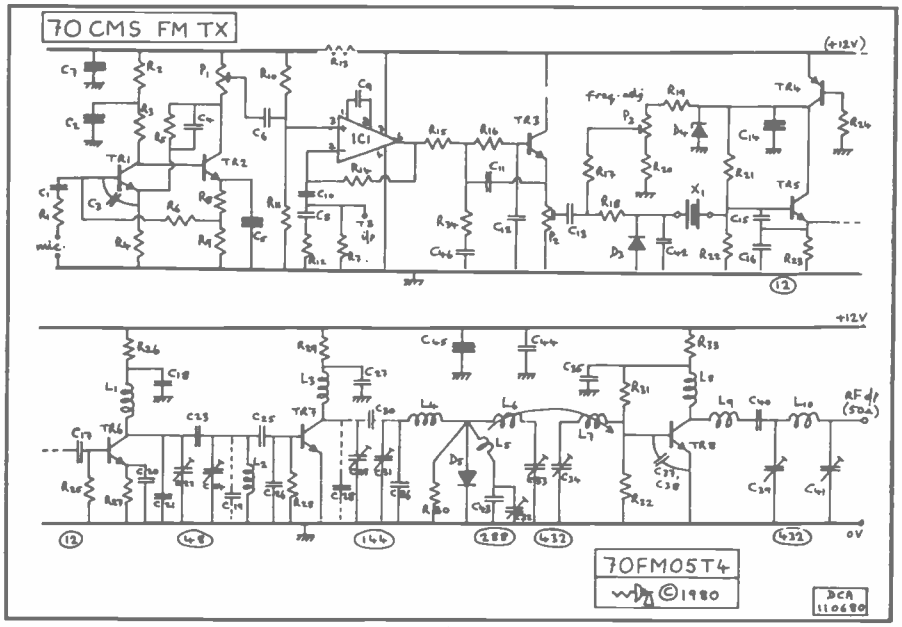


Diagram 70FM05T4. Both drawings are supplied with the build kit.

always take the squelch right out, can't you?

The final step was to get hold of some useful crystals and see how it worked when connected to my antenna. The short answer was "nice", although I got worried when I couldn't hear GB3LW in London. I then remembered that it's been off the air for some time, so another heart attack was averted. GB3NK came storming in, and speech quality sounded good with a nice action on the squelch and enough audio for most applications.

To sum up, I thought this was a superb little receiver. Wood and Douglas deserve to be congratulated for their enterprise in marketing it, and it's certainly dead easy to get it going and to use it. I'd have liked to try out the synthesiser and see how it performed, but if you're in the market for something a bit different from the commercial hand-held rigs, I can certainly recommend this machine.'

ASSEMBLING THE TRANSMITTER

It was down to yours truly to make the transmitter kit, and here again it went together very much like the receiver seemed to. The PCB was even smaller, and I had to pinch an Anglepoise from the Art Editor and assemble the thing with the lamp about two inches from my nose, but it wasn't really any problem. The only thing to be careful of is the output transistor, which needs to go in exactly as Wood and Douglas say it would – I had to fiddle with the cutters to get the lead lengths right for the PCB, and then solder the leads quickly for fear of damaging it. I took about 15 hours to build it, which was a far cry from the two to three hours that Wood and Douglas suggest in their sheet – maybe I'm just slow or something, but that seems like a very short time to make a project of this sort and to make a good job of it, or perhaps I just stopped for too many cups of coffee

Anyway, it was time to test it, and it must have been my lucky day because it worked like a charm. The adjustments and general tweaks were absolutely as per the instructions, and out came just over a watt of RF at the drop of a hat. This was decidedly higher than we expected, but when we got the spectrum analyser out we were delighted to see that the power was all going into the fundamental – the worst sprogs were an output on 144MHz at about −66dB and the next worst was the second harmonic at −78dB. There wasn't anything else worth mentioning, so the next step was to try it out on the air.

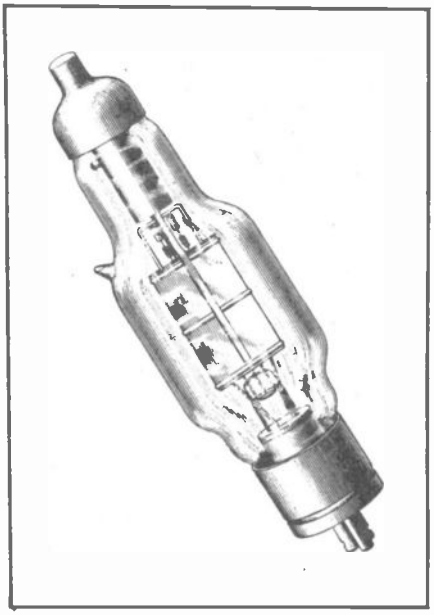
The initial reports were that the audio was very bass-heavy and there didn't seem to be enough deviation. We scratched about a bit and bunged an audio generator in to have a look, but we set the dev. up for 4.5kHz at 1kHz input and had another go. Then we read the instructions, especially the bit that said ". . . microphone impedance should be high – low impedance mikes may produce bassy audio". So we took away our low-impedance microphone . . . and scrounged around for a crystal device. This worked well, and indeed the second contact remarked that the audio was now very good indeed! The moral of the story, folks, is read the instructions.

It was now time to put the two together – which we did at about midnight! They're actually very easy to interface, and Wood and Douglas supplied us with their SSR1 solid state relay for the supply switching. This is a little PCB with a few components on it, which we put together in short order – imagine our pleasure when the whole thing worked a treat? We didn't have the time to make a neat job and tidy up all the wires, so the Editor's office looked like the National Physical Laboratory's experimental department by the time we'd done. But it wasn't too late to have a few QSOs via the local repeater – we had to improvise a toneburst, but we had good reports and everything seemed to work just fine.

All in all, then, full marks to Wood and Douglas for their kit – we both thoroughly enjoyed getting them both going, and we must say that there's something about home-brewing that simply can't be beaten. We'd have liked to make ours into a little hand-held, although the current consumption's a bit on the high side for such a use. We'd imagine that you could have the makings of a great base station or a mobile rig if you had a little amplifier hung on to the back of the machinery, and maybe W & D might think about that for their next kit! Anyway, ten out of ten for very nice and well thought out kits.

VALVES AND THINGS

Virtually anything you can do with transistors can also be done with valves. But this is a step backwards — or is it? CHRIS DRAKE asks the question.



Valves? What are they doing in a super duper state-of-the-art publication like this? Well, in actual fact, those little glass things which need a power station to run them, and take up more space than vast quantities of integrated circuits which could do a thousand times more things and take about a thousand times less power in the process, still have their uses.

Twenty years ago the valve was still the thing you used more than anything else for circuits which would **amplify**. Now if you can amplify (which is just a word meaning to make larger, ie if you put a small signal into the input of the circuit, you get a larger one out the other end) you can do practically anything in electronics, and virtually anything you can do with transistors can be done also with valves. Mind you, what takes up one little box in the corner of the shack might well fill the garden and confuse next door's moggie if you tried to do it with valves. . . .

Anyway, the idea of this article is to take a brief look at how a valve works and then to see what we can use them for. The most basic type of "bottle" (which is often what people call a valve, by the way) contains three electrodes all sealed into a glass envelope from which all the air has been removed. In other words it's a vacuum, and that's why our cousins in the States refer to valves as "vacuum tubes" or tubes (or toobs most of the time). The three electrodes are the **anode**, the **cathode** and the **heater**, and the basic idea of the heater is just what it says it is – it heats up the cathode. The cathode, the thing that gets hot, is coated with certain substances (no, Rastus, not *those* certain substances . . .) which emit **electrons** at a relatively low temperature. Electrons are the things which, when they flow through a wire or thereabouts, are usually known as an electric current. Put another way, any electric current is a sign of lots of little electrons whizzing down the wire and they're driven by the **potential difference** between two points, which you may remember from the article on power supplies earlier in this magazine.

Right. So the heater heats up the cathode, which proceeds to boil off clouds of nice electrons like the kettle here in the office when it's boiling. Ah yes, two sugars, thanks! Assuming that all you do is heat up the cathode, all you'll get is a cloud of electrons which is known in all the old textbooks as the **space charge**, and you won't be any better off than when you started all this. However, your next trick is to connect the anode to a source of positive volts. What happens is that all the jolly little electrons go shooting off towards the anode at hyper speed and connect with it. Then hey presto, a current will proceed to flow. In other words, if you connected a current meter in the anode circuit, between the positive volts and the anode, it'd read something.

That on its own doesn't sound exactly spectacular but stick with us. That sort of valve is known as a **diode** because it comes from the Greek word for two and a diode contains two electrodes. Yes I know we said there were an anode, a cathode and a heater but we can ignore the heater. The di- part of the word refers to the number of electrodes actually involved in conducting the current, and only the anode and the cathode have any part in this.

OK – so we can make a current flow – so what? Well, it only flows if the anode is more positive voltage-wise than the cathode – if you were to turn it round and put the positive volts on the cathode and earth the anode, you'd get no current to flow at all. In other words, it's only good for one-way working, as it were. Now if you've read the power supply article, you'll remember that we use a **rectifier** to remove the part of the mains cycle or whatever that we don't want, and it does this by chopping it off. The diode we've just described would do this job nicely, because it'll only allow the current to flow when the anode is more positive than the cathode; which is precisely what you want a rectifier to do. Have a look at the diagrams if you're not too sure of what I mean – you'll soon twig it.

Diode valves were indeed used in this way for many years, and you'll still find valve rectifiers in some old wireless sets. But being able to rectify is all very well – let's go on to something a bit more meaty now and see what else we can do.

Remember that we've persuaded a current to flow when we make the anode more positive than the cathode? Fine. The thing is that the valve is either or or off (as it were), like the bathroom light – you don't have too much control over the proceedings. However, if you introduce another electrode, known as the **grid**, into your basic diode, life gets much more interesting.

Tetrodes, triodes, pentodes and so on

The grid is usually a bit like its name. It's a sort of mesh structure which is interposed (good word, that) between the cathode and the anode, usually rather nearer to the cathode. What happens is that if you make the anode more positive than the cathode so that some current flows (it's called **anode current**, surprise surprise) you can then control how much anode current flows by varying the voltage on the grid. This opens up about a million possibilities because this is how to make the valve amplify. Suppose you arrange matters so that you can vary the anode current between, say, 50 and 200 milliamps by waving the voltage on the grid up and down between, for example, 10 and 20 volts – you then can say you've **amplified** the original signal by quite an amount, because with the right value of resistance in the anode circuit, that's a voltage swing of something like 100 to 200.

Admittedly we've cut out about a hundred pages of theory here, and if you'd like to know more about it you'll need to delve into any of the old time textbooks to get a bit more detail. The best explanation of valve theory in a nutshell comes in a book called *Foundations of Wireless* by M. G. Scroggie, and it's one of the classic electronic books of all time.

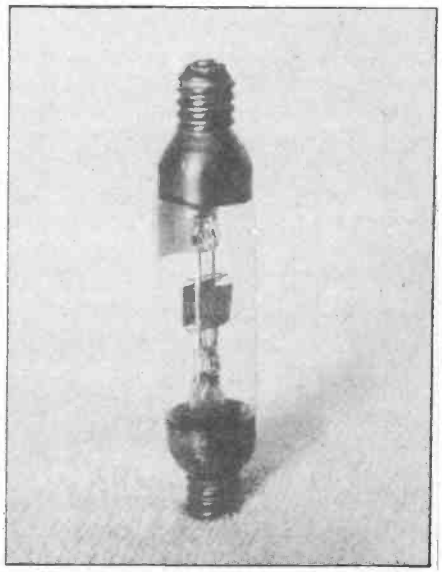
Anyhow, this basic type of valve is called a **triode** because it contains three active electrodes. It was the earliest type of valve which could be made to amplify. However, there are some snags with it. It isn't easy to get much **gain** out of a triode valve amplifier (gain is just a measure of how much amplification you get) without it turning into what is known as an **oscillator** – an oscillator being something which generates waves all by itself, which is handy for some thing but not when you're just trying to make a straight amplifier. The cure for this was to introduce another grid into the valve, called the **screen grid** because its function was to screen the main grid (which is known as the **control grid** – sorry about all the names but you get used to them – we'll give a little test at the end just to see whether you've got it all sorted!) from the anode so that the thing didn't turn into an oscillator quite so easily. The screen grid is also taken to a source of positive voltage, which isn't usually as high as the voltage on the anode. This type of valve is called a **tetrode** and they were quite common before the last war.

However, there's another problem with the tetrode – it has a kink! Now in order to explain that we'd need to fill half the magazine. Suffice it to say that your basic tetrode has a couple of characteristics which make it a bit tiresome in use and it's all to do with how the electrons from the cathode divided themselves between the anode and the screen grid of the valve. The ordinary tetrode is very prone to a nasty called **secondary emission**, which isn't a disgusting disease but which does cause various sorts of aggro. One time you'll come across it as if you want to use valves in the 4CX250 series for high power linear amplifiers on the VHF and UHF bands. This type of valve is almost a classic tetrode in some ways and isn't all that easy to use unless you bear a few things in mind. John Nelson, who was involved in the first issue of *Amateur Radio*, probably knows more than anyone in the country about 4CX250s and he did a brilliant series about a year ago in *Short Wave Magazine* on how to make really good power supplies for these bottles and how to get the best out of them. See? We are not afraid of recommending another magazine's article where credit is due. . . .

So the tetrode was soon modified into something called a **beam tetrode**, in which there are a few modifications to the structure of the electrodes inside the valve so that the electron stream behaves itself a bit better. The beam tetrode is an absolute classic, and superb valves like the 807, 813 and KT66 and KT88 fall into this category, as well as practically every valve that ever found its way into the audio output stage of a radio set. All the really classic transmitting valves were beam tetrodes. They're easy to use and you can't go wrong with them. We love 'em!

Double the maker's ratings

It's worth mentioning at this stage that one of the most endearing things about valves is that they're rugged. Unlike transistors, which don't take at all kindly to anything remotely resembling an overload or a surge, valves just cough or glow a bit brighter and carry on just the same. Even a spectacular internal flashover isn't often fatal, and we'll admit to having inflicted some pretty dire things on 807s when we first got our ticket. In those days it was reckoned that you could just about double the maker's ratings and get away with it. If the anode started to get a bit cherry red you wound the drive down a touch and kept on going. . . .



Oh dear – back to reality. As we've said, beam tetrodes are delightful and so are 4CX250s – except that they're more like ordinary tetrodes and you need to use them with this in mind. The 4CX250 family are absolutely superb for running the legal limit on any band up to and including 432MHz and if you fancy some QRO they're well worth a go. But even tetrodes aren't always the answer to a maiden's prayer, and for various reasons you'll find valves with yet another grid, the **suppressor grid**. This animal is called a **pentode**, and for high gain and lots of stability you can't beat them. Those of you who were into hi-fi twenty or so years ago will no doubt remember the EF86, which was a low-noise pentode which was used in high class preamplifier circuits, and pentodes for higher frequencies can still be found in receivers such as the Racal RA17 series. The thing about valves used in the front end of receivers, by the way, is that it's dead easy to make a simple front end that's more or less "bomb-proof". We all tend to agonise about intermod performance and the third-order intercept performance of our wirelesses, but in the days when valves ruled OK the problems didn't really exist – well, they did but a suitable valve could give you great performance with consummate ease. They were noisier than the best modern devices, but certainly on 144MHz there isn't much difference between a noise figure of 1dB and 3dB unless you're into EME and living about a hundred miles from nowhere. Signal handling is a darn sight more important for most of us than noise factor on this band, and it was extremely easy to do it with valves.

Anyhow, there were valves with even more grids in them but we can leave those for now. Is it worth bothering with valves at all? In a word, yes. Valve circuits tend to be much simpler than transistor versions a lot of the time. They're certainly cheap and if you want lots of power out of your transmitter without paying an arm and a leg or building protection circuitry that's incredibly complicated, there's nothing to beat valves. An SSB linear using valves is likely to be more "linear" than the equivalent transistor device, and also more rugged.

However, it will certainly be larger and hotter! I don't think I'd build receivers using valves nowadays for anything other than fun because it's so easy to do it with solid state thingies. But it's well worth knowing a thing or two about them when you've considering home brew transmitters of more than a few watts output.

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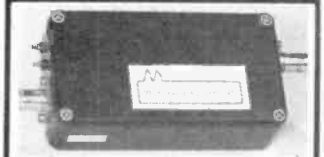

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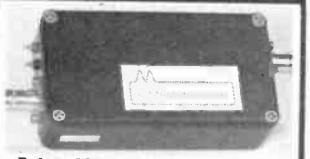

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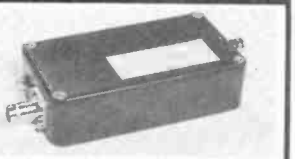

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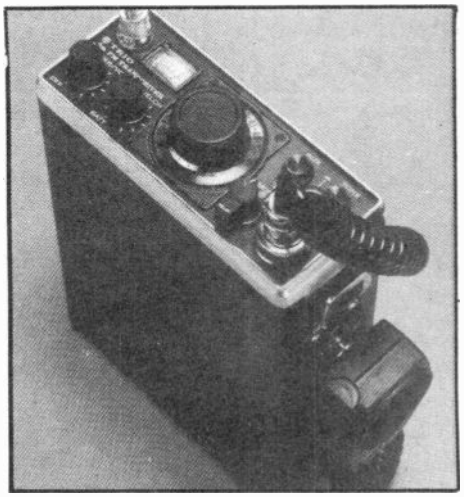
RECEIVING YOU LOUD AND...

DX FM reception can sometimes be of top strength and sometimes of awful quality. Here we delve into the problems and suggest a few cures.

One of the interesting things on our questionnaire – which I suppose we ought to have expected, thinking about it – was that many of you are interested in hi-fi and long-distance FM reception. In fact, the questionnaire seemed to suggest that about 1 in 16 of you spend some time trying to get distant stations. Thinking about this, and bearing in mind the fact that there are a lot of amateurs, especially Class B licencees, who like FM DXing on 144MHz, we thought we'd do a brief article about the increase in interest in 144MHz FM DXing, with a look over our shoulders at how to get good reception of FM broadcast stations in what is known as Band 2.

The first question might be "why bother?" It's a known fact that FM is not such a good mode under weak-signal conditions as SSB and CW – the reasons why are a bit beyond the scope of this article but, broadly speaking, they're to do with the way in which FM is resolved and turned back into speech coming out of your wireless. At least, that's what you'd expect in theory. It's intriguing that the professionals did some tests on this recently, and they found that what is known as **narrow-band FM** – which is what radio amateurs and indeed users of private mobile radio, like taxis, ambulances and those who rush around fixing the space invaders machine at the local use all the time – wasn't really any worse than SSB under weak and noisy conditions. So despite the textbooks you could say that a well-designed FM receiver is almost as good as any other for working DX, but it's all a matter of how well the detector circuitry is designed and also to some extent a function of the nature of the transmitted audio. If you're transmitting FM, you need to have something called **deviation** (no rude comments from the back, chaps . . .) set up properly, and you also need the right sort of frequency response at the transmitter.

However, back to business. For various reasons an FM transmitter tends to be somewhat cheaper than one for SSB or whatever, and the same is true of the receiver. If you read the article on semiconductors last time, you'll remember that we described how you could use something called a varicap (which is short for "variable capacaitance diode") to produce an FM transmission. Maybe we ought to mention before we go further that FM stands for Frequency Modulation, which just means that you take the basic transmitter frequency and wave it about a bit, so to speak, in accordance with the speech patterns of your dulcet tones. It's dead easy to produce FM, and many amateurs use it on VHF and UHF, as do our friends on citizens band. It's worth mentioning at this stage that the the reasons chosen for FM as far as CB goes were technically quite valid, and as many CB users have found out since it all became legal there's no real difference in the performance of an AM and an FM rig, assuming that the circuitry is half-way reasonable.



This is Trio's 144MHz hand portable (TR2300) which has 80 channels and around one watt ouput on FM. Good audio sound.

The "sound" of SSB

So one reason many amateurs use FM is that rigs are quite a bit cheaper than those for SSB, and it's also a fact that many folks simply can't stand the "sound" of SSB and find it difficult to tune in properly. So, not surprisingly, lots of people like to try and work long distances with it. What's involved?

Well, like any other DX work, the first step in life is the best antenna you can buy, or build, or get up on the chimney without getting the local council slapping an injunction on you to remove it pronto. Half the battle with working DX of any sort is to realise that, however good the rig may be, it's so much junk without a decent antenna and it never ceases to amaze us that people go out and spend an arm and a leg on a good rig and then claim they can't afford a decent antennal This really is putting the cart before the horse – yes, we *know* it's nice to have something with stacks of knobs and dials amd meters that look as though they came out of mission control but if the antenna is the proverbial bit of wet string, your gleaming rig is just another ornament. We reckon here in the office that if you have a certain sum to spend, the first thing you ought to do is invest a goodly chunk of it in the biggest and best antenna you can get without your neighbours thinking your desirable residence has just become an out station of GCHQ and thinking you're a second cousin to Geoffrey Prime. When you've done *that,* you can get thinking about the rig itself.

The other thing you'll need to lash out for – whether you're into broadcast-type DX or the amateur equivalent – is some decent feeder. Feeder is the stuff that connects the antenna to the rig, and we had a feature on it last time – for those of you who didn't see it, let's just say that the feeder is another vastly underrated and highly important part of *any* station concerned with VHF and UHF work. The thing is that all feeder possesses something called **loss,** which, to no one's great surprise, means that the signal you've spent a bomb on getting a faint smidgin of into the antenna can get lost between there and your wireless set because the cable isn't good enough.

It's a sobering thought that a longish length of not-so-good feeder can easily lose 3dB (all right, own up; how many of you have forgotten what one of those is? I thought so, You're hereby sentenced to read the article on "feeders" in last month's mag again, assuming you haven't burned it or made the dog's bed out of it) and that cuts both ways; it means not only do you lose half of your hard-earned transmitter power and waste it in heating up the feeder but you degrade the signal-to-noise ratio of incoming signals by the same amount.

Now if you bear in mind that 3dB represents the sort of average signal-to-noise ratio on a really weak-and-watery piece of choice DX, you'll see that that sort of feeder loss can make the difference between just about working someone and not being able to hear them at all. So decent feeder is a must. Something like UR67 or RG8/U is the absolute minimum we'd consider, and we'd want something better than that if we were trying to do great things on 432MHz or higher and also if we were forced to have a long run of the stuff. At my home station, I have to have a feeder run of almost 90 feet on 432MHz, and it wasn't until recently that I bit the

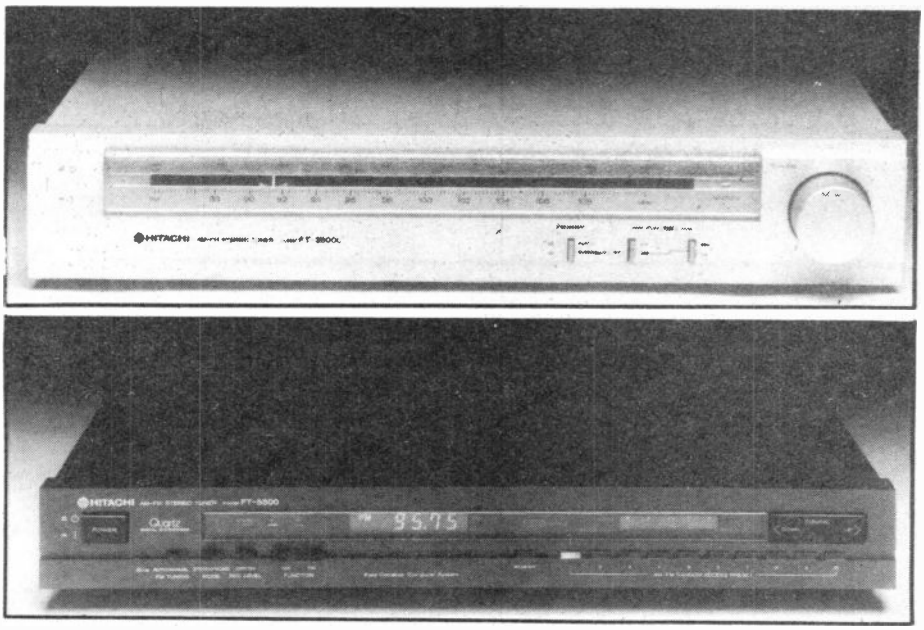
bullet and forked out for some Heliax LDF-4 to replace the UR67. I still wince at the bill of almost £80, but it doesn't half make a difference in what I can hear on 70cm.

So, that's dealt with the things outside, except of course to say that the best place for a preamp is right next to the antenna. If you're a transmitting amateur, you'll have to be careful that the transmitt/receive switching is carefully arranged, because we don't know of any preamp that'll take your transmitted megawatts into itself without departing this life for a better one. That puff of white smoke at the top of the mast might just mean that they've elected a new chairman of your local club, but it's more likely to mean that you loused up the switching arrangements and zapped the preamp. If it contains some state-of-the – art thing like a gasfet, that isn't going to be in the least bit funny, so we'd strongly suggest fail-safe switching and a bit of thought before you fire up the linear for the first time.

The best place for a preamp is emphatically *not inside* your wireless. It isn't going to do anything useful in there unless the front-end is as deaf as the proverbial post, and you're much more likely to cause aggro for yourself when your locals come on than to improve the amount of distant stations you hear and work. This apples particularly to Band 2 FM broadcast DX addicts because it's a fair bet that your local broadcast transmitters are going to be pretty strong and they'll be all over the band if you simply cram a preamp into the receiver without having a ponder about whether you really need it or not. Preamps up the mast, chaps, and not in the wireless, that's the motto.

Right. What about the receiver? Well, the first point to bear in mind is how good its own front-end is, particularly with regard to strong-signal handling and how quiet it is. The latter can be deduced from the spec; somewhere in the small print there should be something called the noise factor, and on Band 2 and 144MHz we'll be most pleased if we see something not more than about 3.5dB. There isn't a lot of point in striving for the lowest possible noise figure at these frequencies because there's usually enough noise from all the things people get up to to create a "noise floor" of anywhere between about 1 and 3dB depending on whether you live in the depths of the country or in swinging suburbia.

In a sense it's more important to have good strong-signal handling than the ultimate in a low noise-factor front-ends, although unfortunately there's no real way you can tell from the spec what the signal handling's going to be like unless the manufacturer specifically mentions either the dynamic range or the third-order intercept point of the front-ends and almost none of them do. So you're reduced to having a peer at the circuit, and ideally you want to see something like a double-balanced mixer of some sort, preferably using Schottky devices, preceded by a good RF stage made of a FET or two. You could do a big article on decent front-ends, actually, so we won't hack away at the details now, but something called a JFET or "jugfet" would suggest that the designer has paid some attention to signal handling. If you're into home brew you can make lovely RF stages for these frequencies from a pair of U310 devices and it's like falling off a log.



Top: Hitachi's FT3500 FM/MW/LW multiplex stereo tuner which costs £84.90 at the time of writing! FM frequency coverage is 88-108MHz. Above: Another from the same company. This one's the FT5500 with a price tag of £160.50. Only 60mm high, it runs through FM in 50kHz steps manually or automatically.

What next? The detector, Brian, or the bit that turns Radio 3 or G8XYZ into an audible signal, and we have to think about the "IF filtering" of the rig in this context as well. What this means is some way of making sure that the IF circuitry of the receiver, which stands for Intermediate Frequency, by the way, and could be said to be the heart of the receiver, is set up to pass the bandwidth of the signals you want to hear and no others. For the broadcast bands, where you're after hi-fi stereo sound, the IF bandwidth has to be a lot wider than it does for an amateur receiver, and in both you'll usually find some sort of crystal or ceramic filtering.

This needs to have been carefully thought about because it's no use having a super front-end if you end up copying three signals at once because there's too much IF filter bandwidth. In an amateur receiver, you're looking for a total bandwidth of not more than about 3KHz at 60dB down, and most will be a good deal better that that – the "60dB down" means that signals outside the passband which are 60dB less strong than those inside it shouldn't be more than 3KHz apart. That's compressing whole textbook chapters into a sentence, by the way, so don't take that as a solemn truth of what IF filtering is about.

The detector circuitry needs to be reasonably well thought out, and there must be something called a "limiter" in any halfway decent FM receiver. The point of this gizmo is to make the receiver insensitive to signals which are amplitude modulated – you might think this didn't matter much but almost every random crash and bang in nature is an amplitude-modulated signal and you'll be happiest if you don't get crashes and bangs all over the place. Mind you, as far as weak-signal FM is concerned it's a matter of argument whether you'll be working under the limiting threshold most of the time anyway unless the receiver is super-clever or super-expensive (the two aren't always the same . . .) so it might be better to concentrate on good IF filter performance. The majority of discriminators (that's the fancy name given to the detector in an FM receiver) these days use something natty called a **phase-locked loop**, and these are usually a Good Thing. Don't worry about how they work otherwise we'll be here all day instead of getting on the wireless and talking to people!

That's a quick look at some of the factors affecting FM reception. FM DXing can make a nice change from the other sort, actually, and especially during good conditions on 144MHz because the Dutch novice licence includes FM only on 144MHz – those with PD0 callsigns – and they're over the moon to work us lot over here. So try it – you'll like it!

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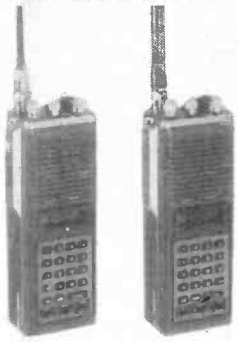

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★ SSB: 1kHz and 100Hz steps
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A Licence for Novices?

The cases for and against, by Chris Drake

You might be forgiven for thinking that, from the title, this magazine should be called Nun's Weekly. But actually we're thinking of the licence for absolute beginners on amateur radio, which seems to have been the subject of fitful discussion over the years.

The RSGB and the Home Office have had, as far as we can gather, a few tentative ideas and proposals floating about for ages now but nothing concrete seems to have emerged, so we thought we'd throw in our two pennyworth. Maybe we'll get a bit of a debate going.

Do we need a novice licence? Opinions differ on this one. Broadly speaking some countries have various grades of amateur licence, the good old US of A being a case in point; if you're a rank beginner to the hobby you take a simple technical exam and a five-word per minute Morse test and then you can legally operate on certain bits of certain bands. The idea then is that you progress to higher things and end up with their highest grade of ticket which is the Amateur Extra Class.

Other countries do the same, and we came across this the last time there was an opening on 144MHz. We were called by hordes of stations with PD0 callsigns when we were trying to find out whether someone's mobile rig was working or not. They're allowed 10 watts on some spot FM channels.

In the UK there seem to us to be arguments both for and against a novice or beginners' licence. On the one hand we don't feel that the RAE is a fearfully demanding examination, given that you need to have *some* idea of what the technical side of the hobby is about. In this way you're making a bit more of amateur radio than social chit-chat and you're aware of the problems that can be caused to other radio users if your transmitter decides it's One Of Those Days and puts RF everywhere except where it should. We feel that the "self-training" bit in the licence means what it says and that amateur radio ought to be a bit more than a glorified CB service – now don't get us wrong, we're not having a snide go at CB and we certainly don't think that amateur radio is simply an up-market CB. They're just different from each other and both have their place. Having said that, there might be a case for something a bit different because it seems to us that not many of today's amateurs have come via the old SWL route into the hobby and it's clear (sometimes, we regret to say, painfully so) that some of the new people on the band haven't the foggiest idea of amateur procedures and how to go about making contact with other amateurs in a meaningful way.

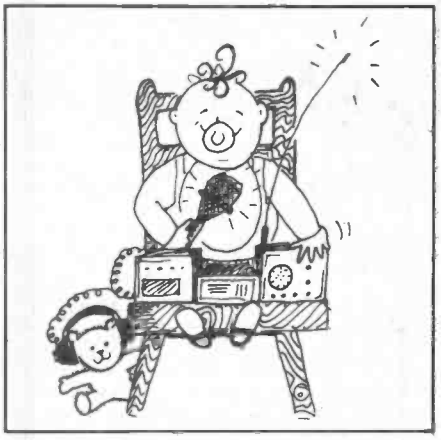
The other thing is Morse. Now we're well aware that there are a lot of people who think that the Morse test ought to be abolished. We at *Amateur Radio* have to nail our flag to the mast and say that we don't agree one bit. Morse is extremely useful for all sorts of things, even in this digital age of ours and we'd hate to see it go. There doesn't seem any harm in having to pass a test in its use, and we feel in a funny way that there's a certain feeling of achievement in passing the Post Office Morse Test – it makes us feel a bit like a cousin of all those radio operators on ships and all that. Maybe we're just too romantic by half!

Useful skill

Okay, so it's a well-known fact that many people resent having to pass the Morse test just to get access to the HF bands and that they intend to forget the whole thing as soon as they get their Class A licence. Everyone has a right to choose, although we feel it's a pity to let a useful skill go when it's so handy for so many things, and the fact remains that a CW transmitter is the simplest and cheapest of all.

In the *Amateur Radio Proposal for a Novice Licence*, we suspect we'd still keep a Morse requirement for somewhere on the HF bands, although maybe five words a minute wouldn't be too bad. We feel that the idea would be to let someone "get his feet wet" as it were, with some part of (say) the 28MHz band and a relatively low power limit of (say) 30 watts. The idea here might be for the novice to learn some things about propagation and basic operating techniques the easy way in order to see if he liked it or not. He'd get asked some basic questions by a fellow amateur, and he'd also get the Morse test submitted by the same man, and in a sense the novice would be "sponsored" by this A. N. Other. Maybe he could operate his own, full-class station, again under the supervision of the owner of it.

We feel it'd be nice to insist on some element of home-brew in the



novices' station, even if it were only the wavemeter or something. Maybe he could go on from that station with his 30 watts or whatever and learn as he went along.

If the said novice wasn't a bit happy about Morse and was keen to have a go anyway, the problem comes in where you put him. The 144MHz band is already overcrowded enough as it is, and the higher bands are technically more difficult, so (after a few more cups of coffee) we felt that we'd do as the Russians do and count 28MHz as a VHF band! Let's face it – in the next few years, as the sunspots stop spotting or whatever they do, this band is going to get more than somewhat under-utilised, and the way pressure on frequency space is going, someone will start putting pressure on someone else and we'll lose it. 1.7MHz of HF space that isn't being used much is really too tempting and if we don't use it we'll lose it as sure as sparks fly upwards.

So how about having non-Morse novices in one bit of it and Morse ditto in a wider segment – let's say 29 to 29.05 for non-Morse and 29.0 to 29.1 for all? Or maybe move those figures down a meg so as to stop CB folks with hi-hi channels from intruding into the amateur megahertz? (We think they do it because they don't know any better, or are we being naive?). It'd mean shifting the bandplan round a bit, but is that such a dreadful thing to ask when the band simply isn't supporting communication over any distance for more than an hour or so a day?

Anyway, we're running out of space so we'll have to leave it there. Officially, the Home Office can't even consider any proposals for a novice licence because they're apparently computerising their licence records, according to a nice gentleman in

their Press Office and they haven't the staff time to spare. We don't know what firm proposals the RSGB have in mind (if indeed they have any) so it would be interesting to hear *your* views pro and con and see what you'd like for novices. We'll analyse your comments in the next issue.

1968

Serial No. 358

Mr. George Wallace (Norwich, North): To ask the Postmaster General, if he has now reached a decision on the extension of Class B (Amateur) Transmitting Licences.

(Thursday 29th February 1968)

(Answered: Monday 11th March 1968)

MR. EDWARD SHORT: I am pleased to say that I have decided that the Amateur (Sound) Licence B can be extended to permit operation in the radio frequency band 144 - 146 Mc/s. I shall be issuing a General Notice to give effect to this decision as soon as possible.

I have also decided to introduce a Beginners Licence, to encourage interest in radio by people not yet possessing the qualifications needed for a fully Amateur Licence. The details of the availability of this new licence are still being worked out, but I expect to have it on issue by the Autumn of this year.

1972

From The Minister of Posts and Telecommunications

1. The aim of the International Radio Regulations governing the radio amateur service, which it is my duty to enforce, are designed to ensure that the already crowded frequencies allocated to that service are used only by qualified persons for the purpose of self-training and technical investigations. I am aware that the Regulations permit some flexibility of approach in this matter but it is evident, since I understand that only one Western European nation has permitted unqualified persons to make use of the amateur network, that other countries - like us - are concerned at the already overcrowded state of the amateur frequency bands in this area.

2. The licensed amateur is at all times responsible for the transmissions from his station. It is hard to see how he could control the content of the messages when someone else is speaking into the microphone.

3. Mr..... scheme could well breach the terms of the Post Office Act 1969 which vested in the Corporation monopoly rights to run communications between third parties.

All this does not mean to say that it is not my aim to interpret the licensing regulations as liberally as possible. Within reasonable limits I have no objection to licensed amateurs passing messages relating to scouting activities at the time of the Boy Scout Movement's annual "Jamboree-on-the-Air", where there are directly intrested amateurs at both ends of the circuit. So long as this concession is not abused I am of course happy for it to continue, but I am sure you will understand that it is not open to me to go any further.

Excerpt from a letter to Mr. Peter Hardy MP, from The Minister of Posts and Telecommunications Mr, John Stonehouse explaining why he turned down a request for an amateur radio network for persons who are not licensed amateurs. The letter is dated November 30th 1972.

1982

HOME OFFICE
QUEEN ANNE'S GATE
LONDON SW1H 9AT

21 APR 1982

Dear Peter,

Thank you for your letter of 17th February to John Belstead about the introduction of a novice licence for radio amateurs, which has been proposed by your constituent, Mr. D. O'Garr. I am sorry you have not had an earlier reply.

Until fairly recently the Radio Society of Great Britain the representative body for radio amateurs, did not favour the introduction of novice licences, but they have had a change of view and have submitted detailed proposals to us for a provisional or novice licence. It remains the case, however, that under the International Radio Regulations we are required to satisfy ourselves as to the technical qualifications of any person operating an amateur radio station. We therefore require applicants for an amateur licence to pass the Radio Amateur Examination (R.A.E.) which is set by the City and Guilds Institute: this clearly establishes an easily identifiable standard required of all applicants. The standard set by the R.A.E. is we believe the lowest possible to ensure a minimum of interference to others services and therefore we have reservations about introducing a lower standard for licensees, even though they would be operating under supervision. We also remain doubtful about the level of demand, especially since the introduction of the citizens' band radio service last November.

The R.S.G.B. have taken account of our views and have made some constructive proposals which would help to remove some of the difficulties but even if we could be convinced that there were no objections in principle to the scheme, the increased administrative burden that its introduction would entail would rule it out for the time being at least.

The Quest for a Beginners Licence 1968-1982

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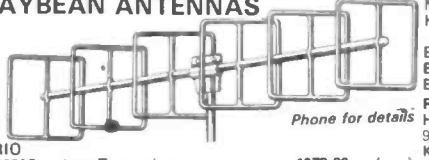

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MML144/100S	2M 100W Linear Amp (10W I/P)	139.00	(—)
MML144/100LS	2M 100W LInear Amp (3W I/P)	159.00	(—)
MML432/30LS	70cm 30W Linear Amp (3W I/P)	85.00	(—)
MML432/50	70cm/50W Linear Amp	109.95	(—)
MML432/100	70cm 10/100W Linear Amp	228.64	(—)
MM2001	RTTY to TV Converter	189.00	(—)
MM4000	TRRY Transceiver	269.00	(—)
MMC50/28	6M Converter to HF Rig	29.90	(—)
MMC70/28	4M Converter to HF Rig	22.90	(—)
MMC144/28	2M Converter to HF Rig	29.90	(—)
MMC432/28S	70cm Converter to HF Rig	37.90	(—)
MMC432/144S	70cm Converter to 2M rig	37.90	(—)
MMC435/600	70cm ATV Converter	27.90	(—)
MMK1296/144	23cm Converter to 2M Rig	69.95	(—)
MMD050/500	500MHz Dig. Frequency Meter	75.00	(—)
MMD600P	600MHz Prescaler	29.90	(—)
MMDP1	Frequency Counter Probe	14.90	(—)
MMA28	10M Preamp	16.95	(—)
MMA144V	2M RF Switched Preamp	34.90	(—)
MMF144	2M Band pass Filter	11.90	(—)
MMF432	70cm Band Pass Filter	11.90	(—)
MMS1	The Morse Talker	115.00	(—)
DATONG PROOUCTS			
PC1	Gen. Coverage Converter HF on 2M Rig	137.42	(—)
VLF	Very Low Frequency Converter	29.90	(—)
FL1	Frequency Agile Audio Filter	79.35	(—)
FL2	Multi-mode Audio Filter	89.70	(—)
FL3	FL2 Audio Filter and Notch	129.00	(—)
ASP/B	Auto RF Speech Clipper (Trio Plug)	82.80	(—)
ASP/A	Auto RF Speech Clippers (Yaesu Plug)	82.80	(—)
D75	Manually controlled RF Speech Clipper	56.35	(—)
RFC/M	RF Speech Clipper Module	29.90	(—)
D70	Morse Tutor	56.35	(—)
AD270	Indoor Active Dipole Antenna	47.15	(—)
AD370	Outdoor Active Dipole Antenna	64.40	(—)
MPU1	Mains Power Unit	6.90	(—)
MK	Keyboard Morse Sender	137.42	(—)
RFA	Broadband Preamplifier	33.92	(—)
	Codecall Selective Calling Device (link prog)	32.30	(—)
	(switch prog)	33.92	(—)

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9-12.30, 1.30-5.30

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All prices correct at time of going to press

BREDHURST ELECTRONICS
HIGH ST., HANDCROSS, W. SUSSEX. TEL: 0444 400786

RETAIL CALLERS
9-12, 1.30-5.30
E&OE

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COMPONENT COLOUR CODES

Many components these days are colour-coded in order to show their value. Resistors have almost always been in one way or another, but so are some types of capacitors nowadays and it's worth being aware of what they might mean. The resistor colour code is very easy, and if you do any home-brewing at all, you'll pick it up in no time.

FOUR BAND RESISTORS

1st COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

2nd COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

	3rd COLOUR BAND
Silver	Divide by 100
Gold	Divide by 10
Black	Multiply by 1
Brown	" " 10
Red	" " 100
Orange	" " 1,000
Yellow	" " 10,000
Green	" " 100,000
Blue	" " 1,000,000

4th COLOUR BAND (Tolerance)
Red ± 2%
Gold ± 5%
Silver ± 10%
No Colour Band ± 20%

FIVE BAND RESISTORS

1st COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

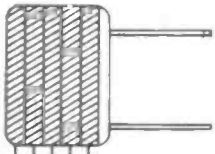
2nd COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

3rd COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

	4th COLOUR BAND
Silver	Divide by 100
Gold	Divide by 10
Black	Multiply by 1
Brown	" " 10
Red	" " 100
Orange	" " 1,000
Yellow	" " 10,000
Green	" " 100,000
Blue	" " 1,000,000

5th COLOUR BAND (Tolerance)
Brown ± 1%
Red ± 2%
Gold ± 5%
Silver ± 10%
No Colour Band ± 20%

POLYESTER CAPACITORS



1st COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

2nd COLOUR BAND	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

3rd COLOUR BAND	
Orange	× 0.001 µF
Yellow	× 0.01 µF
Green	× 0.1 µF

4th COLOUR BAND (Tolerance)	
White	±10%
Black	±20%

5th COLOUR BAND (Working Voltage)	
Red	250V d.c.
Yellow	400V d.c.

STANDARD DECADE VALUES

E24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
E12	10		12		15		18		22		27		33		39		47		56		68		82	
E6	10				15				22				33				47				68			

BOOKS

Some of the letters we've had have asked us what books we suggest for beginners and the more advanced man alike. We thought we'd do a sort of mini-review of some of the books we've seen recently and tell you which ones we use a lot!

For the complete beginner who wants to get a licence, we can't think of anything better than the *RAE Manual*, published by the RSGB. It contains everything you need in the way of the theoretical background and also the licensing conditions, and they've just published a new edition to deal with the changes to the amateur licence that followed the schedule thing last February. There's a lot in it, and it isn't a book to read from cover to cover at one go but more for nibbling away at when you're sitting by the fire with your cuppa after a hard day at the office. If you learn everything in there, you'll pass the exam without a shadow of doubt.

Another RSGB goodie is the *Guide to Amateur Radio*. This gives the background to what the hobby is all about, and there's no better publication for the radio amateur in this country. Some of the pictures look their age now, and we find the style in which it's written a bit stiff, but all in all it's a pretty good book for the newcomer.

For the more advanced man, we'd recommend another RSGB book (no, they're not paying us any commission, alas) in the shape of *HF Antennas for All Locations*. This is distinctly different from any antenna book we've come across – it's what we use as a sort of source-book for the next antenna on the roof of the building here. The author does a good job of removing some of the gunge from the myths and half-truths that have collected around the subject of antennas for yonks, although you do need a bit of background experience in order to get the best out of it. Some of the author's statements are a bit impenetrable (why would he cut a hundred-foot tower in half for "fear of dragons"? – sounds a bit self-consciously literary to the likes of us!) but it really is a super book.

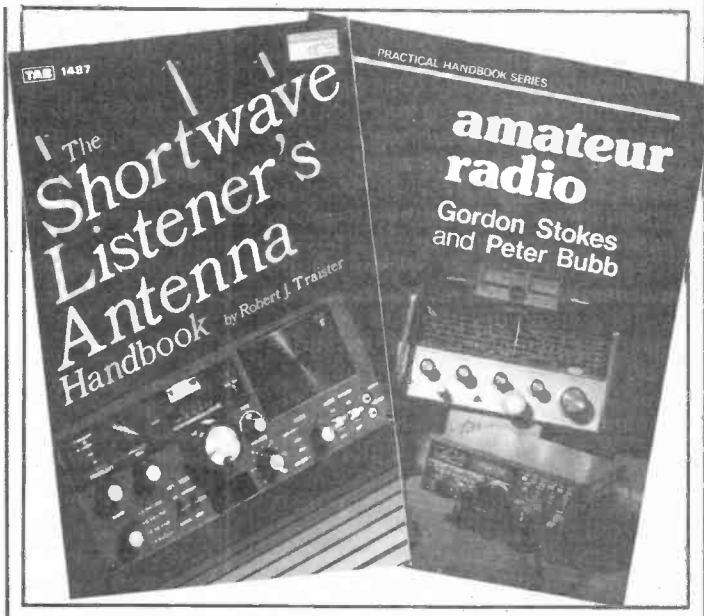
Another antenna book we wouldn't willingly be without is the *ARRL Antenna Book*. The ARRL is the American equivalent to our own RSGB and although some of their books have decidedly limited relevance over here, the Antenna Book is a solid and meaty tome of what's in antennas and transmission lines. There's a new edition out, and it really is recommended if you like messing around with queer things in the back garden. We have a feeling that the Yanks aren't so conscious of VHF DX as we are here, and their VHF antenna technology seems a good way behind Europe in some ways, but for the HF merchants it's a grand book.

One of the most spiffing books to come our way for ages is called *A Practical Introduction to Electronic Circuits* by a gentleman called Martin Hartley Jones. For the guy who enjoyed passing the RAE and wants to know more, this really is terrific. If you really want to know how present-day circuits work, especially solid-state devices, this one is a must and we wouldn't be without it. We've resolved loads of arguments in the office with this one, and we really couldn't do without it, so lash out a few quid and get it in your Christmas stocking without fail. It's published by the Cambridge University Press.

If you're serious about your hobby and your bookshelf can stand the weight, we'd strongly recommend *Electronics Engineers Reference Book*, edited by L. W. Turner and published by Newnes-Butterworths. There's an enormous amount of stuff within about a thousand pages, and here again it's indispensable to us – the only bad thing about it is the colour of the cover, which is a distinctly icky-poo shade of bilious yellow.

First published in 1981, this book entitled *Amateur Radio*, (no relation to this magazine) is written in a fairly easy to understand manner by Peter Bubb and edited by Gordon Stokes. Peter Bubb is an established lecturer and tutor for the RAE, and is therefore technically qualified to write such a book.

The 192 pages cover many aspects of amateur radio, from a basic explanation of radio communication, symbols, AC and DC, semiconductors transistors, receivers, transmitters, transceivers, antennas, and so on, to operating procedures and practices in a 7½-page section at the back. It seems a little expensive at £8.95, but the easy writing style, photographs and many line drawngs make this a valuable book for the beginner to amateur radio. Published by Lutterworth Press, at Guildford, Surrey, and is part of their Practical Handbook Series.



If you're short wave listening, and are prepared to delve into the differences between American and English grammar and technical variations, then you might be interested in *The Shortwave Listener's Antenna Handbook*, by Rober Traister.

It is distributed in this country by W. Foulsham & Co. Ltd., at Slough, and costs £6.95. Publication date is this year.

FREE ADS: Sell your radio equipment and spares for profit!

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Don't forget — the March issue of Amateur Radio appears on February 25th 1983

Classified Ads

•**YAESU FT202** 2M handheld six chan'l S.20, S.21, S.22, S.8, R.5, 144, 875 Raynet, SPD mic, case, Nicads, charger, two aerials, handbook, £89. Midland 2001 40 chan'l legal FM CB rig. Also legal CB aerial, half breed and ground plane £40. Will split, try 'em and buy 'em. G8KOM QTHR. Littlewick Green 2453.

•**PYE CAMBRIDGE** 6 channels 5 watts RF output, tone burst, spare RF, broad values S20, S19, S22, R5, R8, S8, 145.800, 144.800, S18 RX and 8 ELE beam with 30FE cable, £10. Pye offers between £40-£50. P. R. Wilson, 33 Norton Ave, Norton, Stockton-on-Tees, Cleveland. Tel: 534788.

•**12ATV THREE** band vertical antenna, £20. 'G' whip multi mobile base antenna, automatic four band operation complete, all coils 160/10 plus LF telescopic whip, heavy duty chrome swivel base, £50.00 ono, used once. Mr. John Randall, 243 Paddock Road, Basingstoke, Hants. Tel: 65126.

•**HAM INTERNATIONAL** Multimode II, USB, LSB, AM, FM, excellent condition, ideal mobile only, £150 ono. Rainer Veal, Gwel-Enys, Churchtown, Ludgvan, Penzance, Cornwall. Tel: 710171.

•**WANTED BY** new listener, secondhand general coverage receiver, sensible price, will collect. Ring Herne Bay 67979 after 7pm.

•**SONY** I.C.F.5 **900W** general coverage receiver, excellent condition, £75 ono. Tel: 0772-745053.

•**REALISTIC DX-302** receiver coverage 10kHz to 30MHz continuous, LED digital readout, six band tunable preselector, quartz locked tuning, AC or 12v DC, cost £289.95, as new OR6 PKG bargain £145 ono. Reason for sale upgrading to RX-TX. R. J. Lindley, 23 Quadrant Close, Murdishaw, Runcorn, Ches. Tel: Runcorn 711393.

•**WANTED** Heath VF1U VFO, must be cheap and loan of handbook for Eddystone 840A. Please ring G4JNW Scarborough 61191 or write 8 Union Street, Scarborough, North Yorkshire.

•**PANASONIC DR31**, MW-LW-FM-SW receiver, SSB digital display, 240 volt or battery, as new, r.r.p. £194, accept £145. Phone Basildon 21915.

•**CALLSIGNS** in brilliant copper tiepins, lapel, rally badges, 90p. Station car plaques with holders, £1.50p. Delivery included within 10 days. W. E. Griffiths, 6 Stanway Close, Alkrington, Middleton, Manchester M24 1HP. G6CVW 061 643 6944.

•**RACAL RA117E** HF receiver in excellent condition £275, Racal RA63H SSB adaptor, £65. Racal RA137A LF (10kHz-980kHz), converter, £70. Racal SA77 CRT tuning display for RA17 receiver, £75. Racal MA197B HF preselector, £35. All plus carriage but complete with handbooks, all working. Mr S. J. Haseldine G8EBM, Leamington House, Windley Lane, Weston Underwood, Derbyshire. Tel: Brailsford (033 528) 755.

•**FOR SALE** Trio TS520, Icom 701, Tono Theta 7000 communications computer. Wanted: small roller coaster with dial, G4MH mini? Beam, G3NZT Newby Bridge, Cumbria. Tel: 0448 31550.

•**TOGGLE SWITCHES**, cables, test meters etc. Send a S.A.E. for price list to M. J. Seaward, 7 St. Olafs Road, Stratton, Nr. Bude, Cornwall EX23 9AF. Tel: (0288) 4179.

•**BELCOM LS102** 10 metre mobile with freq. readout from 26.000 to 30.000 megs AM/FM/SSB/CW, £160 ono. Ring Scarborough 583905 or write Mr E. J. Wilson, 3 Caymer Road, Eastfield, Scarborough.

•**FOR SALE** Trio 9R-59DE general coverage receiver ideal for beginner, bandspread on amateur bands 80-10 metres in original packing, manual and matching loudspeaker £60. Richard Everitt, Ramsey (0487) 840968.

•**FT101 MK2**, 160m, fan, CW filter, 3N204 RF amp, £300 no offers. Also Drake C-line complete, some extras plus FS4 synthesiser, giving general coverage and full nine band transceive £700 ovno. Edwin Hodson G3XTJ, 20 Spencer Avenue, Palmers Green, London N13 4TR. Tel: 01-888-2230.

•**COMPLETE 2M** station Alpha FM 23-channel rig (II) fitted, 5A PSU 4EL quad rotator, ¼ wave mag. mount colinear, SWR bridge, Ambit GDO/wavemeter, absolutely everything for the new G6 to get on the air. First realistic offer secures. G40IN Andy 021-451-2571.

•**LOWE SRX30** 0-30MHz communications receiver covers AM U.S.B. and L.S.B. £105 or will swop for computer similar to Sinclair Spectrum. Write or call Mr. P. Axon, 15 Parr Street, Macclesfield, Cheshire SK11 8ED, G6 LPN.

•**COMMUNICATIONS RECEIVER**, G.E.C. BRT 403 150KHz-30MHz new set valves but needs attention, £35. 1155 receiver, nice condition, unmodified, £40. Marine hand held S.R.A. PN-74 146-174MHz 6 channels 6,7,8,10,11,16 fitted as new condition, Nicads charger, £100. Mr. J. P. Hupfield, 47 Leeward Road, West Worthing, Sussex. Tel: Worthing 66329.

•**TRIO 500** receiver surplus, good condition, Ham bands preselector, £30 ono. Ring 0425-617007.

•**EXCHANGE HAM** International Multimode and Zetagi 200 watt SSB linear for good quality H.F. receiver. Send details to 1 Westeria Cottages, Down Saint Mary, Devon.

•**CATHOLIC RADIO** amateurs join K.S.C. Net Skeds arranged to suit you, Net has been established for about eight years. Contact G3AKG, 116 Lowfield Road, Caversham, Reading. Telephone 0734-476718.

•**SALE: COMPLETE** Philips valved C.C.T.V. outfit, camera, two 14" monitors, power/control unit, cables. Sell or exchange. Wanted: 23cms transverter, Eddystone Y50, W.H.Y.? Roberts, GW6AYM, QTHR. Tel: Swansea 0792 204146.

•**TANDY DX302** digital receiver 10kHz 30MHz, £150. Dentron linear MLA2500 1.8MHz 30MHz, £500. Both plus carriage and as new, reduction if both. G3KUF QTHR Tel: 0272 296544 days, 027581 3648 evenings and weekends.

•**BROOKES MB6R** RTTY terminal unit, £65. MML 144/100 100 watt 144MHz linear £80. Datong PC-1 general coverage UP-converter, £85. Monochrome 14 inches uhf TV, £30. Contact G8KMV QTHR Tel: 0438-54689.

•**FOR SALE** or exchange MM converter MMC 144/28LO hardly used, sell £15 or exchange radio equipment. W. M. Badley, 20 Standish Grove, Boston, Lincs. Tel: 0205-61952.

•**WANTED**: morse key also morse training aid. Tel: Derby 831300.

•**HEATHKIT SB310** communications receiver 9x0.5MHz wavebands: 3.5, 5.7, 7.0, 9.5, 11.5, 14.0, 15.0, 17.5 and 21.3MHz (crystal-controlled valve, analogue readout to 1kHz) with Datong active antenna, £120) Also Tandberg Solvsuper 10 tuner-amplifier (valved, short-wave) needs attention, £15. R. Doble, 42, Betham Rd, Greenford, Middx. UB6 8RZ. Tel: 01-578-0539.

•**FT101Z HF** transceiver, 9-band, inclusive of microphone and fan, mint condition £410. G4HNN Tel: 01-778-9756.

•**FOR SALE** DX160 receiver with speaker, mint condition with manual and SL22 A.T.V. £50. Lincoln 682021.

•**HAVE TV/DX** antenna band III; pre-amp band I staggered tunable; uhf tunable pre-amp (set top); plus all band TV tuner (go's into I.F.) open to offers, non-amateur. Phone Evans (01) 242 3732 anytime.

•**WANTED DRAKE** MN4 or MN2000 matching A.T.U. also Drake RF wattmeter type W4 or WY4. Details and price ring Pete, Nuneaton 349461.

•**IDEAL BEGINNER'S** DX station! Heathkit SB-401 transmitter, SB-303 receiver, SB-600 speaker. Works as transceiver or split, good working order. All cables, just plug in and go! £275, carr. extra. G3UML, Tel: 01-202-7071.

•**YAESU FRDX400S**, 160-2m, £150. Unica UR-1A, 0.5-30MHz, £20. Sound air 008 vhf scanner, S20/22, RO/4/6/7; including charger and Ni-cads, £30. Phone Jon Kempster, BRS45205, Berkhamsted 4175.

•**FOR SALE** Realistic DX300 receiver, good condition, handbook and circuit diagram available, £100 ono. A. S. Hawley, 114 Brooksby Lane, Clifton Estate, Nottm. Tel: Nottm. 841520.

•**YAESU FRG7** Communications Receiver, 0.5-30MHz, excellent S.W. receiver, immaculate bargain at £120. Microwave Modules 28MHz pre-amp, for satellite reception, £15. 70cm, 19 element antenna, £15. G6ASA, Oxford 863333.

•**HELP!** I've got a Redifon ship to shore communications transceiver but cannot get it to work, any info or manuals needed. A. C. Butcher, 17 Bramham Road, Bingley, West Yorkshire, BD16 4HP.

•**YAESU FT101** transceiver with extra bands, very good condition, demo if required, £375. Farnham Common 5775.

•**WANTED RII55** receiver in working order or requiring slight attention. B. J. Redfern, Hopesay School House, Aston-on-Clun, Craven Arms, Shropshire SY7 8ET.

•**VARIABLE CAPACITORS**, 500PF/300PF ganged and geared, suitable ATU, £2 each inc. P & P. 50pF airspaced trimmers 75p each. G. Southwell, G6MPH, 49, Hartington Street, Bedford MK41 7RN. Tel: 46788 (0234).

•**EX-RAF TRANSMITTER** T1154 unmodified, as issued, condition new, offers. G3AOT, Washington 469374.

•**HEATH HR 1680** amateur band communications receiver and HS 1661 speaker, very good condition, £90. Mr B. J.Radford, "Ryecroft", 9 New Rd, Bolehill, Derby. Tel: Wirksworth 2866.

•**TS 130S TRANSCEIVER**, boxed as new / hardly used, first offer of £495, cash secures sale. I need cash to buy the Rolls Royce of H.F., the Trio TS 930S. Phone Richard Jones (0633) 270110.

•**U.S.A. ARMY** RX BC1147/x, Murphy R.W. RX both v.g.c., but very heavy, 65lbs, Heathkit GR64 RX, ideal beginners radio, £60, £40, £30 respectively, inspect and collect all ono. D. Williams, 7 Rosebery Court, Craig Ydon, Llandudno, Gwynedd. Tel: 0492 76465.

•**SWAN 700CX TRVCR**, 230 XC P.S.U., Crystal oscillator 510X, Datong R.F.C. spare valves, handbook, collect or carriage extra, for quick sale £395. QTHR Tel: 0202 579115 anytime.

•**TRIO 2400** 2M FM hand/held transceiver base charging unit, mobile charging unit, microphone, soft case, spare NI-CAD pack handbook, new condition, boxed complete base, mobile station £190 ovno. Collect or carriage extra. Mr D. F. Thompson, 52 Miller Drive, Fareham, Hampshire. Tel: Fareham 232799.

•**ICOM IC2E** as new in carton complete with accessories, £140. 10 months old Yaesu FT200 with mains and mobile PSUs, £225. 2M/10 element parabeam, £20. G3XGE QTHR 061-865 3191.

•**FOR SALE** Icom 240 1 year old full set of channels installed with VHF, SWR meter, AWD, ¼wave mag mount in original packaging, immaculate, £130. QTHR G6GKN. Phone Tadley 2798 evenings.

•**MIZUHO SB-2M** SSB/CW portable 2m tx/rx, VXO controlled, 1 w PEP output, good condition, £85. G6HPA A. Smith, 23 Hurle Crescent, Boston, Lincs.

•**KW ATLANTA 80-10M** transceiver, PSU/SPKR, EXT-VFO, 500W PEP, £200 ono, or p/ex Liner 2, Mizuho SB-2M, Mizuho SB2X, Icom IC202(S), Trio TR7010 sideband equipment. Paul Lockley, 52 Bunkers Hill Lane, Bilston, West Midlands WV14 6JR.

•**813 VALVE** (U.S.A.) new and boxed, £20. G3NRZ. Tel: Erith (Kent) 34699.

•**FOR SALE** Panasonic DR26 FM (88-108MHz), LW, MW, SW (1.6-18.6MHz) double superheterodyne digital frequency display, BFO tape, in/out mains/battery, 174 countries received, £75. Need money for R.A.E. Mark Cooper, 33 Park View, Royston, Barnsley, South Yorkshire S71 4AA.

•**HALLICRAFTERS SX100**, £115. Hallicrafters SX43, £120. Sony 6700 digital, £140. Panatonis 32 band, £135. Eddystone 960, £130. Realistic DX 302 digital, £125. Grundig satellite with BFO, £98. Grundig professional 1400, £135. All excellent. S. N. Andrews, 12 Malton Way, York YO3 6SG. Tel: 0904 59035.

•**EDDYSTONE 730/4** receiver with handbook and circuit, superb original condition (new electrolytics), 15 valves, Xtal calibrator, 500kHz to 30MHz, unused for eight years, £95. Telephone Pershore (03865) 552086. Don't suffer transistor front ends anymore.

•**MICROWAVE** modules MML155/100LS 2 metre 100 watt linear amplifier, 1 watt or 3 watts input, switchable with receive preamp boxed as new, bargain, £130. 041-554 0516, 24 hours.

•**FERGUSON 20D** studio music centre for sale, £60 or exchange for AR88. G. W. West, 37 Welford Gardens, Abindgon, OX14 2BN. Tel: 26635.

•**SELLING**, Grundig Satellite 2100 radio with headphones, also SSB attachment, full instruction books and packing box, mint condition, £90 ono. G. E. Pearce, 57A Corve Street, Ludlow, Shropshire SY8 1DU. Tel: Ludlow (0584) 5645.

•**SONY ICF2001** synthesized receiver, 150kHz to 30MHz, AM and SSB, VHF broadcast; LCD frequency display, keyboard tuning, £125 ono. Tel: Luton 33456.

•**AR77E COMMUNICATIONS** receiver for sale not working, believe valve blown, offers? Wanted working receiver such as Trio R.1000, Yaesu FRG 7 or 7700 or 2 mtr transceiver. Contact Lewis Hunter, Lacken, Edgeworthstown, County Longford, Republic of Ireland.

•**TRIO TR2300**, excellent condition, complete with Nicads and accessories, £125 or any offers? Tel: Devizes (0380) 3087.

•**H.A.C. TRIPLE-T** short-wave receiver with slow motion dial and earphones, range: 10-170 metres, 30-1.765MHz, requires PP3 battery and external aerial, £30.00 ono assembled and in working order. N. H. Foster, Flat 9 - 19 Earlsdon Way, Christchurch, Dorset BH 23 5TB. Tel: Highcliffe (04252) 71122.

•**TRIO TR-2200GX** fully crystalled R0-R2 R4-R7 S8, S20-S23 12 channels complete with rubber-duck Nicads charger, ¼ wavewhip mobile ant, carying case £65. Mr J. H. Dyson, 2 Grange Road, Barnton, Northwich, Cheshire.

•**70CM AMPLIFIER** W & D 1W in, 10W out, aligned and tested by W & D, £23 post paid. G3MEW Portsmouth 820315

•**HOME BREW** morse course on six C60 cassettes, £10 including post and packing (U.K. only), or S.A.E. for details. J. P. Billingham, 22 Lawday Place Lane, Farnham, Surrey GU9 0BT. Tel: Farnham (0252) 722649.

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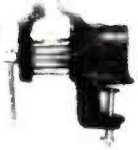

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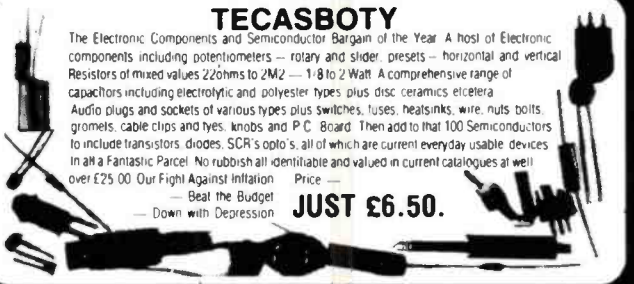

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