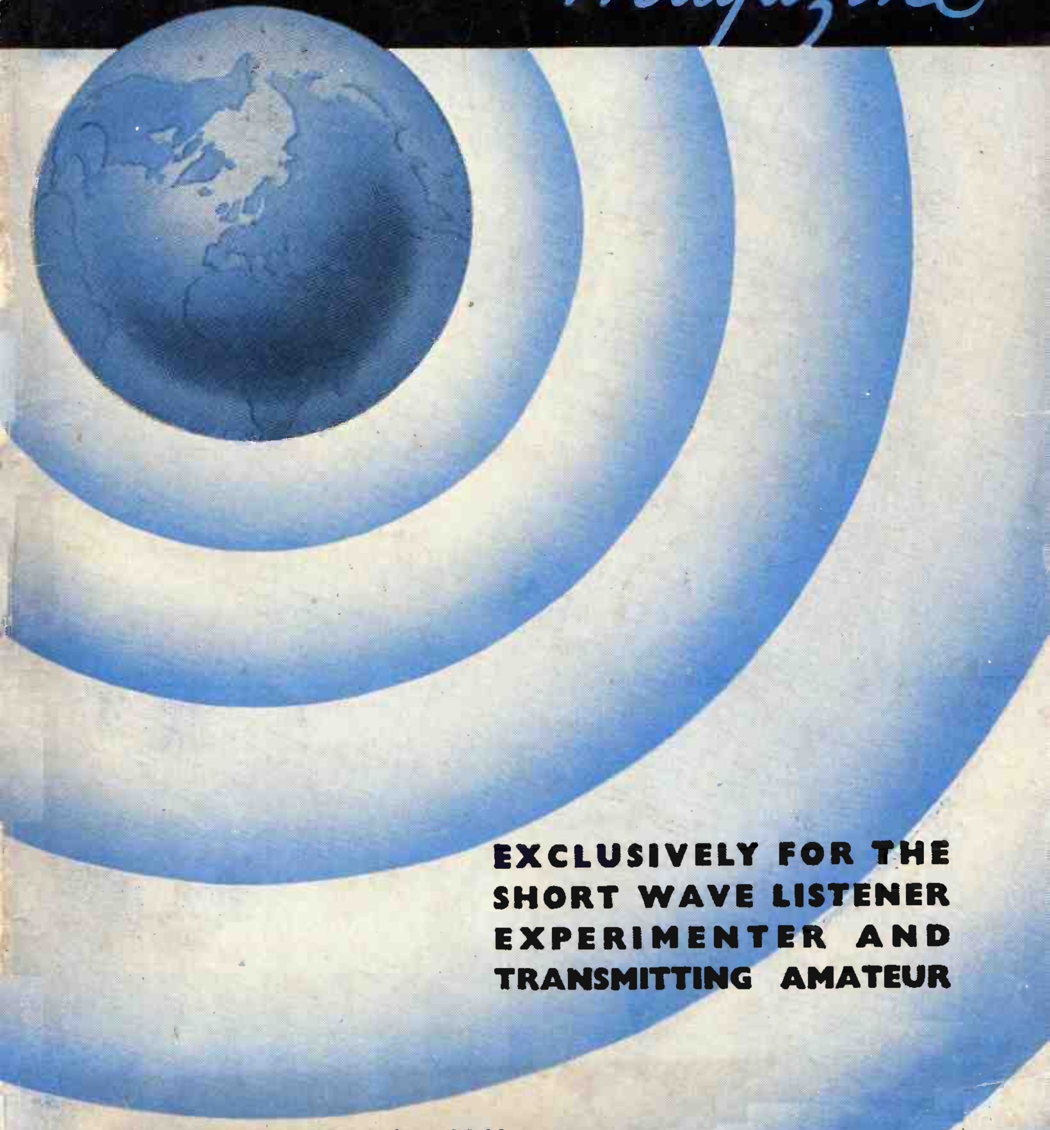
The SHORT WAVE Magazine

1/6



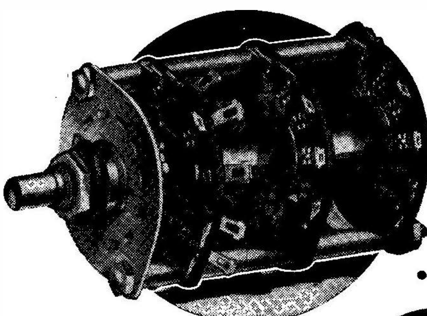
EXCLUSIVELY FOR THE SHORT WAVE LISTENER EXPERIMENTER AND TRANSMITTING AMATEUR

VOL. IV. No. I. MARCH 1946

THE world-wide use of "AVO" Electrical Testing Instruments is striking testimony to their outstanding versatility, precision and reliability. In every sphere of electrical test work, they are maintaining the "AVO" reputation for dependable accuracy, which is often used as a standard by which other instruments are judged.

Write for pamphlet descriptive of the "AVO" Instruments illustrated above.

Sole Proprietors & Manufacturers:—
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
WINDER HOUSE · DOUGLAS STREET · LONDON · S.W.1 TELEPHONE: VICTORIA 3404/8



SHORT WAVE MAGAZINE

FOR THE RADIO AMATEUR AND AMATEUR RADIO

Vol. IV. MARCH 1946 No. 1

CONTENTS

Editor : AUSTIN FORSYTH, O.B.E., G6FO *Advert. Manager :* P. H. FALKNER

Published on the first Wednesday in each month at 49 *Victoria Street, London, S.W.*1
Telephone ; Abbey 2279. *Annual subscription ; Inland* 20s. *Abroad* 22/- *post paid.*

AUTHORS' MSS.

Articles submitted for Editorial consideration must be typed double-spaced with wide margins, on one side only of quarto sheets, with diagrams shown separately. Photographs should be clearly identified on the back. Payment is made for all material used, and a figure quoted in the letter of acceptance. A large stamped addressed envelope should be enclosed for the return of MSS. not found suitable for publication.

EDITORIAL

Reappearance

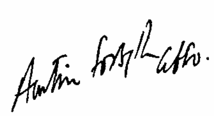
The heavy clouds of war were gathering over Europe and the world when the SHORT WAVE MAGAZINE *last appeared on the bookstalls. For nearly three years, gaining steadily in prestige and influence, it had been the only public periodical entirely devoted to short-wave radio. We might perhaps be allowed to make the modest claim that during its pre-war existence the Magazine succeeded in doing much to foster and encourage the short-wave enthusiast, to help and advise the amateur transmitter and experimenter, and to assist the British manufacturer into an expanding market. We enjoyed a rising circulation and steady support from both trade and public. Moreover, the country gained an unseen dividend in that thousands of radio men were training themselves, as a hobby, in the art which was to play such a vital part in the winning of the war.*

Came September, 1939, *and within a few days of No.* 7 *of Vol. III being published, most of the staff and nearly all the regular contributors were in their R.A.F. uniforms. Two of them, the Assistant Editor, S. W. Clark* (2AMW) *and F. A. Beane* (2CUB), *a well-known contributor, will not be returning. They were among those who had to pay the full price. We mourn their loss and remember their work.*

When the heavy raids on London started, our premises, plant, records and equipment were completely destroyed, and it began to look as if the SHORT WAVE MAGAZINE *might become no more than a memory.*

So much for the past. We are now looking forward to the future. You have in your hands No. 1 *of Vol. IV. We hope you will like it. The Editorial policy of the* SHORT WAVE MAGAZINE *is unchanged, and can be summed up in the words on the front cover. We stand for the advancement and expansion of the art of Amateur Radio, and all that pertains to it. We cannot expect, and indeed will not attempt, to please all tastes in every issue, but we shall hope to cover all interests in successive issues.*

We also wish to see, and will do everything possible to assist, a flourishing trade in amateur equipment of British design and manufacture. To our business friends, we offer the suggestion that now is the time to study and develop the home market for amateur short-wave equipment, both in components and finished apparatus. The Dollar Agreement may otherwise result in American manufacturers, now waiting to export to us, capturing the market.



The Licence Situation

How Existing and Prospective Amateur Transmitters Stand under the New Regulations

ENOUGH publicity has been given to the removal of some of the war restrictions on transmitting amateurs for nearly everyone even remotely interested in Amateur Radio to know that private transmitting stations are now allowed back on the air.

The position requires some further clarification, however, particularly for the benefit of those readers who may at this moment be hearing of these things for the first time. Broadly speaking, the present regulations allow anyone who held a full radiating experimental transmitting licence before the war to operate again in the frequency bands 28,000-30,000 kc and 58,500-60,000 kc, with a maximum power of 100 watts on the 28-30 mc band and 25 watts on 58·5-60 mc, using either telephony or telegraphy.

The other class of transmitting amateur, who held a pre-war non-radiating or "artificial aerial" licence, will be allowed to operate on these two bands with telegraphy only, subject to possessing the necessary Morse qualification of 12 words per minute, sending and receiving. This may be proved either by examination, or by the holding of a Service trade classification which implies knowledge of Morse. There is a probationary period before licencees in this category are allowed to operate on telephony.

The form of the licence has also been changed, in that amateur transmitters are now recognised as holding their licences purely for private communication purposes, and not necessarily for experimental work. In other words, the licence is issued as an *amateur* licence, and not as an experimental transmitting licence, as it was before.

So much for those amateur transmitters who satisfied the G.P.O.'s pre-war requirements. Those in the first category can be recognised by their call-signs of two letters, preceded by G and a number. Those in the second, who had non-radiating permits before the war, will use call-signs of three letters, prefixed G2.

New Licences

Now for those who aspire to a new licence under post-war conditions. They will either have to pass a simple examination in radio, or possess recognised qualifications which exempt them from the examination. They will have to qualify in Morse, sending and receiving, unless they have a Service trade classification carrying exemption from the test.

The standards which will give exemptions have not been finally decided, but it seems probable that they will not be too high, and the examination itself will be within the capacity of anyone who has taken a serious interest in short wave radio.

The Radio Amateur's Examination is under the direction of the City and Guilds of London Institute, and arrangements have been made for candidates to sit for it at their nearest technical college, for which certain nominal fees are payable.

On passing the examination, the G.P.O. will grant a licence after they are satisfied as to the applicant's ability in Morse. The licence, for which a registration fee is charged, will as finally issued allot the holder a call-sign consisting of the international prefix G followed by a number and three letters.

The first Radio Amateur's Examination is to be held on May 8 next, entries for which close as early, unfortunately, as March 8. It is expected that there will be another examination in November of this year. All matters connected with these examinations are handled by

The Superintendent,
City and Guilds of London Institute,
Department of Technology,
31 Brechin Place,
South Kensington,
London, S.W.7.

The issuing authority for licences is the General Post Office—Engineer-in-Chief's Office, Radio Branch, G.P.O., London, E.C.1.

The notes above summarise the information available at the moment and we are indebted to the authorities concerned and the *R.S. G.B. Bulletin* of the Radio Society of Great Britain for it all. We shall keep readers informed of the developments as time goes on, and will print the first examination paper when it is released for publication.

We cannot close without recording an appreciation of the work of the Radio Society of Great Britain in making possible such a satisfactory state of affairs. During the whole of the war period, the executive officials of the Society have never failed to keep before them the ultimate objective—that of securing the eventual freedom of the amateur transmitter. Their labours in the matter could not have been brought to fruition without the enlightened and co-operative attitude of the authorities concerned at the G.P.O., and we may be sure that further frequency allocations will be made to amateurs as and when it is possible.

The Amateur Codes

What they mean and How to use them

READERS new to short-wave working constantly ask about the various codes used by amateurs.

Devised primarily to give speed in commercial radio-telegraph operation, a secondary result is that they make possible intelligible communication irrespective of the language difficulty, i.e., a Hindu can carry on quite an understandable conversation, using Morse and the various groups of the "Q" code, with a Russian or a Portuguese. The barrier of language simply does not arise, except when it is desired to convey a relatively complicated idea.

Furthermore, amateurs on their own have developed, by long usage and tacit international acceptance, a kind of universal language, which luckily for us is based on English. For instance, please becomes "pse," thanks is "tnx" —or "tku " for thank you—many is sent "mni," very "vy," I hope to see you again abbreviates to "hpe cuagn," and so on. Readers who can see the derivations of these forms will have no difficulty in getting at the meaning of "gb," "cul," "ur," "hw r u," and so forth. They can only be learnt by practice on the air.

The RST Code

Then there is the RST Code, which is also strictly amateur in its application, and is used throughout the world to report the readability, strength and quality of note of a CW signal, the whole of this information being sent in one group. For instance, where an English amateur might want to say to a Frenchman "your signals are fully readable, moderately strong, but the note is rough AC, low-pitched and only slightly musical"—this is just an example, of course—the actual transmission made by the British station to cover it all would be simply "ur sigs RST 573," which would tell the Frenchman what he should know.

Another very useful code, much in vogue some years ago but now almost forgotten, is the old F system, for 'phone reporting. This graduated from F1, which was meant to indicate a dirty noise, quite unreadable, to F9—perfect speech and a well modulated carrier. About 1926, no self-respecting telephony operator ever gave the B.B.C. better than F8.

R Strengths

In amateur working, there will always be a certain discrepancy in the reports given by any two listeners; this is only to be expected, in that estimates of strength are largely a matter of opinion. Even a receiver fitted with an "R" meter does not solve this difficulty, for a great deal depends upon the way the set is handled. It is possible to get full loud-speaker signals by turning up the LF gain on a communication-type receiver when the carrier-level meter reads R3 only. Since the ultimate effect of the signal depends upon what reaches the ear, it is evident that a report of R3 is misleading.

On the other hand, as the "R" meter is usually operated by the RF and IF stages of the receiver, it can be a valuable indication of *comparative* signal strengths, especially where the received station is testing.

In practice, it is surprising how closely experienced operators agree in their estimates of signal strength when going by ear alone. This is not so marked now as it was in the old days, when the "0-v-1 with 'phones" was the receiving standard.

THE Q CODE (as used by Amateurs)

QRA—Location (address).
QRB—Distance (miles).
QRG—Frequency, kc.
QRJ—Weak signals.
QRK—Good signals.
QRL—Busy.
QRM—Radio interference.
QRN—Atmospheric interference (static).
QRO—High Power.
QRP—Low Power.
QRQ—Send fast.
QRS—Send slow.
QRT—Close down.
QRU—Nothing further.
QRX—Listen.
QRZ—Who is calling?
QSB—Fading.
QSL—Send a card.
QSO—Contact.
QSP—Pass on (message).
QSQ—Send single.
QSY—Change frequency.
QSZ—Send double.
QHM—Listening from HF end to middle of band.
QML—Listening from middle to LF end.
QLH—Listening from LF end to HF end.
QHL—Listening from HF end to LF end.

When sent with a query, as "QRT ?", the meaning would be "Are you closing down ?". Similarly, "QRM ?" means "Are you getting interference ?".

To say "My frequency is 28055 kc," the signal transmitted would be "QRG 28055"

THE RST CODE IS :—

R1—Unreadable.
R2—Barely readable, occasional words distinguishable.
R3—Readable with considerable difficulty.
R4—Readable with practically no difficulty.
R5—Perfectly readable.
S1—Faint, signals barely perceptible.
S2—Very weak signals.
S3—Weak signals.
S4—Fair signals.
S5—Fairly good signals.
S6—Good signals.
S7—Moderately strong signals.
S8—Strong signals.
S9—Extremely strong signals.
T1—Very rough hissing note.
T2—Rough AC note, no trace of musicality.
T3—Rough, low-pitched AC note, slightly musical.
T4—Rather rough AC note, moderately musical.
T5—Musically modulated note.
T6—Modulated note, slight trace of whistle.
T7—Near DC note, smooth ripple.
T8—Good DC note, just a trace of ripple.
T9—Purest DC note.

If the note appears to be crystal-controlled, add an X after the appropriate number.

F CODE FOR TELEPHONY

F1—Speech distorted and badly over-modulated. Quite unintelligible.
F2—Distorted but 10-15 per cent. intelligible.
F3—General sense followed, but intelligibility low.
F4—Pronounced distortion, 30 per cent. intelligible.
F5—Speech breaking, poor quality, but intelligibility 60 per cent.
F6—Unnatural speech, but readable.
F7—Slightly distorted, 100 per cent. intelligible.
F8—Good, clean speech.
F9—Perfect, well-modulated telephony.

Five Metres

Pre-War Activities and Post-War Prospects

By **A. J. DEVON**

THE last article under this heading was written in August, 1939, a few days before the outbreak of war, when your contributor was worrying not so much about DX on 56 mc as how he would look in his R.A.F. war paint, and what was meant by "reporting to the Adjutant at 0915 hrs." Happily, we can at long last again turn our attention to the absorbing business of exploring five metres, and it is hoped that many of our old readers will see these lines and pick up the threads once more.

The licensed frequency range under the new conditions is 58·5-60 mc, with a maximum permitted input power, at present, of 25 watts. This band is not in harmonic relation* with the amateur range, 28-29 mc, on 10 metres, so it means a special selection of crystals for doubling up into either band. This is a point to be carefully noted when ordering crystals.

Though we used to have the whole range 56-60 mc, pre-war activity was almost entirely at the LF end, between the limits of 56-58 mc, since the 58-60 mc area was out of harmonic relation with all the rest of the amateur allocation below 28 mc.

Some Pre-War Results

Of course, our explorations on 56 mc in the old days were mainly with the idea of developing and exploiting any possible DX properties the band might have. It also had, as it has now, great value for local communication purposes. The mechanics of propagation on these frequencies were not at all clear; and though theoretically only visual-range working should have been possible, in fact much better results were regularly obtained by a number of workers. On occasion, even DX—in the shape of French and, particularly, Italian stations—broke through, and who of our earlier readers of these notes will forget the intense interest which was aroused when the news got about that on July 2, 1938, G5MQ of Liverpool had obtained two-way *'phone* contact with I1RA on 56 mc, and that G2HG had been heard in Switzerland on the same day.

For some time before this, the Americans had been obtaining remarkable inter-State contacts, to distances of anything up to 1,500 miles; these results were without doubt mainly due to the fact that there was at that time, and actually always has been, far more 56 mc activity in America than in Europe. Hence, with a larger population on the band, it was constantly under observation at all distances, and DX contacts were obtained whenever it opened. By August 18, 1939, W9ZJB of Kansas City had become the first W to work all American districts on 56—a truly remarkable achievement. An Australian record must also be noted here; in August, 1938, VK2NO of Sydney was heard in New Zealand, a distance of 1,800 miles, and the same listener had had a 56 mc report confirmed by a West Coast American, W6ENC, the first across the Pacific.

European Record

Progress in Europe was much slower, mainly due to the lack of interest in 5 metres on the Continent. The Gs kept hard at it, however, and their ranks gradually increased till towards the middle of 1939 we were getting up to a hundred or more activity reports monthly, from both transmitters and listeners. Outstanding workers on the

(This was written before A. J. Devon knew that the 10-metre band had been extended to 30 mc, as reported elsewhere in this issue.—Ed.)

band were G2OD (Worthing) and G8KD (Sheffield) who held—and probably still hold—the inter-G record for two-way working, established on August 20, 1939, over a distance of 190 miles. Then there was G6YL, famous for her DX reception, who can probably claim the first W heard in this country; GW6AA, who worked so hard to make the Snowdon Tests the success they always were; G8LY, who used QRP and was in on everything that was going in the way of G DX; G6DH, who made a careful study of 56 mc over a long period and also had his share of DX; many other Gs like G2XC, G2IN, G2BI, G2MC, G5ZI, G5JU, G6IH, G6LI and G6VA, to mention only a few who were consistently active; G6CW of Nottingham, who between July 7 and 13, 1939, worked no fewer than fifteen stations over a hundred miles distant and who, with G2ZV (Rustington, Sussex), held the inter-G record from June to August, 1939.

Probably, the palm for consistency can fairly be claimed by G5BY (Croydon) and G6FO (Newport), who obtained two-way contact over their distance of 126 miles in October, 1938, and then maintained a practically unbroken thrice-weekly schedule till August, 1939; they had the record for the eight months until June, 1939, when it was wrested from them by the G6CW-G2ZV combination, who in turn gave way to G2OD-G8KD.

On the reception side—consistent listening work is quite as important as transmission—one immediately calls to mind 2AAH of Chichester, R. Holmes of Painswick, 2BIL of Hove, R. J. Lee of Heathfield, and 2DDD of Littlehampton, all of whom were enthusiastic operators who turned in regular and most useful lists of calls heard on 56 mc.

European Highlight—June, 1939

The 56 mc band "gave" in small doses and seemingly with reluctance, which only served to increase the thrill of expectation with which one went on the air. Take, for instance, the events of June, 1939; here are some of our notes at the time, quoted verbatim: ". . . On June 1, I1IRA hears G5MP, G5MQ and G6DH, 1800-1900 BST. . . June 13, G6CW and G8JV obtain two-way contact with I1FA and I1SS, R8 both ways, at 2115-2130 BST. . . June 24, I1FA works G8KD at 2005, G2MV at 2020 and G6XM shortly after; G6XM receives F8AA, I1BE, I1SS and English voice with American accent calling "CQ five"; G2MV gets R6 harmonic from Addis Abbaba commercial transmitter and G6YL logs 'phone from F8VC and I1IRA, all on that same evening of June 24. . . G2MR works I1TKM on the 25, and G2MV hears I1RS at 1150 that morning. . . Also on June 25, R. J. Lee at Heathfield receives I1BE and I1TKM, 1600-1700 BST. . . The Italians and some unidentified European 'phones severally heard by G2XC, G3FA, G3HW, GW6AA, G6IH, G8NM and others. . . G2ZV-G6CW establish new inter-G record (150 miles), and R. J. Lee brings in G2WS at 156 miles. . . In eight days G6CW puts down thirteen contacts over 100 miles with six different G's. . ."

We could go on in this strain for columns, but since space prevents the mentioning of every individual achievement, it is hoped that enough has been said not only to stir some memories of the past but also to record in general terms what has already been achieved on the 5-metre band. This is in itself important, as we are on the threshold of a new era in Amateur Radio, and it is essential that we have, so to speak, a jumping off point for the future.

Equipment

As regards the gear that was used on the band before the war, most 56 mc operators will know that for a time, in the early days around 1936, it was the fashion to work with modulated self-excited oscillators and super-regenerative receivers. The former were easy to build and adapt for portable work, and the latter gave high gain on strong modulated signals. In those days, it was fairly generally believed that, due to the visual-range characteristic, the practical application of the band would be restricted to local communication varied by occasional excursions to high ground with portable equipment in order to increase range and work a few new stations. Thus, organised 56 mc field days became popular.

From this, for serious workers, it was an easy step to more ambitious equipment—in the sense of stabilised transmitters and straight or superhet receivers—and the attempt to improve ranges from the home QRA. It gradually became clear that while the super-regenerative receiver certainly gave good results on nearby modulated transmissions, it was useless on weaker signals, which could not be heard above the quench noise. Nor could the super-regenerative Rx take CW, unless the transmitter was reverse-keyed, and the only practical way to communicate in morse was by using a keyed audio tone to modulate the transmitter.

It was then found that by far the best and most consistent results, always excluding the strong nearby modulated signal, were obtained by use of crystal-controlled transmitters working to straight- or superhet-type receivers capable of taking CW. This development took time, and it was not until well on in 1938 that the old idea of "squish" working—modulated transmitters and super-regenerative receivers—was finally shown up for what it was, and killed. This is not to say that there is no application at all for the super-regenerative receiver. The point is that its usefulness is strictly limited to those conditions where the field strength of the received signal is high enough to ensure effective quench action. In general, this means only local reception of modulated signals.

Hence, by the middle of 1938, those who wanted to do something useful on 56 mc had equipped themselves with CC transmitters and receivers for straight CW working. As on all other amateur bands, the power used varied in individual cases from several hundred down to a few watts. And again, as on other bands, when conditions were right, the QRP stations got out quite as well as those with their 100s of watts.

Aerial Design

One of the most interesting trends in pre-war development was that in regard to aerials for transmission and reception—rather naturally, since proper aerial arrangement becomes more and more important as the frequency goes up. Since 8½ ft. of radiator constitutes a ½-wave on 56 mc, it was possible to build up a highly directional aerial system without much mechanical complication. Provided this array was properly designed, matched and fed, the bulk of the radiated energy could be put in the desired direction. Very good results were obtained by many operators who favoured such systems, whether as transmitters or listeners.

A directional radiating system on such a band has, however, one fundamental disadvantage. Since it transmits and receives best in one direction only, it obviously cannot give the all-round coverage which is so desirable for general exploratory and experimental work. In other words, to put out a "Test" call (we shall always use "Test" instead of "CQ" as matter of personal preference) with the aerial looking W.N.W., when activity on the band at the time happens to be E.S.E. to the station concerned, is likely to be a waste of time. It can, of course, be argued that before making his call the operator with the directional aerial could listen round and see where the activity is, and then call in that direction. But on such a band as 58·5-60 mc, it is not at all unlikely that in some districts he might never hear anything, or be heard, under these conditions, because reception is affected by such factors as local noise, whether a station happens to be on when the aerial is looking in that direction, and the location of the receiving station concerned. In other words, activity is in a sense created by a number of stations with omnidirectional aerials.

These arguments encouraged the use of the long-wire or multi-wave aerial, which—after about 10 ½-waves have been accommodated—becomes practically omni- directional. Though signal strength in a particular direction is, of course, not as high as it would be with a properly designed beam, this disadvantage is offset by the wider angle of coverage obtained with the long-wire system. Obviously, in effect, this means that the signal goes to many more possible receivers than it could do under beamed conditions. Hence, on a relatively unpopulated band (we are speaking still of pre-war days), a QSO was more likely to result with an omni-directional than with a beamed aerial.

Many well-known amateurs accepted these theories and adopted long-wire radiating systems. Almost without exception, they did well, and in some cases, at least, the form was to explore with a multi-wave aerial and then, having obtained contact, to switch over to a beam aerial lined up in that direction and consolidate the QSO.

New Age for 5 Metres

So, having, as we hope, picked out the important points regarding 56 mc in the pre-war period, we arrive at the present.

First, there can be little doubt that the occupancy of the band will soon be higher than ever it was before the war, for the obvious reason that with only two frequency ranges on which to work, many amateurs will go to the 58·5-60 mc band (hereinafter referred to as the 58 mc band) much sooner than they might otherwise have done. Others will recognise the value of 58 mc as a local contact channel, appreciating the undesirability of cluttering up 28 mc, which is essentially a DX band, with local 'phone and the like. Or are we wrong? Will, as some prophesy, 28 mc become worse than 7 mc used to be on a Sunday morning before the war?

Whatever may be the answer to this particular query, the fact remains that equipment for 58 mc ought to be designed and operated with an eye to the firm possibility of outside-the-local-area contacts. In other words, using CC, CW receivers and DX aerials—whether beam or omni-directional, is a matter for individual preference in the light of the foregoing discussion.

A great deal more is now known about propagation at these frequencies and it is unquestionable that DX working will be possible when conditions serve—which may not be very often. But good inter-G contacts at ranges over 100 and up to 200 miles should be fairly consistently recorded, and we hopefully suggest that the first G-W contact on 58 mc may be brought off within the twelve months.

The immediate move is to get going on 58 mc and, as we did before, we shall henceforth be running a regular monthly article entirely devoted to activity and results on 58 mc.

March Test Period

In order to make a start, we suggest a monthly test period on the lines of those adopted before the war. Just to remind you what happened, we give a date-time period during which as many operators as possible, both transmitters and listeners, are on the air, the idea being not only to encourage activity but also to correlate and analyse results.

For this month, the test period selected is March 14-18 inclusive: 2000-2230 nightly; Saturday, March 16, 1400-1600; Sunday, March 17, 1100-1300, 1430-1600, 1830-1930, all times GMT.

Reports

If this is to be really useful, we need your reports, even if negative. Reports should reach this office, addressed to A. J. Devon, by March 21 *latest,* to ensure inclusion in the April issue. Please give details not only of QSOs or reception, but also of gear and aerial used, and a list of calls heard, arranged in alphabetical order; if possible, give the distances as well. We should also like to see some good clear photographs of interest to other readers—apparatus, aerial systems, and so on.

The Principles of Short-Wave Reception

PART I *of a Short Series—Explains Some Fundamental Principles—Contains Information on Simple Circuits of Proven Worth*

By A. A. MAWSE

IT is generally understood that the term "short wave" applies to all wavelengths below about 100 metres; in other words, to frequencies above 3 megacycles per second. But it is necessary to extend our definition because there are several techniques, all differing in detail, employed for transmission and reception of frequencies above the limit already mentioned.

In consequence of this, it will be well to start by subdividing the frequency spectrum and then to decide with which parts of it we shall deal. To make a very broad subdivision, one might say that the first group of frequencies in the short-wave range is that between 3 and 15 mc. The second is from 15 to 30 mc, and a third can be considered as extending from 30 to 60 mc. Even beyond that, we can make further subdivisions, such as 60 to 150 mc, 150 to 300 mc and 300 to 3,000 mc. It would be possible to go even beyond this, but the still higher radio frequencies are chiefly of academic and "laboratory" interest.

Frequency-Wavelength Conversion

For the benefit of those readers who still prefer to deal with wavelengths rather than frequencies, it should perhaps be explained that it is a simple matter to convert from one to the other by remembering two numbers—300, and one. A wavelength of 300 metres is equivalent to a frequency of 1 megacycle per second. So, by dividing a frequency given in megacycles into 300 we can easily determine the corresponding wavelength in metres. For example, 15 mc is 20 metres; 30 mc is 10 metres; 60 mc is 5 metres; 300 mc is 1 metre; and 3,000 mc is one-tenth of a metre, or 10 centimetres.

It has become customary in dealing with short waves to speak in terms of frequency only; but when we pass the 3,000 mc mark a return is generally made to wavelengths. This is because it is easier to say, or write, 5 centimetres than 6,000 megacycles per second. In fact, there are many who prefer to drop the frequency notation at 300 mc and to speak of decimetre and/or centimetre waves.

But all these figures are becoming rather a nuisance, so let us return to more practical matters. Receivers for use on frequencies up to 15 mc need not differ very greatly from those employed for normal broadcast reception. And even up to 30 mc the changes necessary are not great. Above this frequency, however, it is desirable to employ different types of valve, as well as components of different value. When we approach a wavelength of 1 metre, valves must be changed again and, in general, tuning coils have to be replaced by rods; and even short-wave valves require to be replaced by somewhat special "tubes."

Below 60 mc

In this series of articles we shall restrict ourselves to practical details of reception on frequencies up to, and not beyond, 60 mc. The reason is that this frequency is the limit of activities in the bands which were recently allocated for use by amateur transmitters; it will be remembered that the actual bands allocated are 28 to 29 and 58·5 to 60 mc. Below 28 mc, however, there is a large variety of transmissions, particularly around 15,

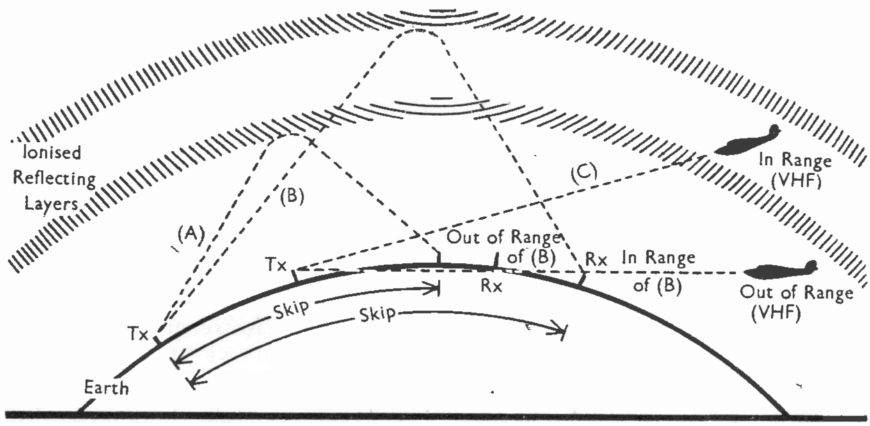


Fig. 1. Showing the propagation of radio waves at different frequencies.
Lines (a) and (b) refer to frequencies below approximately 25 *mc; line (c) refers to frequencies of* 30 *mc or higher.*

20, 7·5 and 3·75 mc which correspond to wavelengths of approximately 20, 30, 40 and 80 metres.

Visual Range

Now let us see what are the chief differences in the techniques required for the various bands to which reference has been made. There is a very big dividing line somewhere between 15 and 30 mc; the line is not very clearly defined, but it exists nevertheless. At frequencies above the line the radio waves are readily absorbed by both earthed objects and upper atmospheric layers. In consequence, the range of transmission and reception tends to be visual only. That is, the transmitting and receiving aerials should be "within sight" of each other for reliable communication. This does not necessarily mean that the range of communication is very small, but that there should be no obstruction between the two aerials.

If the aerials were both, say, 20 ft. above ground level, the effective range would be a few miles only. On the other hand, if one of the aerials could be suitably elevated (by being carried on an aircraft, for example) the range could be extended to a figure determined only by the height of the aircraft. Thus, an aircraft flying at 30,000 ft. could work a ground station at ranges up to about 250 miles. Greater ranges have been covered, but only under unusual conditions. These ranges are limited by the curvature of the earth, as illustrated in Fig. 1.

On frequencies below the dividing line previously mentioned, we obtain all sorts of "skip-distance" effects. These are due to the radiated waves being reflected by the various ionised layers in the upper atmosphere. The layers are given various names according to their heights, and most readers are familiar with the names Heaviside and Appleton layers—if not with the *E* and *anomalous E* and other layers known to research workers and those concerned with radar techniques. Fig. 1 also gives an indication of the type of reflection referred to, although the reflecting layers are not specified by name.

Skip Distance

It is because of these reflected waves that a transmitter working on, say, 7 mc might not be heard on a receiver situated a few miles away, although it could be giving a strong signal in a receiver 200 miles away. The length of the skip is governed by the particular layer, or layers, producing the reflection, and this in turn depends upon the frequency employed. Whereas a radiation on 3 mc may be reflected by the lowest of the ionised layers, one on 15 mc would generally be reflected by a higher layer.

Another point to bear in mind is that the various reflecting layers are not in the form of simple spherical surfaces. Instead, the surfaces are undulating and constantly varying according to the time of day or, more accurately, according to the action of the sun. These movements explain, not only the variations in reception conditions over any 24-hour period, but also the fading which may occur at all times due to surface movements and changes in the "reflectivity" of the layers.

It is very largely because of these changes and uncertainties that short-wave reception is so fascinating; there is always the feeling that one is attempting to utilise—and sometimes to combat—the forces of nature.

Practical Points

We have now seen some of the reasons for the changing conditions of reception when utilising certain bands of the frequency spectrum. There are others, but these are more concerned with the practical politics of receiver design and construction. On the longer waves, connecting leads several inches in length have little or no effect. A tuning coil for medium-wave broadcast reception would consist of, say 25 ft. of conductor ; an extra 6 in. in the connections to it would be insignificant. But a coil for 30 mc may well be of no more than 12 in. of conductor, and therefore the same connections would be relatively long and would have a profound effect.

In the same way, an extra capacitance of, say, 5 $\mu\mu$F between two connecting leads or between two valve electrodes would not have a very marked effect in a circuit operating at 1 megacycle, but the effect would be at least 30 times as great in a circuit tuning to 30 mc. This can be seen from the fact that the reactance (which may be considered as the resistance to alternating current) of a condenser or capacitor is found from the formula:

$$X = \frac{1}{2\pi fC}$$

where X is the reactance in ohms, π is 3·14, f is the frequency and C is the capacitance.

From this it is evident that the reactance is inversely proportional to the frequency. Thus, the reactance of a capacitance of 5 $\mu\mu$F is approximately 30,000 ohms at 1 megacycle, whereas it is only 1,000 ohms, or 30 times smaller at 30 mc. In the case of a valve, for example, a capacitance between grid and anode could be regarded as a load, and therefore as a source of loss. All this should explain the need for the utmost care in minimising unwanted capacitance in a short-wave receiver.

The position is very similar when leakage or power loss across insulators is considered. It can be assumed, in general, that the effect of any such leakage increases proportionately with frequency.

Short-Wave Valves

Without analysing these factors more closely, then, it should be clear that in making a short-wave receiver, strict attention must be paid to the questions of reducing the lengths of all connectors to the greatest possible extent, of spacing as much as possible all connectors (to minimise capacitance between them), and of using valve holders and variable condensers of special types which have low-loss insulating materials of the various ceramic and plastics patterns. It also shows why special valves are required for receivers operating on frequencies above 15 mc, although more particularly above 30 mc. Ordinary valves for broadcast receivers have relatively long leads to their connecting pins, and their bases are often made from insulating materials which show marked losses when subject to very high frequencies.

Valves designed for short-wave work are smaller than those more generally employed and, even in the case of triodes, often have the grid connection brought out to the top cap instead of

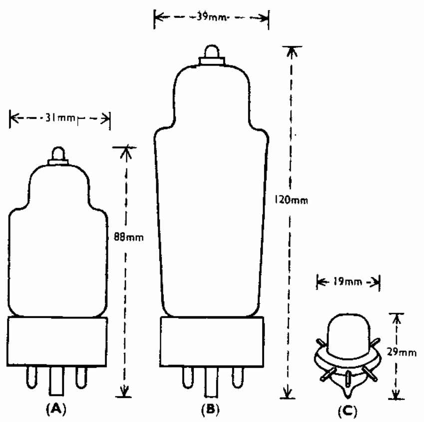


Fig. 2. Comparisons in valve types.
(A) is an RF pentode specially designed for short-wave use; (B) is a corresponding valve for medium waves; (C) is an acorn-type triode designed for use on ultra-short waves—say, below 5 metres (60 mc).

to a base pin. In addition, they have bases made from special low-loss material; alternatively, in the case of many types, they are not provided with moulded caps and pins, but have short connecting wires leading directly from the glass envelope (see Fig. 2). Valves of the last-mentioned type are not essential in receivers for frequencies below 100 mc, but they can often be used to advantage for reception on frequencies as low as 20 mc. These acorn-type valves are not as readily obtainable at present as those of the more usual type, and their use will not be definitely specified for any of the receiver designs which will be given in this series of articles.

It will now be appreciated that the acorns have very definite advantages for short-wave work. For instance, there is no moulded base across which leakage can occur. In addition, the connecting wires, which replace the normal plug-in pins, are very short, make direct contact with the electrodes, and are so widely spaced that there is the lowest possible capacitance between them. Valves of this type have unusually small electrodes, and therefore the internal capacitance is at a minimum.

The importance of the points which have been raised so far will be more readily understood later when we come to consider the designs of different types of short-wave receiver. Moreover, if they are well grasped, it will be found that receiver design and layout is considerably simplified.

Receiver Circuits

There are three main types of receiver which can be used on the frequency bands now being considered. They are: The so-called "straight" circuit, which comprises detector and audio-frequency stages, with the possible addition of an R.F. stage; the superhet, in which the signal frequency is converted to a new and lower frequency prior to amplification; and the super-regenerative circuit, in which the detector valve is kept in a state of oscillation while receiving, the oscillation being interrupted at a frequency of not less than 20,000 cycles per second, which is above the audible limit.

Of these three types, the first is the simplest, and is most popular with beginners in short-wave work. It should be stressed, however, that many experienced amateurs also prefer this type of receiver and obtain remarkably good results with it. The superhet has the advantage of simpler manipulation once it has been built, higher gain or amplification, and better selectivity. Against this must be set the disadvantages of increased cost, slightly greater difficulty in construction and much greater difficulty of initial setting-up and circuit alignment.

The super-regenerative is, in general, more sensitive than the average "straight" circuit. On the other hand, it is very unselective, is likely to cause interference, and produces a very pronounced "background hiss" when not tuned to a strong signal; moreover, it will not receive CW. For these reasons it is not strongly recommended, and will not be described in this particular series of articles.

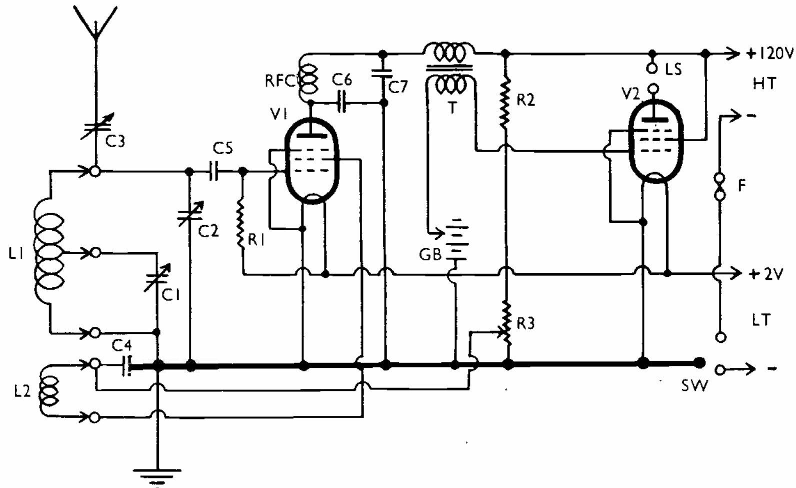


Fig. 3. Circuit of an excellent two-valve battery-operated receiver suitable for operation on wavelengths between 10 and 100 metres (30 and 3 mc).
Component values are given in Fig. 4.

Two Good "Straight" Circuits

Let us now consider one or two "straight" circuits of types which are very suitable for anyone wishing to make a start with short-wave reception. Figs. 3 and 4 refer to two-valve circuits which can be used on frequencies between about 3 and 30 mc. Fig. 5 shows the circuit of a mains power unit for working with a receiver similar to that represented by Fig. 4. Next month a circuit will be described which will give very good results when operated on frequencies up to 60 mc.

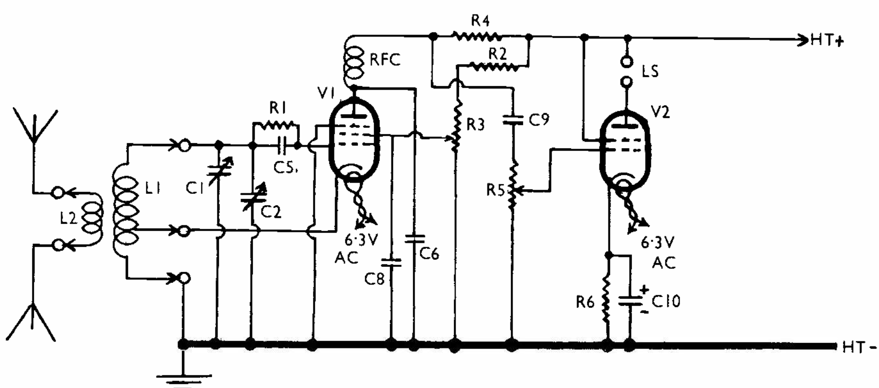


Fig. 4. A two-valve mains-operated receiver, with electron-coupled reaction circuit and band-spread tuning.
The circuit of a mains power unit for this receiver is given in Fig. 5.
The following component values apply to Figs. 3 and 4: C1, 25 μμF; C2, 100 μμF; C3, 50 μμF; C4, ·002 μF; C5, 100 μμF; C6 and C7, 100 μμF; C8, ·25μF; C9, ·05 μF; C10, 25 μF low-voltage electrolytic; R1, 5 megohms; R2, 50,000 ohms; R3, 50,000 ohms; R4, ·25 megohms; R5, ·5 megohms; R6, 350 ohms: RFC, SWRF choke (to be described); T, 1 : 3 ratio AF transformer; Sw, three-point on-off switch; F, 250 mA fuse; L1 and L2, six-pin plug-in coil (to be described); V1, 210 SPT (battery) or 6J7 (mains); V2, 220 HPT (battery) or 6V6 (mains).

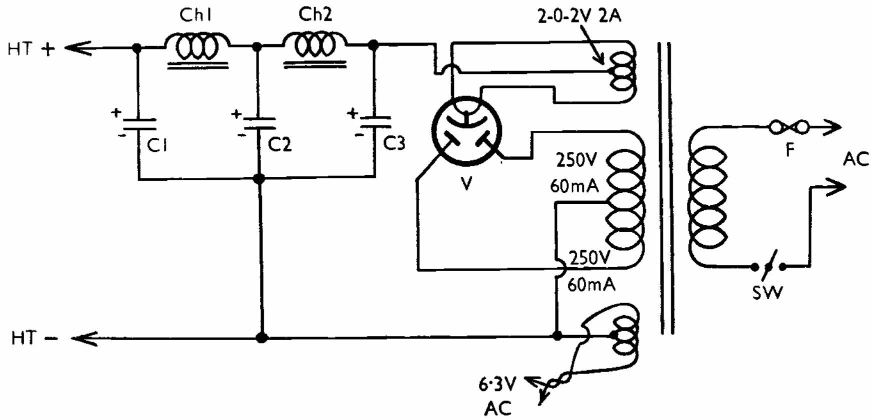


Fig. 5. A mains-operated power unit for the operation of a receiver such as that shown in Fig. 4.
Component values are: C1, C2, and C3, 4μF, 450-volt electrolytic; Ch1 and Ch2, 10-20 henry, 50 mA iron-core chokes; F, 1-A fuse; SW, QMB single-pole on-off switch: V, indirectly-heated full-wave rectifier such as a type IW2 (max. rated output 250 volts, 60 mA).
Note that a twin-choke smoothing system is often unnecessary; sufficient smoothing (indicated by absence of background hum) may result if Ch2 and C3 are deleted, and Ch1 connected directly to the centre tap of the rectifier heater winding.

It will be best to start by giving detailed consideration to the circuit in Fig. 3, because the others are based on this. It will be seen that an RF pentode is used as detector, this being followed by a power pentode to give audio-frequency amplification. The circuit of the second valve follows perfectly normal practice and calls for little comment. But the detector circuit will appear novel to those who have not previously concerned themselves with short-wave reception.

Band-spread Tuning

Six-pin plug-in coils are used, the coils being wound on standard six-pin formers, of which only five pins are connected. There are two tuning condensers, one of which is connected across the whole of the grid winding while the other is across only a portion of it. The first condenser is for band *setting;* that is, for selecting a relatively narrow band of the frequency range covered by the tuning system. This need not have a slow-motion drive, but should have a well-marked scale. The second condenser is for band *spreading*, which means that it is used to cover the particular band (say 28 to 29 mc) which has been selected by the band-set condenser.

The latter should be provided with a really good slow-motion drive, for it is used for final station selection or fine tuning. The band-spread condenser not only has a lower capacitance, but is connected across only a portion of the coil. In consequence, the tuning pointer can be moved over a relatively large sector of the scale when changing from one frequency channel to an adjacent one. The object should be so to choose the capacitance and so to arrange the tapping point that any particular frequency band can just be covered by rotating the condenser spindle through its full range. How this is accomplished will become more evident next month when we consider the design and construction of the coils.

Reaction-Control Systems

The method of reaction control is somewhat unconventional, because the reaction condenser (C4) is fixed. Feedback is regulated by varying the potential on the screening grid of V1 by means of the potentiometer marked R3. As the slider is moved upward, toward the positive end, the SG potential is increased and the tendency of the valve to oscillate is increased. This arrangement gives very smooth control—which is absolutely essential for efficient working—provided that the potentiometer is of good quality.

It may be noticed that the screening grid acts virtually as an anode in this circuit. The actual anode, in conjunction with the grid and filament, works as part of a triode amplifier. Strictly, the action of the valve is slightly more complex than this, but purely theoretical considerations are not important here.

While on the subject of reaction or feedback circuits it is of interest to examine other suitable arrangements, of which the three principal ones are shown in Fig. 6. It should be mentioned in passing that band-spread tuning is not indicated in these circuits, in the interests of simplicity; there is, however, no difficulty in making the slight modification necessary to incorporate it. The circuit shown at (A) is conventional, and is similar to that used in broadcast receivers; in fact, the only difference is in respect of component values. At (B) is shown a circuit very similar to that in Fig. 3, but feed-back is from the anode instead of the screening grid. Circuit (C) employs cathode reaction coupling, which is also known as electron coupling; the arrangement is very similar to that used in Fig. 4. Other information regarding these reaction circuits is given in the caption. All are interchangeable, and any of them may be employed in the full circuits given in Figs. 3 and 4.

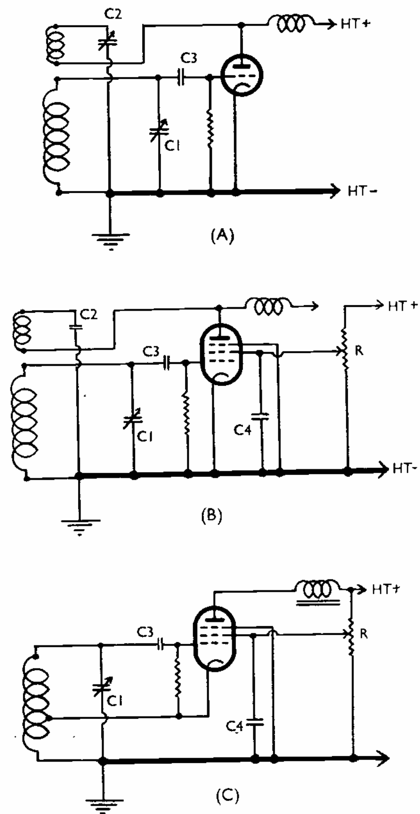


Fig. 6. Three regenerative detector circuits suitable for use in short-wave receivers of the "straight" type.

(A) is the standard capacity-coupled arrangement with reaction controlled by a variable condenser. In (B) a fixed feed-back condenser is used and control obtained by varying the potential at screening grid of the RF pentode. At (C) the so-called electron-coupled circuit is shown. Average values are; C1, 100 $\mu\mu F$; C2, 150 $\mu\mu F$; C3, 100 $\mu\mu F$; C4, ·25 μF; R, 100,000 ohms.

Mains Operation

The mains-operated circuit shown in Fig. 4 will give extremely good results and has a somewhat higher gain than the battery-operated arrangement already described, because of the higher mutual conductance of the mains-type valves. Electron coupling is used for feed-back, and it may be seen that the lower portion of the grid coil acts as a reaction coil because the detector anode feeds back to the earth line through C6.

A separate aerial winding is used on the coil, and this is suitable for the connection of a dipole or doublet aerial. This is an optional feature, and the aerial connection could well be made as shown in Fig. 3 if that were more convenient. In this case the band-spread condenser (C1) is in parallel with the band-set condenser (C2). This is merely a convenience, and is desirable from the practical point of view when using a tapped coil and electron coupling.

Choice of Valves

Suggestions regarding suitable valve types for Figs. 3 and 4 are given in the caption to Fig. 4, but it will be understood that there are many other types which can be used with equally good results. For example, the 210 SPT valve specified for use in the detector stage of the battery receiver could well be replaced by the VS 24/K, which is an RF tetrode specially designed for short-wave use. Alternatively, the HL 2/K triode could be employed by adopting the reaction circuit shown at (A) in Fig. 6. This also is intended for short-wave use and has a special electrode construction; for that reason it is preferable to many other types. The 6J7 specified for the mains version is a special short-wave valve, but it could well be replaced by a VP4B tetrode or a ZA1 acorn pentode. It is not possible to make specific recommendations at present, when valves of most types are in such short supply; to a large extent, therefore, one must be governed by the availability.

The next article of this series will describe a 60 mc "straight" receiver and give some practical hints regarding the construction of the three sets referred to above. It will also include some information regarding short-wave aerials. A third article will deal with short-wave receivers of the superhet type.

TIME-DISTANCE TABLE

Showing the distance from London, and the time with reference to G.M.T., of some of the more important cities of the world.

City	*Distance Miles*	*Time ± GMT*
Aden	3,600	+3.00 hrs.
Berlin	600	+1.00 hr.
Berne	400	+1.00 hr.
Buenos Aires	6,800	−4.00 hrs.
Budapest	900	+2.00 hrs.
Cairo	2,100	+2.00 hrs.
Calcutta	5,000	+5.30 hrs.
Capetown	5,900	+2.00 hrs.
Chicago	3,900	−6.00 hrs.
Copenhagen	600	+1.00 hr.
Guatemala	5,000	−6.00 hrs.
Havana	4,600	−5.00 hrs.
Honolulu	7,200	+9.30 hrs.
La Paz	6,100	−4.33 hrs.
Lima	6,000	−5.00 hrs.
Lisbon	500	GMT
Los Angeles	5,500	−8.00 hrs.
Manila	6,700	+8.00 hrs.
Melbourne	10,600	+10.00 hrs.
Mexico City	5,200	−6.00 hrs.
Moscow	1,600	+3.00 hrs.
Nairobi	5,200	+3.00 hrs.
New York City	3,400	−5.00 hrs.
Oslo	700	+1.00 hr.
Paris	200	GMT
Panama	5,000	−5.00 hrs.
Perth	8,900	+8.00 hrs.
Rabat	1,200	GMT
Rio de Janiero	5,600	−3.00 hrs.
Rome	900	+1.00 hr.
St. Johns (Newfoundland)	2,300	−3.30 hrs.
Santiago de Chile	7,400	−4.00 hrs.
Sydney	10,500	+10.00 hrs.
Tokio	6,000	+9.00 hrs.
Toronto	3,500	−5.00 hrs.
Vancouver	4,700	−8.00 hrs.
Wellington	11,800	+11.30 hrs.

Examples. *If it is* 8.30 *a.m. in London, it is* 2.30 *a.m. in Chicago and* 8.00 *p.m. in Wellington. If it is* 9.30 *p.m. in Sydney, it is* 11.30 *a.m. the same day in London. But if it is* 11.00 *p.m. in London, it is* 9.00 *a.m. the next morning in Sydney.*

The Editor Wants

★ Articles on short wave BC reception and war-time experiences in short wave radio.

★ Photographs of amateur stations, amateur built equipment and club meetings.

★ News of DX worked from amateur stations throughout the world.

★ Station descriptions, in the form of notes on the gear, results, experimental work, etc., with good clear photographs, any size. This material will be used in the "Other Man's Station" series, and the contributor concerned suitably rewarded.

Here and There

Seventy-Three

Used by all amateurs to convey the greeting "best regards," how many know why the mystic numerals 73 came to have that meaning? Here's the story.

During the American Civil War, the railway—and therefore the telegraph—administration was in the hands of one Andrew Carnegie. After the end of the war, the telegraph operators formed themselves into the "Order of Military Telegraphists," and when old Andrew Carnegie reached the age of 73, they gave him what was described as a testimonial dinner; from that date 73 began to be used among line telegraphists as the greeting for "good wishes" or "best regards," and so found its way into our procedure of to-day.

Calls Heard

We welcome Calls Heard lists for the 28 and 56 mc amateur bands, and for DX broadcast stations between 5 and 25 mc. These lists should be clearly set out in alphabetical order, and specify the type of receiver used, with dates or period of reception; exclude G's on 28 mc, unless it is an overseas reader who is reporting. All lists should reach us by the 20th of the month, addressed to—Calls Heard, *Short Wave Magazine*.

Tube for Aerial

It is now possible to obtain duralumin tube for the construction of 28 and 56 mc radiating elements. Webbs, of 14 Soho Street, London, W.1, have it in 8 ft. 6 in. lengths, ⅜-in. outside diameter, at 4s. 6d. a piece. They also have stocks of a very good transmitting triode, priced at only 12s. 6d.—the Tungsram OQ-15/600, which is rated at 18 watts anode dissipation and can be operated at up to 600 volts on the plate; it is ceramic based.

Do You Know That

It is *essential* to switch on the LT to mercury vapour rectifiers before HT is applied? If the valves have been out of use for some time, it is also a good thing to run them on LT only for fifteen minutes or so.

More Room on 28 mc

The G.P.O. has just announced another easement in regard to our frequencies. The 28 mc band is now extended from 29 to 30 mc, so that we have the whole of the old 28-30 mc band back again. This is good news, which only reached us a day or two before going to press. It is to be hoped that the area between 29 and 30 mc will become well populated, as at the moment the bulk of the activity is at the LF end, around 28·0-28·5 mc. This is obviously all to do with pre-war crystals and harmonic relation with the old lower frequency bands. But, as announced elsewhere in this issue, there is now no difficulty in getting crystals which will give frequencies in the 29-30 and 58-60 mc region.

One other point: Anyone operating between 29 and 30 mc will probably have a second harmonic which will be going out in the 58 mc band. Hence, when you are on "ten," sign "ten" or your frequency in mc when calling; conversely, when operating in the 58 mc band, sign "five" or your frequency.

Our Print Order

The number of copies of the *Magazine* which we can produce is limited not by the present demand, which we cannot possibly meet, but by the paper quota. This determines our total print, and thus ultimately the number of copies available for bookstall sales. Once they have gone, there are no more. To make sure of your copy, why not consider becoming a direct subscriber? Twenty shillings will bring you the *Magazine* direct by post each month for a year. Write the Manager, *Short Wave Magazine*.

New QRA's

We shall be glad to publish the names and addresses of amateurs as they receive their new licences, where these either differ from the QRA's given in the September, 1939, issue of the Call Book, or did not appear in that issue. Write clearly and send to—QRA Section, *Short Wave Magazine*.

The Cathode-Ray Tube

First of Five Practical Articles on an Important Subject

EDITORIAL NOTE.—It is intended in this series of articles on the cathode-ray tube and oscillographic work in general to cover those practical aspects of C.-R. tube applications which will be helpful from the amateur point of view.

A great deal of extremely useful and interesting work can be done with a simple oscilloscope, even without a time-base, and its application is by no means limited to the measurement of the depth of modulation of one's carrier. Not only every stage of the transmitter, but much of the receiver circuit, can be tested, and once the principle of operation of cathode-ray equipment has been grasped, it is possible to devise methods of using it to solve particular problems.

While much can be done on a small tube without a time-base, the real value of an oscilloscope in the strict sense of the term lies in using a fairly large tube with its associated time-base. The former point is evident when it is remembered that many tests involve actual measurement of the image on the screen: thus, the larger the scale, the greater the accuracy.

Articles to follow will deal with the interpretation of simple images and the arrangement of time-base circuits, leading up to the design and construction of a complete oscilloscope for use in the amateur station, with a summary of the work which can be done with it. Many amateurs have already found out for themselves that oscillography applied to radio is a study in itself, and it can be truly said that every up-to-date amateur should be equipped with a C.R. tube unit as surely as he has installed his frequency meter and other monitoring apparatus.

IT is not intended here to delve deeply into the theory underlying the design of the modern cathode-ray tube, but merely to indicate the basic principles upon which the operation of such tubes depend.

Introduction

In its simplest form the cathode-ray tube consists of an emitting cathode, an anode with a small aperture, positioned opposite the cathode, and a fluorescent screen.

Such a tube might be either of the high vacuum type or of the "soft" type in which a certain amount of residual gas has been left within the tube.

Many years ago it was discovered that in an evacuated or partially evacuated tube containing two electrodes, between which a high electrical pressure is maintained, a stream of negatively charged particles or "electrons" will pass from the cathode (negative electrode) to the anode (positive electrode), providing that the cathode is composed of a substance which will emit electrons under working conditions.

Originally the cathode was of the "cold emitting" type, but in the later tubes "hot" cathodes, similar to those of radio valves, were used. It was also discovered that the electron stream (the so-called cathode ray), while not of the physical nature of light, obeys many of the laws which govern the behaviour of light; for example, cathode rays are normally propagated in straight lines, and therefore cast "electron shadows" if bodies capable of absorbing the rays are placed in their path. They can be focused into a concentrated beam or pencil, and can be reflected or refracted by electrical or magnetic means, just as light can be focused, reflected and refracted by lenses, mirrors and prisms.

A third, and equally important point, is that if the electron stream is made to impinge upon a surface coated with certain chemical substances, those substances will radiate light at the point and instant of impact.

There are to-day two main classes of cathode-ray tube available to the experimenter, the "soft" or gas focused type and the high vacuum type.

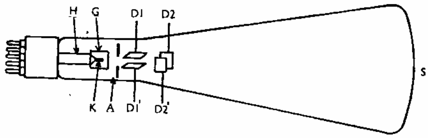


Fig. 1. Elements of a gas-filled cathode-ray tube. H—Heater. A—Anode. K—Cathode. D1 D1′—D2 D2′—Deflector plates. G—Control Electrode. S—Fluorescent screen.

Operation of the Gas Focused Tube

The electrode system and operation of the "soft" type of tube differs somewhat from the high vacuum tube, and perhaps the main point of difference is in the focusing mechanism.

The tube may consist of an electrode system having the following elements. (See Fig. 1.)

1. A cathode.
2. A control electrode.
3. An anode.
4. Two pairs of deflector plates.
5. A fluorescent screen.

The cathode is of special construction, entirely different from the type of cathode used in ordinary receiving valves. It is essential in a cathode-ray tube that the electron emission should be as concentrated as possible, and the emitting surface of the cathode should therefore approximate closely to a point source.

The control electrode, which is usually in the form of a cylinder surrounding the cathode, fulfils a function somewhat similar to that of the grid in a receiving valve. With negative bias applied to this electrode the number of electrons passing through the tube decreases, and conversely, reduction of this bias results in an increase of the electronic current.

A further function of this electrode is that of forming the initial concentration of the beam.

The anode of the tube is maintained at a high positive potential with respect to the cathode, this potential being from a few hundred volts to several thousand volts according to the type of tube and the purpose for which it is intended.

The focusing action takes place during the passage of the electrons from the cathode towards the screen. As a result of impact between the electrons and gas molecules, positive ions are formed in the path of the beam, and because of their greater mass they will remain in the beam for an appreciable time after formation. As a consequence, a positive space charge is produced within the beam tending to neutralise the negative space charge due to the electrons and thus causing the beam to converge.

At this point it will be of interest to examine some of the secondary effects associated with gas-filled tubes.

In the first place, due to the finite time taken for the ionisation of the gas within the tube, a very rapidly deflected beam becomes blurred since it does not remain in one position long enough to permit the formation of sufficient positive ions for satisfactory concentration of the beam.

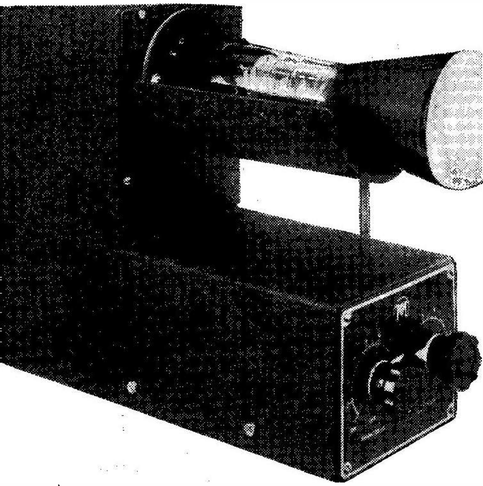
Two further effects associated with gas-focused tubes are a departure from linearity of the deflection characteristics, as the field between the deflector plates is reduced below a certain value, and a somewhat lower value of impedance between the deflector plates than in the high vacuum tube, due to the ionic current.

However, both of these two last-mentioned effects can be overcome, either by modifying the normal construction of the tube, or externally by adjustment of the electrical circuit connected to the tube.

Operation of the High Vacuum Tube

The general construction of the high vacuum tube is fundamentally the same as that of the gas-focused type, with the exception that additional means for concentrating the beam have to be provided, since the concentration effect of the residual gas ionisation is lacking.

The method of focusing the beam in a high vacuum tube may be either magnetic or electrostatic, but since the magnetically focused tube is not in general use for oscillographic work



The Mullard B.100 Oscilloscope Unit.

it is intended to deal here only with the electrostatically focused type.

Electrostatic Focusing

Reference to Fig. 2, which shows the beam outline of a normal two-anode tube at correct focus, will facilitate appreciation of what actually takes place. In the first place, the electrostatic field between the cathode and the first anode is such that the stream of electrons leaving the cathode are initially convergent at the first anode but almost immediately tend to diverge again, then, due to the field existing between the first and second anode, the beam is finally brought to focus at the screen.

The behaviour of the beam within an electrostatic field is thus similar to the behaviour of light when passed through a lens, and in the same way the "focal length" of the beam of electrons may be adjusted by varying the position, size and shape of the electrodes and/or the strength of the focusing field. Since, however, in a given tube the electrode system and the optimum focal length are fixed by the dimensions of the tube, the ratio of voltages on the first and second anodes, necessary to produce the correct focusing field, is also fixed, and is virtually independent of the magnitude of the applied voltages within the working range. For the type of tube under consideration this ratio is approximately 1 to 4.

Power Supply

Fig. 3 shows a suitable circuit for the high tension supply. It should be noted that in order to obtain a sharp image free from disturbance, the ripple voltage should not exceed about 3 volts and the tube itself should be screened from stray magnetic fields.

It will be observed that the *positive* side of the high tension supply is earthed; therefore in building such a unit it is important to remember that, contrary to normal radio practice, the heater and cathode of the tube are at high tension with respect to earth, and these parts of the apparatus should be made inaccessible. Also, special attention should be paid to the insulation of the heater transformer, which must be adequate to withstand the full high-tension voltage between the heater winding and earth. All potentiometers must have insulated spindles which should be earthed.

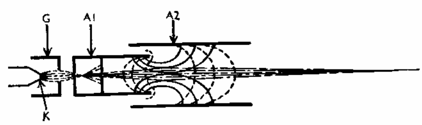


Fig. 2. Electrostatic focusing in a high vacuum tube. The two anodes A1 and A2 are supplied with different voltages, and due to the electrostatic field thus formed, the electrons are concentrated in a point at the screen.

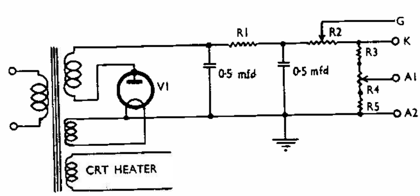


Fig. 3. Circuit diagram of high tension unit for mains operation of two anode type of C.-R. tube.

Operation—Deflector Circuit—Deflection Sensitivity

The *brightness* of the image depends upon the magnitude and velocity of the electron stream. The *sharpness* or focus of the image depends upon the ratio of the voltages applied to the first and second anodes. Therefore, since the second anode voltage (which controls the velocity of the electron stream) is normally a fixed value, adjustment is made to the brightness of the image by increasing the beam current, which is controlled by the grid bias.

However, in making this adjustment it must be borne in mind that by increasing the current density of the beam the negative space charge within the beam is also increased with the result that the spot size tends to increase as well, so that for the observation of any phenomenon which requires a fine trace for its accurate interpretation, the beam current should be maintained at the minimum value consistent with the required brilliance.

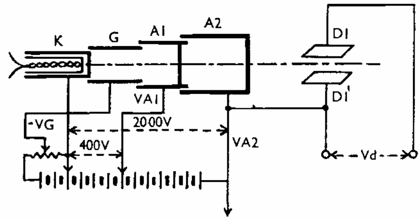


Fig. 4. Theoretical circuit of HT connections, showing relative potential differences between the electrodes and deflector plates. Battery supply is shown for simplicity.

The Deflector Circuit

For accurate interpretation of the image on the screen, and for an exact appreciation of the magnitudes involved, it is necessary that the deflector plate characteristics should be fully understood, and it is intended for this reason to deal with these characteristics at some length.

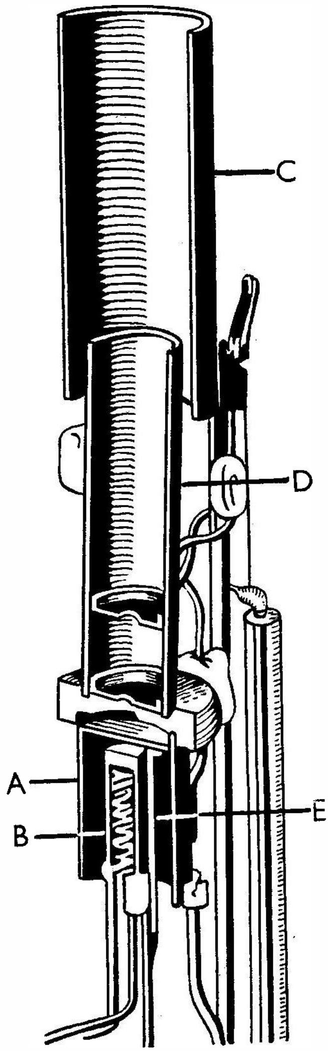
It can be stated that the deflection sensitivity of the type of tube being considered will vary inversely as the velocity of the electron stream which, as stated, is determined by the second anode voltage. That is to say that as the second anode voltage is increased, the voltage necessary across the deflector plates for a given displacement of the spot at the screen must also be increased, in approximately the same proportion.

Considering now the circuit diagram shown at Fig. 4, which in principle is a normal type of circuit in common use, it will be observed that one of the deflecting plates D1 is connected to earth and will always therefore be at the same potential as the second anode, but as soon as a voltage Vd is applied between the plates, then the opposite plate will have applied to it a voltage which is either higher or lower than the anode voltage. The electron stream therefore, in passing through this pair of plates, undergoes a change of velocity, and this in turn changes the deflection sensitivity of the tube. It follows from this that the deflection of the spot at the screen is no longer proportional to the voltage Vd and the image becomes distorted.

In considering a single pair of deflector plates the above effect by itself merely causes a greater displacement of the spot from the zero axis when a negative voltage is applied to the free plate than when a positive voltage is applied. However, as the two pairs of plates are positioned at different distances from the anode, and the beam passes first through one pair and then through the other, the second pair of plates introduces a further error by affecting the velocity of the beam as deflected by the first pair, and a form of distortion is introduced which is commonly known as trapezium distortion.

In addition to this form of distortion, the use of such a circuit as that shown in Fig. 4 would influence the definition of the light spot. If the spot is correctly adjusted when Vd = 0 it will become ill-defined and larger for values of Vd corresponding to a wide angle of deflection.

In order to overcome both of these forms of distortion, the plates should be connected in symmetrical push-pull



A—Grid. B—Heater. C—Anode 2. D—Anode 1. E—Cathode.

arrangement, as shown in Fig. 5, in which both plates of a pair are connected to the anode through an impedance of equal value, and oscillate in potential symmetrically about the earth potential of the anode.

Deflection Sensitivity

The deflection sensitivity is usually expressed as the deflection in millimetres at the screen per volt DC between the plates, at a given anode voltage; but since, as has already been stated, it is inversely proportional to the final anode voltage, it may also be expressed as X/Va mm. per volt, where Va is the final anode voltage. Thus a tube with a sensitivity of 0·19 mm. per volt at 800 volts anode voltage might be quoted as having a deflection constant of 150/Va mm. per volt approx. But whichever way it is expressed, it must be remembered that the figure given should refer to a specific pair of plates, since the deflection sensitivity is different for each pair, the plates further from the screen having the higher sensitivity.

To consider a practical case, supposing this tube is connected up and is operating at a deflection sensitivity of 0·3 mm. per volt, Fig. 6 shows what happens under operating conditions.

With the plates all connected together to the second anode, the spot should be in the exact centre of all four plates. Now, on connecting a battery of say 50 volts between the vertical plates the spot will move towards the positive plate, the amount of movement being proportional to the applied voltage ; on reversing the battery the deflection would be in the reverse direction, and in the same proportion, so that the spot would first move a distance of 50 $\times$ 0·3 = 15 mm. from the centre of the screen, in one direction, and on reversing the battery, 15 mm. in the opposite direction.

If, now, instead of using a battery an AC voltage of 50 volts is connected to the plates, the spot will move rapidly to and fro at the periodicity of the mains, and since these alterations cannot be followed individually by the eye they appear on the screen as a line. Now the important point to remember about this line is that its length is proportional to the *peak* value of the voltage : hence, since the deflection takes place alternately in two directions the length of the line will be approximately 1·4 $\times$ 50 $\times$ 2 $\times$ 0·3 = 42 mm.

From the above, the following data become available, where D = screen diameter in inches and S = sensitivity in mm. per volt.

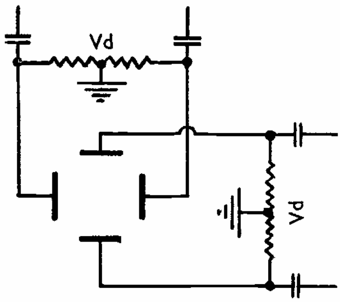


Fig. 5. Method of balanced circuit supply to deflector plates.

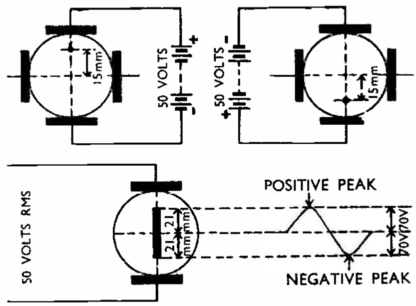


Fig. 6. Deflection characteristics. Showing relative movement of spot by DC and AC.

DC voltage required per inch deflection $= \frac{25 \cdot 4}{S}$.

RMS voltage required per inch deflection $= \frac{25 \cdot 4}{\sqrt{2} \times 2S}$ volts, so that the RMS voltage required for full sweep of the tube $= \frac{D \times 25 \cdot 4}{\sqrt{2} \times 2S}$ or approximately $\frac{D \times 9}{S}$.

In dealing with an irregular waveform, such as for instance the output from a gramophone pickup, it is the peak voltage which is of interest and the peak voltage necessary per inch deflection $= \frac{25 \cdot 4}{2S}$.

Obviously, in estimating the length of line which would be produced by a given voltage the reciprocal of the above figures would be used.

(To be continued.)

To Intending Contributors

WE are always glad to see work, whether a briefly expressed idea or a long article, which may be suitable for publication. We pay good rates for all material used, and a note on how to submit articles appears in the Contents page. The following points are added for further guidance.

It is seldom, if ever, possible to print anything exactly as drafted by the author and we invariably have to make alterations or corrections, either on the purely literary side or for technical accuracy, since the *Magazine* sets a high standard in both respects.

But we do not wish to destroy the individuality of any author's work, hence intending contributors can best help themselves and us by arranging their material in the form in which they would expect to see it in print. This involves a close study of the general contents of the *Magazine*, from which can be learnt not only the type of article most likely to be accepted, but also such points as permitted abbreviations, the use of sub-headings, and sequence in laying out an article. Diagrams and sketches, which are always finally drawn for publication by our draughtsman, need not be copper-plate, but they *must* be clear and accurate for copying.

The time taken to give a decision on uninvited outside contributions varies from three days to three weeks, depending upon the amount of work we have on hand when the material is received. The rate offered is indicated in the letter of acceptance, and payment is made within a few days of the work appearing in print.

We do not use precious space thus to deter our intending contributors, but to encourage them to let us see their work in its most acceptable form.

A Workbench and its Equipment

Some Ideas and Practical Suggestions

By **JUSTIN COOPER**

(Editorial Note.—In pre-war years, Justin Cooper was responsible for a regular flow of practical ideas, which appeared in our columns under his pseudonym of " Tester." He is essentially an experimenter who likes to do everything himself. He has not changed with the years, so he will be appearing again, as and when his muse prompts him. This is a strictly practical article which should help many readers.)

IF ever there was a time when rebuilding, refurbishing and re-designing of the station was in the mind of nearly everyone who aspires to some private corner for the pursuit of radio, that time is now. Whether transmitter or listener, beginner or serious experimenter, the dawn of the new era in Amateur Radio—for we may rightly regard the issue of new licences, for what to a great many people will be new bands, as marking a new phase in the game—will mean that they will be either building a station, or thinking about a rebuild. The purpose of this article is to discuss and enlarge upon those points which are common problems for everyone who is getting under way—whether for the first time, or that "last" time which somehow never is the last.

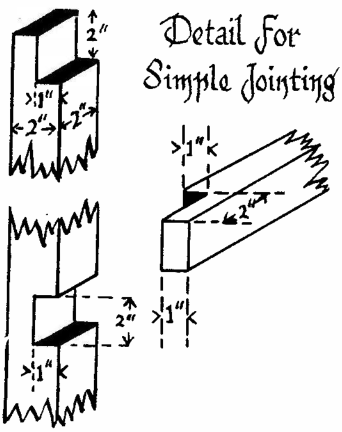
Now, it is obviously not possible to suggest a standard design—because every case is an individual one. Some amateurs are lucky enough to have an outside building, complete with fitted workshop, to which they can retire in peace when the mood takes them; many work in a spare room in the house; others use part of the garage; some have the equipment built into the roof-space, or a cupboard, or under the stairs, operating by remote-control from the living-room. But generally speaking, most amateurs have at least part of a room which they can call their own, and in which they can construct and instal their apparatus.

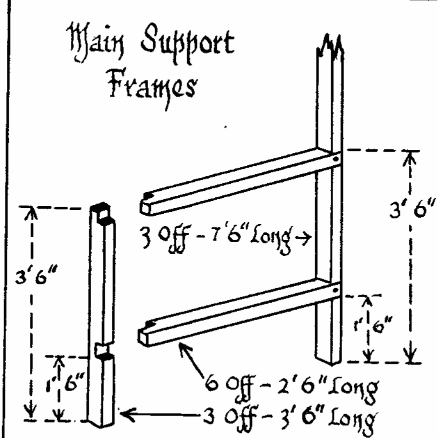
The first requirement is a workbench of some kind. This can either be built up, or an old kitchen table can be converted for the purpose. Unfortunately, such articles of household equipment fetch remarkably high prices in the second-hand market nowadays, and it is by no means as easy to get them as it used to be before the war, when a pound was a fair sum for a full-sized deal table with drawers. A substitute for a table is a converted bureau or an unwanted writing-desk; usually, however, these are too small to serve as workbenches, but can be admirably adapted for mounting the completed apparatus.

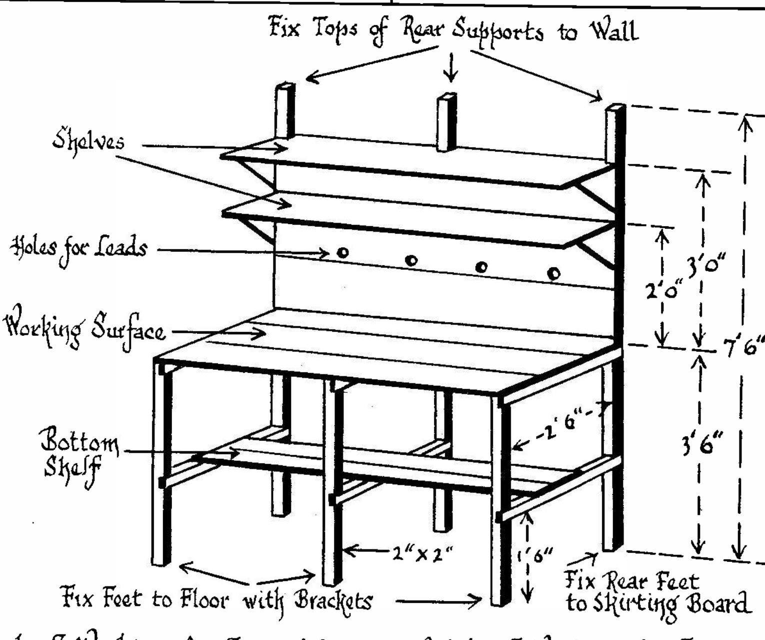
Constructing a Bench

A bench is, however, almost essential, so that in most cases it will be necessary to make one. This can be done quite easily by anyone with but slight ability in the use of tools. The sketches accompanying this article show a simple but practical design, the leading dimensions—height, length and width —of which can be varied to suit the space available. For maximum dimensions, 6 ft. long by 2½ ft. wide is ample; there should always be lower and upper shelves (two are shown in the drawing) and the height of the working surface should be chosen in accordance with whether it is desired to sit or stand at the bench. The height given in the sketch is convenient for standing while working; one usually wants to move about and reach round when busy on a job, so that it is generally better to choose the standing height for the working surface.

The main members are of 2 in. by 2 in. timber, with the working surface,







Length of Working Surface 6ft • Width of Working Surface 2ft 6ins

CONSTRUCTIONAL DETAILS
FOR THE DESIGN DISCUSSED IN THIS ARTICLE

back board and shelves of ½ in. planking. With three supporting frames, there is no fear of any sagging of the working surface, particularly if the supports are moved in a little at each end. The bench can be constructed in sections, and since it must be absolutely rigid, it should be fixed to the wall and floor at the points shown. The length of the main uprights should be such as to bring their ends above the top shelf; while the bottoms of these uprights can be notched out to fit over the skirting board, to which they can be screwed; the tops must be secured to a batten which in turn is held to the wall by Rawlplugs.

If the constructor's ability as a carpenter is equal to it, a good, deep drawer can also be provided under the working surface. Such a drawer is extremely useful for keeping all the necessary odds and ends, such as small tools, spools of wire, boxes of screws, and so on.

Obtaining the Timber

While the sketches give all necessary information for building the bench, there are points to mention in connection with getting the wood for it. Wood is a controlled item, and seasoned imported timber can only be obtained and used under licence. And it is unlikely, to say the least, that the Timber Control would grant a licence for the supply of such wood for a radio workbench. But merchants are allowed to supply up to twenty shillings' worth of home-grown timber per month to individual customers for essential household purposes. Every town of any size supports a wholesale timber supplier, who usually has cut lengths on hand.

There is, of course, a serious drawback about all this; home-grown timber is normally sawn and sold very soon after being felled. It is therefore "green"—wet and unseasoned—and anything made of such timber cannot be entirely satisfactory, since the process of drying out causes shrinkage and consequent distortion. Hence, every effort should be made to obtain seasoned timber in the first place; if this is not possible, it is well worth keeping it to dry out for a few weeks before it is put to use.

Having cut the pieces to the different sizes, the 2 in. by 2 in. lengths should be carefully notched in the manner shown and the main support frames fitted together. They should be fixed in their correct positions before the planking is put on, making sure that they are in square both horizontally and vertically. All fixing should be done with screws, *not* nails, in order to ensure a rigid job—use 1½ in. wood screws for the main support frames and 1 in. screws for the planking.

When the structure is complete, the bench can be finished by having the working surface covered with two or three layers of the imitation American cloth which is now available in some household stores; the exposed parts can be given a coat of grey paint.

The wood for the bench illustrated amounts to 70 ft. of ½ in. plank and 50 ft. of 2 in. by 2 in., and the total cost should be less than 30s.

Providing Power

Assuming the availability of mains, the next thing is to wire the bench for power. From a main supply point which incorporates an on-off switch, leads should be run to subsidiary points for plugging in the soldering iron, a table lamp, and HT/LT power units. One cannot have too many power points—and they should be of two types: Batten lamp-holder and two- or three-pin 5 amp. Secondary switching should be provided at some of these points, so that when testing apparatus, it can be switched off quickly if anything begins to smell hot. By the same token, a 5 amp. fuse should be fitted in both mains leads between the inlet point and the station main switch.

Earthing

This is most important if accidents are to be avoided and the gear itself is to be stable. A heavy gauge insulated lead should be clipped to the nearest cold water pipe—it will not be possible to solder it—and a bare wire lead (a length of 7/22's aerial wire will do admirably) run along the first upper shelf of the bench; this will enable earth connections for apparatus to be easily made by means of clips or screw connectors. All HT negative connections and any chassis carrying power packs should be permanently bonded to the earth line. If the power inlet is three-point, as it should be in a house wired in accordance with the latest regulations, the fat pin on the plug is the earth connection. It should be left untouched, since with an AC supply all the radio apparatus in the station will be fed through transformers, and thus will have no direct connection with the mains. In other words, the station earth should be kept for everything on the station side of the power transformers.

Choosing Tools

While the tools actually needed depend upon the scope of the work which it is proposed to carry out, it is at the same time a good thing to have as many useful tools as can be obtained. In these days, small tools are neither as cheap nor as easy to get as they used to be, but it should be possible to find without difficulty a soldering iron, three sizes of screwdriver (one with a long shaft), two or three pairs of pliers in different sizes and shapes, a steel rule, a hacksaw, a brace or breast-drill and set of drills in sizes from $\frac{1}{16}$ in. to $\frac{3}{8}$ in., files in three sizes, a centre punch, light hammer, and calipers. Not all of these are essential, but they will always be found worth having.

Additional items which may or may not be obtainable are a small electric pistol-grip drill taking drills up to $\frac{3}{8}$ in. or $\frac{1}{4}$ in. (a priceless asset), a table vice, a wood rasp, a metal reamer tapering from $\frac{1}{4}$ in. to $1\frac{1}{4}$ in., a pair of metal shears, a steel square, an adjustable radius cutter, and a large pair of spring-loaded pincers.

If much of the constructional work is to be in wood, other requirements are a small saw, chisels, fretsaw, plane and mallet.

While one cannot go wrong in having plenty of tools, it is a fact that much useful work can be done with only a soldering iron, screwdriver, pair of pliers and a penknife. But when it comes to making and drilling chassis, whether in metal or wood, and undertaking the more complicated jobs which progress in constructional work will demand, a rather more ambitious range of equipment is necessary.

As to where and how to obtain tools, a visit to the local ironmonger for his advice will be useful even if it does not produce everything that is required.

Workshop Material

One of the items most needed in wireless is wire. This should be purchased in $\frac{1}{2}$ lb. reels in the lighter gauges from 24 to 14 SWG, and the most useful insulation finish is not DCC or DSC, but enamelled. A pound or two of hard-drawn bare copper wire in gauges from 12 to 8 SWG will serve to make up self-supporting air-spaced coils for the transmitter and 28-58 mc receiver. Then there will be the need for a stock of a dozen or so yards of lighting flex and, for connecting up, single wire insulated with rubber or plastic compound. Wires in all these sizes and categories can often be obtained from good ironmongery stores, if not from the local radio dealer, and in any case from advertisers in this issue.

A good assortment of BA brass screws, nuts and washers is also necessary. These should be in sizes from 8 to 2 BA, and in lengths from $1\frac{1}{4}$ in. to $\frac{1}{4}$ in., either round head, cheese head, or countersunk. A few dozen of each will suffice for stock—remember to provide plenty of washers, at the rate of 2 doz. of washers to one dozen of screws. In regard to wood screws, two or three dozen in 1 in. to $\frac{1}{2}$ in. lengths, size 7 or 8, and again either countersunk or round head, will be useful. Try the ironmonger again for all this material.

The next requirement is metal and bakelite sheet and strip, and light gauge enamelled steel for chassis and panels. The right gauge for aluminium sheet is about 12's, and for steel, 14's or lighter. If the metal is too thick, it is very difficult to work. On the other hand, if too thin, it will not support heavy pieces of equipment without buckling. Aluminium in the sheet is hard to find at present, though there are enormous dumps of it about the country, but it should become in good supply soon. It is preferable to steel for constructional purposes in that being softer, it is easier to work. Bakelite sheet is quite easy to get through certain of the advertisers in the *Magazine*, and the best thickness is ⅛ in. In the strip, it is extremely useful for small panels, for carrying a row of terminals, mounting components which need to be insulated from the metal chassis, and a hundred and one other similar purposes.

Another useful acquisition in the line of material is a quantity of insulated sleeving in various lengths, bores and colours. It is also easy to obtain now, since it was very largely used on Service apparatus.

There are many other items of equipment and material which will suggest themselves as being either useful or necessary as time goes on, though they may not be generally available. An occasional tour round the ironmongers and household stores will often produce something worth having in the way of tools, small fittings and metal sections of various dimensions.

A good rule in starting a workshop, or re-stocking an existing one, is not to buy too much of anything at first. The material one really needs is usually in reasonably good supply, so that it is a waste of money and space to overstock, as there is always the possibility of finding that one has too much of one item.

Learning Morse

Some Ideas for the Beginner

By **FRANK AUSTIN**

THE tears that have been shed over the learning of the code are only equalled by the ink and "beans" which have likewise been spilt on the same subject.

Sooner or later, every enthusiastic SWL worth his salt longs to be able to decode the weak CW DX he so often picks out in his search for the 'phone stations. Who is that fellow, sending so slowly and with such a pronounced echo on his signal ? Is he a VK, a W6 or just another G whose signals have been reflected right round the world to the place from whence they went forth? What a thrill to be able to identify Antipodean signals on 28 mc, where they are still real DX! And what is all this chatter about on 600-metre spark, and what does Portishead say to the ships on the Atlantic run? We know that loud signal on about 4 metres is a police station, but what is he telling the patrol cars?

These and a thousand other questions must have flitted through the minds of nearly every listener with a CW receiver, always to be answered in the same way—"I don't know, because I can't read Morse."

While we cannot here give you the key to all this in so many words, we can at least make some suggestions as to the easiest way in which to tackle the problem. Note, however, that learning Morse is not so simple that it can be picked up by anyone in five minutes. It requires patience, application and the rigid determination to follow a prescribed course of study,

THE MORSE CODE

A	. —	O	— — —
B	— . . .	P	. — — .
C	— . — .	Q	— — . —
D	— . .	R	. — .
E	.	S	. . .
F	. . — .	T	—
G	— — .	U	. . —
H	. . . .	V	. . . —
I	. .	W	. — —
J	. — — —	X	— . . —
K	— . —	Y	— . — —
L	. — . .	Z	— — . .
M	— —		
N	— .		
1	. — — — —	6	— . . . .
2	. . — — —	7	— — . . .
3	. . . — —	8	— — — . .
4	. . . . —	9	— — — — .
5	. . . . .	0	— — — — —
Bar (/)	— . . — .	Question (?)	. . — — . .
Full Stop	. . . . . .	Exclamation (!)	— — . . — —
Break sign	— . . . —	Ending transmission (SK)	. . . — . —

(*Note.*—Above is only what is required for ordinary amateur working. Most amateurs use the "break sign" instead of a full stop.)

though the method suggested below has the attraction of making it possible to read call-signs in a very short time; anything from a few days to a week or two, depending on the learner's ability and honest effort.

Preliminary Points

The first step is to disassociate the mind from any previously conceived ideas or methods; it is no use trying to learn the code by opposites or by mnemonics (words suggesting letters) as is so frequently recommended. Or rather, it would be fairer to say that either of these two methods, while eventually giving results, also involves *secondary mental processes*: That of remembering A is opposite to N in the Morse sound equivalents, or that "Queen-Queen-the-Queen" suggests Q. It's all quite correct, but why worry the already overburdened brain with lists which must first be learnt by heart and then unscrambled in order to get at the required letter!

It follows that if these intermediate processes can be eliminated, learning will be quicker and easier. The beginner should not even try to visualise the code, nor should he think in terms of "dot-dash" for A, or "dash-dot-dot-dot" for B.

What does one actually hear when listening to CW signals? "Dah-dit-dah-dit Dah-dah-dit-dah" in a high-pitched singing tone, made audibly by the tongue and lips, would be readable instantly as CQ by any listener knowing Morse. Try it and see.

Learning by Sound

This, then, gives us the key to the first part of the lesson. The Morse Code, consisting of the alphabet, numbers and most commonly used stops, is given with this article. Get it into your mind that a dash is "dah," and about three times as long as a dot, "dit." Also, that the space between the dah's and dit's of the same letter is one dit, between the letters of the same word two dit's, and between the words of the same sentence three dit's. It is quite permissible to increase this spacing a little, as it makes for legible sending. Anyway, spacing comes with practice, and a little reading ability will help to give guidance in this.

The next thing to do is to learn the code thoroughly and by heart, so that the sound equivalent of any letter can be uttered—in that same high-pitched singing tone—at sight. The practice is carried out, not with key and buzzer or by the help of any friend, but by "singing" to one's self, audibly, the various letters in their Morse equivalents. In this way, the *sound* of the letters is gradually impressed on the brain, and there is never any question of visualising the list, remembering words, counting the number of dots and dashes, or using any similar alleged "memory-aiding" process. You just go straight for what you want to know: the sound of each letter.

Of course, your family and friends will seriously consider sending for a specialist in mental diseases when they hear this singing business going on, but then all radio enthusiasts are generally thought to be "crackers" by the uninitiated.

Practice

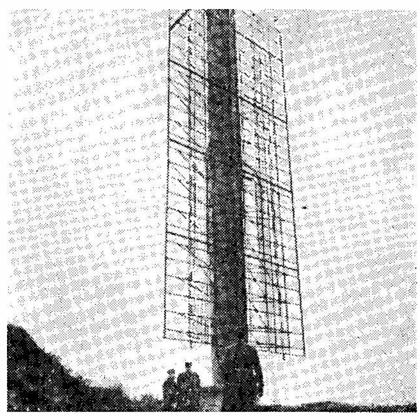
Having thoroughly learnt the code in this way—do not bother about numbers and stops at first—get the receiver going on the CW signals, and listen for what you can pick out. All round the short wave bands you will hear commercial stations "idling," i.e., sending "VVV de SUC," "ABC ABC ABC de OXB," "VVV de WIK," and so on, the whole sequence being repeated over and over again. Sometimes, the sending is rather fast, but often the transmitter is slowed right down, and then a little concentrated listening will soon identify what is being sent and the call of the station. Note that you are definitely recommended at this stage to listen for repetition signals, such as the above, because in that way—particularly if they are commercials—your time values will be corrected and you will know how properly spaced Morse should sound.

In the amateur bands, "Test" and "CQ" calls can be heard at any time, though the sending is not always good from the point of view of formation and spacing. "Test," if it is a G station, and "CQ" in the case of a foreigner, is repeated several times, followed by "de" and the call-sign sent twice or thrice; the form is therefore "Test test test de G6ZE G6ZE G6ZE," all repeated three, four or five times, and sometimes with the hopeful "DX" slipped in between "Test" and "de." Foreigners use the same formula, except that it would be "CQ CQ CQ DX de W2XZX W2XZX W2XZX."

A Minimum of Aid

It is in the reading of amateur calls that you can practise numbers, so that this should be the next thing to learn, stops and punctuation marks following when the last stage is reached, that of listening to complete QSO's. For QSL'ing CW transmissions, however, all that is required is to be able to identify the station—and preferably the one being worked as well—such matters as the RST, etc., not being dependent on further reading ability.

It will be seen that if this method of learning Morse is adopted, it is not necessary either to have outside assistance or to use a buzzer ; it can all be done from the receiver after the Code itself has been absorbed. This has an important secondary result—the beginner who can read before he sends will develop into a good operator much more rapidly, because he will start with the advantage of knowing how properly sent Morse should sound. This brings out the obvious point that two beginners, learning together on the key and trying to send before they can read, are wasting time and impeding each other's progress, because neither can possibly send well enough to give the other really useful practice. Allied to this is the fact that they only learn to read one style of sending—that of the partner.



Puzzle Picture—What is it ? Answer on page 56

TELEVISION TEST TRANSMISSIONS

We are informed that Alexandra Palace is now active again to the following schedule : Weekdays only, 11.0-12.0 a.m., 4.0-5.30 p.m., 41.5 mc (7·23 metres) for sound, and 45 mc (6·67 metres) for vision. These are test transmissions only, and mainly for the benefit of the trade. The picture is a black-cross-on-white-ground still, and the accompanying sound is a tuning note and interval signal. These transmissions will, however, be useful for calibration purposes and the checking of our 58 mc receivers for performance. We shall be very glad to have reception reports for ranges in excess of 50 miles from Alexandra Palace.

DX COMMENTARY

ON CALLS HEARD, WORKED & QSL'd

ON THE AMATEUR BANDS

By H. A. M. WHYTE (G6WY)

Nearly six and a half years is a long time in anyone's life, but we can be quite certain of one thing—that the seeds of Amateur Radio sown in the war years are now producing a harvest of new enthusiasts ready to go on the air. This means that Amateur Radio as we knew it before the war cannot be the same again. More amateurs mean more QRM. Therefore, a high standard of operating will be required by all, so that our policy for this monthly feature is not only to report the good signals, but the bad ones as well. The most satisfactory system of policing is self-policing, so if you hear a bad signal from a nearby amateur—remember he may be in trouble—help him all you can. Don't be frightened to give an *honest* report; if you think his signals can be improved, tell him so; but please don't give misleading reports. You know there are some types who will believe one wrong report (if it flatters their signals) and disbelieve all the other honest ones!

We intend to try to meet two definite requirements each month: First, the reporting of all interesting calls heard, and secondly, general information on anything which may be considered as useful to help amateur transmitters and to improve operating technique. This commentary is therefore "soap box"; it can only be successful if you contribute your ideas and tell us what you hear.

Calls Heard Lists and SLP's

It is proposed to publish lists of calls heard, and a few of the best will be selected each month for their general interest. For the purpose of receiver and location comparison, it is proposed to reintroduce the Set Listening Periods which we ran before the war. This feature will be valuable on 28 mc as it appears that strong signals at one place are frequently inaudible a mile or so away. It is not intended to have set listening periods on any bands other than 28 mc for the present. Will you therefore let us know what you hear on 28 mc on Sunday, March 17, between 13.00 and 16.00? A selection of the best logs will be published.

Transmitting Licences

After a patient wait, the Post Office started issuing our licences again during January, and the number of amateurs active is steadily increasing. It is good to hear old familiar voices and "fists" again after so long. Some G's were not quite so patient, however, and they burst forth on 14 mc, mostly around 14,100 kc, and quite a lot of DX was worked. Of course, they did not use their real calls, but it is a pity when the calls of other nearby amateurs are used for illegal purposes of this kind.

Although our licences cover operation on "five" and "ten," we have reason to believe that it may not be long before other amateur bands are released to us by the G.P.O. We *might* have some of the lower frequencies back before the summer. When you come to think of it, it's a good thing to have to start up on five or ten metres, because if we get efficient results on these bands, we shall certainly have no trouble at all on the lower frequencies when they come along. It used to be the other way round—a transmitter was slung together and gave results of a sort, but failed to work when converted to higher frequencies. How frequently was it heard said before the war, "I don't operate on ten because I can't get my Tx to go down there." Now we have no option, and it should make for greater efficiency.

Service Requirements

We should have had more of our old frequencies back if it was not for "Service requirements." During the war, the Services used our bands freely, and had enormous numbers of crystals ground for operation within these bands. It therefore takes time for the Services to change back, as some will know who "served their time." We understand that there is every hope that this exit from our territory will be taking place by the time this appears in print. We think we may safely say that the G.P.O. is on the side of the amateur, and has no intention of frustrating him, as some cynics may think; furthermore, the relationship between the Radio Society of Great Britain—which has done so much to keep the flag of Amateur Radio flying during the war—and the Post Office has never been better, and the amateur can expect a straight deal from the authorities, provided he plays the game.

The Worth of the Amateur

We cannot conceive that anyone will in future speak disparagingly of the British amateur. This war has proved that semi-skilled enthusiastic radio men can be trained into first class technicians for the Services. Many entered the war with great enthusiasm and practical knowledge and did a great job—not always in a service-like way, be it said, but was this a disadvantage? Many amateurs, having only knowledge learned while "playing" in their own homes, achieved senior rank with great responsibilities and to our own knowledge did a great job. In other words, the British radio amateur has established his place in the community, and should receive the maximum consideration from Government.

With such a good start for the post-war era of Amateur Radio, let us see that we behave ourselves in all ways, especially on the frequencies which can easily be heard by standard short-wave broadcast receivers.

"Phoneys" and Others

November, 1945, may be said to be the beginning of amateur activity from a world angle. This month produced excellent DX conditions, and some very good calls. Service amateurs, notably Americans, radiated genuine signals from their theatre of operations in the Pacific. Signals have been received from such places as Leyte, Philippines, Iwojima, and Saigon, while it is quite common to-day to hear operators signing their own home calls, suffixed by the prefix of the country in which they are stationed. One example is 6CU/ZC2 in Cocos Island, Indian Ocean—he is ex-G6CU—working on 28 mc. Others on 28 mc include W6RNJ/PY7 and W9KXN/CT2. British amateurs do not seem to have the same liberty of action in "foreign parts" as our American friends, but perhaps some of the stranger calls do emanate from British service men. Some D4s are on, but we cannot believe that these are operated by Germans, but must be by Allied personnel working in Germany unofficially. However, let us work all we can—we may be quite surprised at the QSL cards we receive!

Some of these queer calls may produce new countries when we get confirmation. We understand that EP5SO is quite genuine in Persia, and the Andaman Islands have had their own amateur in PR1VY at a seaplane base. Turkey, which was frequently the phoney's choice before the war, has again been producing some "TA" calls. It may be that these will turn out to be genuine. Italy furnishes us with quite a lot of activity on 14 mc, while genuine Portuguese have also been heard. Norwegians are active, but they are only supposed to use 5 *watts*! Egyptians with SN1MW, SU2GV and SU1EC are working on both 14 and 28 mc, so we shall have plenty of fun as the number of strange and genuine calls increases. Although U.S.A. and Canadian amateurs are not allowed on 14 mc at the time of writing, VO1S was heard putting in an S8 signal on 14 mc during January.

On 28 mc, SU1MV's 'phone was S8-9 at 1500 on February 14, and ZS2X—a regular signal on 10 metres—S6 on CW at 1510. On February 24, XACD on CW was a good S7-8, giving his QRA as "Greece"; fair enough. OQ5BQ was also heard. The same Sunday afternoon yielded a crop of LU's between 1445 and 1615, some of whom (LU7AZ in particular) were above S5 on CW; in the main, they worked W's. On February 25, G6CU/ZC2 was a very nice 'phone signal, at S7, all the morning. The next day, W6PQV was heard at S5-6 CW at 1105, from the Pacific area.

QSL Cards

It cannot be denied that there is a large streak of the collecting habit in most of us, possibly in all of us. We know there are superior people who claim to have no interest in QSL cards, but we sometimes wonder whether this is a pose! However, one thing is quite certain—the popularity of QSL cards will never diminish, but go on from strength to strength. We want to give you the addresses of unusual stations heard, so will you let us know the QRA's you overhear so that others may know where to direct their cards?

May we point out to newly licenced amateurs who operate on 'phone that they must expect to have to deal with SWL reports, which can be of great assistance if well rendered. There can be very few amateurs who have not begun their hobby by being SWL's in the first place, and we know how much we appreciated the coveted QSL card thanking us for our report. Please remember that a card in reply to a SWL report is not only a courtesy but a kindness—even if the report isn't of great value. Remember, too, that you probably started that way. We do stress, however, the need for care by the SWL in rendering a report worthy of the attention of the recipient. Make it as accurate and detailed as possible.

We are prepared to publish reproductions of QSL cards from rare or unusually interesting stations. Similarly, good station photographs are wanted for publication; these must be clear, well-defined prints.

Conditions

It is too early yet to make a forecast o probable DX conditions for 28 mc. The band has behaved in its usual unpredictable way. January was dead, but February produced signals from all parts of the world, although the band was never the same from one day to the next. Asian signals, represented by 6CU/ZC2, came through as early as 09.30 GMT, and North Americans have been heard up to 18.00 GMT. South Americans have been there from 13.00 to 15.00. When Australia is heard, it will no doubt be before noon, as in pre-war days.* Africa may be expected at any time in daylight. Now that so many stations *have* to operate on 28 mc, it will be interesting to study conditions during the summer months. Usually, a much shorter skip prevails, and Europeans can be worked, probably by reflection from the "E" layer (approximately 40-60 km up).

Local Contacts

It cannot be too strongly stressed that care should be taken not to use 28 mc for long-winded local contacts when DX is coming through; at least, not more than is absolutely necessary to get a report. 28 mc permits of DX irrespective of power used, so do not think that your flea-power will not bridge the Atlantic. It will, if your aerial has a lobe going that way. When the band is dead, however, it is to be hoped that we shall have a lot of local activity. Much useful data can be obtained by local and semi-local working; fading has been noticed after dark on signals as near as 10 miles. Of course, 56 mc provides plenty of space for short-range activity, and we hope that much use will be made of this band.

In addition to calls heard, we want in this feature to publish details of your snags and bright ideas; so remember, the more information you send us, the more there will be for everybody.

Telephony

With the production of high efficiency valves, most amateurs are equipped for telephony transmission these days. In the past, in the 1920s, it was not so, and many transmitters used CW on 14 mc and 'phone only on the lower frequencies. Newcomers to Amateur Radio will probably be surprised to know that two-way 'phone contacts between cont tinent and continent were almost unknown —all DX work being on CW. The advent of international telephony contacts brought with it the disadvantage of more QRM; this factor in turn gave rise to more selective receivers and beam aerials. But the fact remains that we are all faced with a very grave problem when 5,000 British amateurs "take the air." We must face up to this problem and recognise the right of everyone to enjoy his place in the spectrum. Do not indulge in lengthy discussions—keep your remarks short and to the point, and change over quickly. Avoid repetition and if you have not got anything useful to say—don't say it, but confine your remarks to the report. Another point—always sign your call distinctly and phonetically, and use correct operating procedure when changing over. We shall campaign against the unnecessary use of Americanisms such as "take it away." We have a perfectly good language of our own and though we have every respect for our American friends, must we copy their methods? They do not respect us for it, either. There are too many nasalised G's on 28 mc 'phone already.

Correspondence

All correspondence for this feature should be addressed "H. A. M. Whyte (G6WY), c/o *The Short-Wave Magazine*, 49 Victoria Street, London, S.W.1." We hope our post-bag gets heavier and heavier as the months go on.

**G2MV worked VK4RC on the morning of February 14.—Ed.*

Two Valves for Ten

Simple CO-FD Arrangement Giving 25 watts at 28 mc

By **AUSTIN FORSYTH (G6F0)** *Editor*

ILLUSTRATED here is an effective low-power CW transmitter which can be used for preliminary work on the 28 mc band, and which will also serve as a drive source—giving more than ample output—for a third unit operating as a PA on either 28 or 58 mc.

The circuit arrangement is basically CO-FD, with both valves doubling from a 7 mc crystal. The CO is tritet, and the FD follows another direct-coupled doubler.

While it is not by any means desirable in the ordinary way to feed the aerial directly from a doubler, in this case it is possible because of the high output obtainable from the FD stage. This means that when operating the FD at maximum permissible input (50 watts) for the valve, RF output is not being killed, because the drive from the preceding stage is high enough to maintain reasonable efficiency.

These results derive from the use of a pair of KT8c (the "c" is for ceramic base) valves, connected in the circuit shown and with the form of construction suggested by the photographs. It may be remarked here that considerable time has been spent in arriving at the right values for best results and, whatever form of construction is adopted, the circuit and its values should be adhered to, even if the transmitter as built does not follow the model exactly.

In fact, apart from the valves, which in this case are the key to succesful results, it is not proposed to specify particular components, but only their values, since it may be of interest to readers to know that this transmitter was built *throughout* from pre-war components, some of which are not now available in the actual types illustrated. The point is that the design is intended to serve as a guide for the construction of a similar outfit using KT8c valves, and other components of good make (but the right value) can be readily substituted for those recognisable in the photographs.

Circuit Points

There are one or two points to mention in regard to the circuit, which is conventional, except that the screen grids of the KT8's are fed by series resistors (R5, R6 in the circuit diagram) instead of a potentiometer arrangement. This is a distinct economy and simplifies construction, since no bleed current has to be allowed for and it is not necessary to use resistors of high wattage rating. The heaters of both valves are earthed, since this was found to increase RF output. Additional bias is obtained from cathode resistors, which help to safeguard the valves, and jacks are provided at the required points for keying and metering.

The coupling between V1 and V2, and hence the drive to the FD, can be controlled by C3 or the tapping point T, preferably the former. C4, the output tuning capacity, is a split-stator variable condenser with the rotor providing the earth return for the output tank circuit. This improves stability, ensures proper balancing of the circuit, provides for neutralisation if needed when the stage is operated as a straight PA, and makes for easier tuning. As for the present V2 is being operated as an FD, there is of course no need to neutralise it.

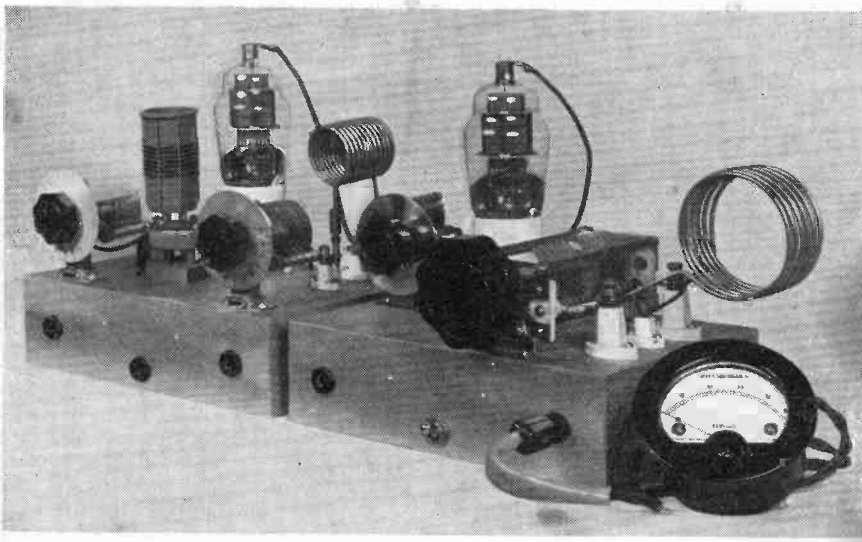
A MAGAZINE Design

It will be noted that the CO takes a plate voltage lower than the FD. The main reason for this is to prevent over-excitation of the crystal, but it is in any case not necessary to use a higher voltage on V1 since the drive is already more than enough for the doubler. The CO could in fact be worked at voltages down to 250, and still provide sufficient second-harmonic output for the FD.

A word about the KT8c's. They are extremely efficient beam tetrodes, indirectly heated, with a British 5-pin ceramic base and top anode. They are good for up to 600 volts on the plate at these frequencies, and have 6·3-volt 1·27 amp. heaters.

Construction

The main point here is to emphasise the importance of keeping a compact layout, even if it does not follow the illustration. The lead between T on L2 and C3 *must* be as short as possible; it is equally important to keep all RF carrying leads short, and it is also desirable to bring all earth returns in each unit—considering the CO and FD as separate items—to a common earthing point.



The photographs are clear enough for most of the constructional detail to be followed. The chassis used for the model are of heavy die-cast aluminium and are only 8½ in. by 5½ in. by 2 in. deep; an excellent Eddystone pre-war production, ready marked for drilling and complete with insulated strips for the terminals. All the coils are home-made to the dimensions given in the table of coil values, and the method of mounting L2 is to use valve pins fitting into valve sockets taken off an old Eddystone baseboard mounting valveholder. These sockets are set at the correct centres for the coil and are carried on midget insulators. This makes a neat and tidy job, and coils are easily changed. The output tank coil L3 is near enough to the camera for the method of its mounting to be clear. L1 is wound on a standard former, spaced as shown in the photograph, and mounted in a baseboard-type valveholder.

The overall efficiency obtained by adopting this general method of construction is well illustrated by the figures given in the table of operating data, which were taken from the model as illustrated. Moreover, the CO *will* give a fourth harmonic at 28 mc, and the FD quadruples from 14·5 to 58 mc. But more about that next month.

In the particular case of the model, LT was supplied as a matter of convenience from an external LT transformer which gives a wide range of voltages and outputs for general test and experimental purposes. In regard to the middle jack on the CO unit, this was originally fitted for keying in the cathode of the oscillator, but in the final version this was not found necessary. The HT switch on the FD is not required if the HT feed is already switched on the supply side. The switch is not shown in the circuit diagram for this reason.

The crystal in its holder and mount is a standard Q.C.C. unit of pre-war days, and can be seen between the two condensers, which are C1 and C2, on the left-hand chassis.

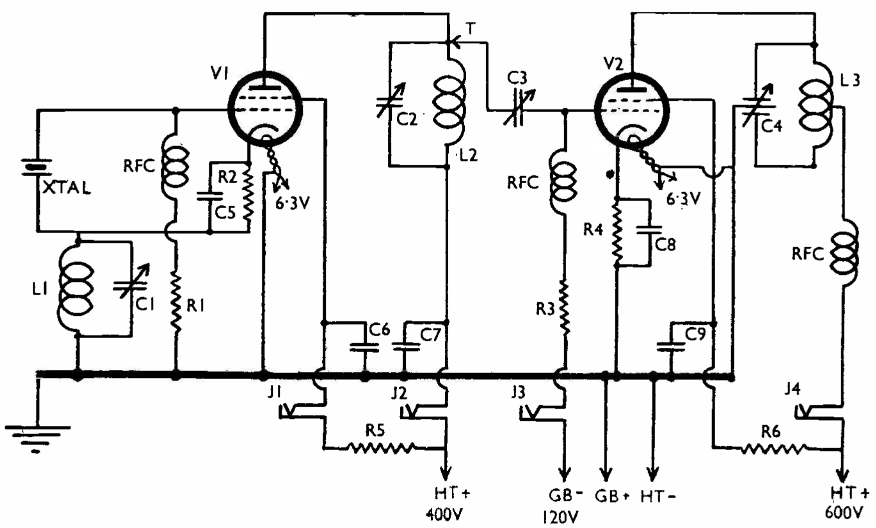
Operation

Start with the CO only at first, switch on LT to V1, and then apply HT with the meter jacked in at J2 and the key at J1. On pressing the key, plate mA will rise to a high value unless the setting of C1 happens to be about right. Swing C1 from minimum towards maximum capacity, when a point will be reached where the plate mA needle drops back. Move C1 beyond this point, towards maximum capacity, and then listen to the note in the monitor. It should be clean and sharp. Adjust C1 towards maximum till this is so; never mind if the plate current does increase a bit.

Now to find the second harmonic on C2/L2. As C2 is rotated from minimum to maximum, two or three *downward* flicks of the meter needle will be noted. These indicate that various harmonics of the crystal are being passed. The deepest dip is *probably*, but not certainly, the second or 14 mc harmonic, which is the one we want. It must be checked with an absorbtion wavemeter to be certain. Set C2 for minimum plate current for the correct harmonic.

Now for the FD. Apply LT to V2 but not HT, yet. Clip T on at the "hot" or plate end of L2 and set C3 to maximum capacity. Retune on C2 to find resonance—that 14 mc harmonic again—and then move the meter to J3. It should show from 5 to 8 mA grid current, in accordance with the figures given in the table. Now listen on the monitor again. Swing C4 and a point will be found where the note

(*Concluded on page* 44)



Page 43
Missing

Page 44
Missing

Design

The appearance and workmanship of all the equipment on view was uniformly good, and it was interesting to see that some designers in the Amateur Radio field have been developing their own ideas, rather than plagiarising the Americans. Nevertheless, so far as the strictly Amateur Radio aspect of the Exhibition was concerned, there were distinct signs of a tendency to follow American fashions. Not that this is in itself a bad thing, but the other trend is of course rather to be encouraged, as it is high time that we in this country had more manufacturers producing equipment for our particular needs.

Amateur Influence

Another interesting sidelight on "current affairs" in this section of the radio industry was the large number of holders of callsigns officiating at the various stands. Your reporter met several, from a G2 with a callsign famous among the old hands, to some G4's and G8's with very sound ideas about the future development of Amateur Radio.

To your representative, it was also very gratifying to renew some old business acquaintanceships and to find that not only had the pre-war existence of the *Short Wave Magazine* not been forgotten, but that its reappearance was being awaited with considerable interest.

This short and quite inadequate note upon what was a most useful and instructive show would not be complete without a word for the organisers of the Third Private Exhibition of British Radio and Communications Components, Accessories and Materials—to give it its full official designation. The R.C.M.F. is to be congratulated on its enterprise in arranging these affairs, and we hope that there will be many such. We feel that they are more useful and effective from the point of view of all seriously interested in radio than the Olympia Exhibition of pre-war years, which by 1939 had degenerated largely into a display of fancy cabinet work.

AMATEUR BAND CRYSTALS

We are glad to be able to announce that amateur band crystals are in good supply. Messrs. Quartz Crystal Co., Ltd., have reintroduced their P5 power-type crystal, which is a modified X-cut with a temperature coefficient of 20 cycles per megacycle per degree centigrade. The crystal is fitted in their Type U dustproof interchangeable mount, and the complete units are available with fundamental frequencies in the 1·7, 3·5 and 7 mc bands.

Units from stock frequencies can be delivered in three days, price 32s. 6d., and for specified frequencies in seven days, price 37s. 6d.

Q.C.C. crystals are also obtainable from Messrs. Webb's Radio, 14 Soho Street, London, W.1.

★ ★ ★

A NOTE FROM GERMANY

The authorities in the British Zone have decided to allow holders of pre-war British callsigns to operate from Germany, using the prefix D2 followed by the letters of their original callsigns. Thus, if G6WY were operating from Germany, he would use D2WY as his call. The licencing conditions regarding frequencies, power, etc., follow exactly those recently approved here. Though we understand that no official information has yet been given from the American Zone, it is believed that the D4's now to be heard are American operators working under the same conditions as the new D2's.

John Clarricoats of the R.S.G.B. also informs us that now the licence conditions have been agreed for this country, it is expected that the Colonial Office will shortly authorise colonial administrations to grant local licences on similar terms.

All good news, which augurs well for the future of Amateur Radio.

★ ★ ★

A WORD OF THANKS

Speaking for many amateurs who have remarked upon it, we should like to pass a word of thanks to the officials of the Post Office for the manner in which amateur equipment was cared for while impounded. Apart from the inevitable small breakages—it may not be generally known that in some districts the equipment had as many as three moves while in G.P.O. custody—gear was returned in very good condition, and accounted for in full. This is all the more creditable when one remembers the rush conditions under which it was collected.

Some Notes on UHF Propagation

Accepted Theory as Applied to 58 mc

THE opinion is held in some quarters that there is a fundamental difference between wave propagation on 58 mc and that on lower frequencies. Reception on 58 mc does not, at times, appear to correlate at all with that obtainable on other bands, and this is particularly the case in summer. Let us therefore endeavour to tidy up our ideas on the matter by considering briefly the mechanism of short wave propagation and the factors which affect it.

We will neglect the ground wave and consider only that part of the radiated wave which is propagated by the ionosphere. This is quite justifiable, because the ground wave is completely attenuated, and is not likely to provide reception at any great distance from the transmitter, particularly on 58 mc. Another justifiable assumption is that weather conditions play no part in the propagation of short waves, since most of the ionosphere layers are many miles beyond that part of the atmosphere which is affected by weather.

It may be taken that short waves are usually refracted by the F layer. With a given degree of ionisation prevailing in this layer waves up to a certain frequency are refracted back to earth. Raising the degree of ionisation increases the highest frequency which is refracted.

Critical Frequency

The highest frequency which the layer will refract from a wave sent vertically upwards is known as the *critical frequency*, and is a measure of the ionisation prevailing in the layer. If a wave is sent out at a small elevation angle (angle to the horizontal), it will strike the layer at an angle. The latter is the *angle of incidence* and is measured from the normal to the layer boundary. Under these conditions, the layer can refract a much higher frequency than the critical frequency. Thus, the greater the angle of incidence, the higher the frequency that can be refracted. Owing to the curvature of the layer round the earth, there is a limit to the angle of incidence that can be obtained, and the highest frequency that the layer can refract at the greatest angle of incidence is the *maximum usable frequency*.

Ionosphere Variations

As is well known, the ionisation of the layer—and hence the value of the critical and maximum usable frequencies—undergoes diurnal, seasonal and long period changes. At the sunspot maximum the ionising radiation reaching the layer is greatest; thus the ionisation is greatest. During the winter, the air in the layer is densest; consequently it is capable of absorbing more radiation and its ionisation is therefore higher than in summer. Also, during the day when sun is affecting the layer, the ionisation is obviously greater than at night.

From all this, we see that the ionisation is greatest during daylight, in winter and at periods of high sunspot activity. It is lowest during night, in summer and for periods of low sunspot activity. We will consider only periods of high sunspot activity—like the present—and take it for granted that the highest daytime ionisation occurs rather nearer the equinoxes than in mid-winter.

If we examine curves which show the hourly critical frequency for all seasons of the year, we shall see that it is quite commonly in the region of 14 mc in February, March, October and November. The maximum *usable* frequency at such periods is therefore often as high as 43 mc. Frequencies of this value are, therefore, well refracted at these times of year—for waves radiated at low elevation angles —and so are all frequencies below this, until a point is reached where the attenuation becomes severe. This may be as much as 30 mc below the maximum usable frequency.

Deduction

It therefore seems that in February, March, October and November, frequencies from about 13 to 43 mc are well propagated by normal F layer refraction. The ionisation of the layer is not, however, by any means constant, and it is quite feasible that it may rise so high as to take the maximum usable frequency up to 58 mc. In fact, as the seasons mentioned are known to produce good results around this frequency, it seems strongly indicated that 58 mc propagation at such times is by normal F layer refraction.

The case is altered in the summer months. The critical frequency of the F layer is then highest just before sunset and lies in the region of 8 mc. The maximum usable frequency is only about 22 mc, and it is extremely improbable that the ionisation is ever high enough to refract a wave of 58 mc.

The Sporadic E

There is another phenomenon which may account for this, however. The ionisation of the normal E layer is much below that of the F and is never high enough to refract a frequency of this order. But in the summer the E layer (and the region just above it) is often in a very disturbed state. This is such that ionised "clouds" are formed—patches of ionised air which exhibit markedly different characteristics from the normal layer. These may cover very large areas and may persist for quite a long time. They are particularly prevalent near sunset in summer and are known as *sporadic E.*

The ionisation prevailing in the sporadic E may be much greater than that in the normal F layer, and furthermore, as it lies at a lower effective height, a much more useful angle of refraction will occur for a given elevation angle than could be produced by the F. Thus, the sporadic E is capable of refracting much higher frequencies than the F layer.

The indications are, therefore, that summer long distance communication on 58 mc is by the sporadic E. The reception is erratic, which is what one would expect from the nature of the refracting medium, and the early evening will probably give the best results.

It is evident that there is much useful and interesting exploratory work to be done for amateur communication purposes in the 58-60 mc band, and in some future notes, an attempt will be made to correlate results with known ionospheric conditions.

PERSONAL NOTE

The Editor would like to thank most sincerely all those kind people, pre-war readers and Trade friends, who have written with good wishes for the future success of the *Short Wave Magazine*; many of them have also embarrassed him by their generous remarks regarding his recent decoration.

Looking Back

A Veteran recalls the Achievements and Highlights of Twenty Years of Amateur Radio

PART I

By **L. H. THOMAS, M.B.E. (G6QB)**

AS far as I am concerned, it all started in the year in which the BBC was born—1922. In that year I became the possessor of an experimental receiving licence, a collection of parts sufficient to build a single-valve receiver, and 100 feet of 7/22 copper wire. From that time until now I freely confess that the germ of Amateur Radio has never been completely out of my system.

To listen at all in those days meant getting closely acquainted with the amateurs. To the schoolboy or the teen-ager in his first job they were the heroes of the generation. For apart from 2 Emma-Toc-Writtle-near-Chelmsford, on the air every Tuesday evening, and occasional broadcasts from Marconi House (the first 2LO), there was practically nothing in the telephony line except the amateurs. Nor was anything wanted, for they were the supreme source of entertainment, education and thrills.

Listening, as I did, in South London, I remember most vividly 2OM at Brentford—owner of a wonderful collection of gramophone records including the memorable one of Galli-Curci singing "Una Voce Poco Fa"; 2KF at Merton, 2ON at Walthamstow, 2BZ at Marble Arch Pavilion, and the loudest voice of them all, 2FQ of Blackheath. By contrast to the marvellous apparatus which I felt sure was owned by all these giants, my own "station" consisted of a single "R" valve as detector, with home-made plug-in basket coils, a home-assembled variable condenser and a pair of Brown's-A phones, dating from the 1914-18 war. Not much of a magic carpet to our way of thinking nowadays, but I wouldn't have changed it for a Rolls-Royce.

The days in which amateurs worked on 1,000 metres were just over. There had been too many cases of interference with Croydon on 900 metres, and in any case the rival "short-wave band" of 440 metres was looking far more attractive. So there they all were, in theory on a fixed wavelength of 440 metres, but actually spread around somewhat. There was even talk of some ridiculous wavelength of 150-200 metres, but people who could persuade a receiver to oscillate down there were few and far between, so for a while one didn't take it seriously. The 440-metre band became a little more approachable with the coming of a few amateurs in my own neighbourhood—real live people that I could go and call on !—and that was my real undoing. It dawned upon me that even I could become an amateur one day. My Morse was well up to the 12 w.p.m. stage, and I could convince the GPO as well as anyone else that I had some pressing need for the radiation of wireless signals. And so, in 1923, the first step was mounted. An artificial aerial licence, with the call-sign 6QB (six q b) allotted to it, was pinned on the wall.

I much regret to state that not 100 per cent. of my outpourings went into an artificial aerial; there was even some slight spot of bother with officialdom. But it all passed over, and a radiating licence arrived not long after.

Pioneering on 200 metres

By this time the 440-metre band was practically dead. This was 1923; broadcasting was in full swing and the amateurs could no longer be tolerated in among the BBC stations, some of which used only 1 kw. So that fantastic 150-200 metre band was brought into use. It was rapidly discovered that when one had recovered from the phenomenal sharpness of tuning that was necessary, the signals received down there were even stronger than on 440 metres. Amateurs from all over the country were heard on 'phone and CW, and the Continental giants like the famous 8AB at Nice began to come in nightly.

Then, as the next thrill, a session at 3.30 a.m. one morning was rewarded by a score of American call-signs inscribed in the log. A list of Calls Heard sent to QST brought back a dozen or more cards asking for confirmation—and that was definitely the end of the bedroom wallpaper!

My own humble transmissions were confined to 5 or 6 watts input from dry batteries and did not get very far until a year later, when the quite illegal use of wavelengths round about 100 metres became common. Quite a few stalwarts risked their honour and their reputation down there, and many Americans were worked on that band before the official licences for 115-130 were issued. At this time it was very much a matter of "The Amateurs *versus* The Others." No one else was frightfully interested in these goings-on, and the amateur who had been fortunate enough to make his transmitter and receiver work down on 100 metres became a sort of information bureau on the subject.

The chief factors that I remember as influencing my own success were the belated discovery of the Reinartz circuit and the tentative removal of the bases from valves of the DER type, both for reception and transmission. Imagine de-basing valves to get "down" to 100 metres! But our ignorance was certainly bliss, and no one knew the extent of the former. We were all most pleased with ourselves!

Then 100 metres

Some time round about now (it must have been the winter of 1923-24) a further series of thrills burst upon the world of radio. In quick succession came the first two-way contacts with Canada, U.S.A., Australia and New Zealand. I write this far away from my logs, so I cannot give dates or details, but I well remember that the particular heroes were Jack Partridge (2KF), Cecil Goyder (2SZ) and E. J. Simmonds (2OD). Others like Jerry Marcuse (2NM) soon followed up with other brands of pioneering, and there were just about half-a-dozen names firmly inscribed on the pages of history round about this time.

My own trusty Reinartz receiver (a single-valver with a tapped coil and capacity-controlled reaction) seemed to bring in practically everything that was to be heard. About my transmitter I can't enthuse, but I remember getting a few contacts with the States when using 8 or 9 watts—still from dry batteries, but bigger ones. The transmitter was just a plain Hartley or Colpitts oscillator using a DER (dull-emitter receiving valve) which later grew into an LS5. But those little DER's, run at twice their rated filament voltage, delivered the goods, if not for very long.

Only the more godlike of the amateurs used any form of modulation which would be called good nowadays. They went in for "Choke Control," the acme of quality, while all the little fellows like myself used absorption modulation (microphone across a loop coupled to the tank coil!) or some form of grid modulation, the workings of which I can no longer remember. The mike was a GPO "solid-back," and the quality, which I was frequently assured over the air was "like the BBC," must have been perfectly frightful.

There were some outstandingly good telephony transmissions in those days, however, and naturally it was not long before long-distance 'phone was in the news. Many of the old CW heroes went over to 'phone and repeated their first contacts with distant parts.

Things were never static for a single day. No sooner was all this DX work on 100 metres an accomplished fact than one began hearing tall tales about a 45-metre band which was in use. And so it was. Another set of troubles in "getting down to it"! Tuning coils for receivers were getting so small that they hardly existed; and transmitters were most unlovely and intractable things. But off we all went, some with permission and some without, and it soon happened that the 115-130 metre band was scrubbed by the GPO, and our licences were issued for 45 and 90 metres. These, in theory, were "spot frequencies," but the accuracy of measurement was not so hot in those days, and even if it was—well, we managed to avoid each other somehow.

The new 45-metre band led to headaches in getting going, but much joy immediately afterwards. No sooner had one solved the problems of getting down there than a new thrill had appeared—the possibility of working DX in daylight. Amateur Radio had been very much a matter of midnight oil up to this time, but now there was the whole of Europe open all day long, and even better things in the early evenings and at breakfast time. I imagine that 45 metres was, up to that time, the best band we had ever worked on, and it provided more changes of outlook than any of the others.

CC on 45 metres

For one thing, I think I am correct in saying that 45 metres saw the first widespread use of crystal control. This was more or less forced on us by the difficulty of getting a steady note out of a self-oscillator or even a MO-PA. The latter combination was well known, but the Master Oscillator was often so constructed that there was little "mastery" about it. Just an oscillator, in fact! And the PA coupled to it used to pull it about more or less as it liked, so that the note was little better than that of a self-excited oscillator. Then some bright investigator discovered that many old-fashioned opticians had large stocks of quartz "pebbles" which, when laid on the coil of an oscillating receiver, gave birth to curious plinking noises that indicated piezo-electric qualities. These were soon tried in holders of crude design, and when placed across the grid coil of a low-powered TP-TG transmitter, gave a good measure of control and a beautiful note, the like of which had never been heard before.

The tuned-plate tuned-grid circuit had by then become one of the most popular transmitting circuits. It was stable and well behaved, easy to lay out, and always worked. I well remember the improvement in my own transmitting results when I scrapped some shocking Hartley arrangement in favour of a TP-TG.

Another discovery in 1925 or 1926 was the efficiency of the Hertz aerial for short-wave transmission. Most people had hitherto been using as much wire as they could conveniently string up in the sky, and tuning it in conjunction with an earth or counterpoise. Some articles in the *T & R Bulletin* (by now a flourishing but rather small publication) drew attention to the other type of aerial—one which was cut accurately to length and fed by means of a single wire tapped one-third of the way along.

Tuning the Aerial

Before long many bulbs were seen to glow brightly in the sky around the more prominent centres of DX work; no one ever put up a Hertz without a bulb at the centre-point! It is curious to reflect that practically every early attempt at a Hertz aerial used what we should now call a "Windom." The tapping-point was all wrong; the feeder was generally tried on quite the wrong part of the tank coil; and few people used a good earth. But they worked better than the heterogeneous collection of Marconi aerials that had previously been in use.

(*To be continued*)

ON THE MARKET

NEWS *from the Trade and* NOTES *on Equipment*

Each month under this heading we shall be reporting new equipment and discussing those matters which are of common interest to readers and the Trade alike. We might well begin by cataloguing the long list of amateur wants—from a good moderately-priced communications receiver to a really well made key—but we shall confine ourselves to remarking that those firms who are in touch with the amateur market know what is needed, and are making considerable efforts to meet requirements.

Eddystone.—Jerry Walker, well known as G5JU of Bristol, in pre-war days, has joined Messrs. Stratton & Co., Ltd., as their contact man with the amateur and experimental fraternity, and will also be responsible for that firm's technical publications. Eddystone short-wave equipment has a very high reputation and Stratton's were one of the very first manufacturing concerns to grasp the importance of giving the amateur what he wanted, rather than trying to sell him what was thought to be good for him. Many another firm has failed through making this psychological error. A new Eddystone communications receiver is in hand at the moment, and we hope shortly to be able to publish the technical specification, followed by a test report.

Among components of immediate interest in this firm's current catalogue are their Microdensers in five capacities from 5-15 $\mu\mu$F to 15-170 $\mu\mu$F. all of which are suitable for transmitting circuit operation. Then there is a series of RF chokes of very low DC resistance and almost negligible self-capacity, a 4¾ in. flexible insulated shaft which will drive through 90 deg., stand-off insulators, and receiving and transmitting coil formers.

S. G. Brown.—For many years now their Type "A" headsets, with the adjustable reed, have been regarded as the ultimate in sensitive headphones. They are now to produce for the general market another type which so far has been used only by the Services—a headset with moving coil elements; we shall be discussing them more fully in an early issue.

Quartz Crystal Co.—Of particular interest is their Q5/100 frequency sub-standard crystal unit, for the generation of accurate calibration points from 100 kc to 20 mc. For practical purposes, the temperature coefficient may be disregarded, as when used in the correct circuit, the error should never exceed 10 cycles from the stated frequency. The circuit recommended for the oscillator allows even this error to be minimised, since by the use of a small tuning capacity the second harmonic output of the oscillator can be adjusted to beat accurately with the BBC's 200 kc transmitter (the Light Programme in the long-wave band) which is itself maintained at a calibration accuracy within plus or minus one part in a million. Thus, it is possible not only to provide one's own sub-standard oscillator, but also to keep it dead right.

The Q.C.C. literature accompanying the Q5/100 unit describes all this in great detail, and gives, together with the circuit, all the other information necessary to build the oscillator.

As to the uses for such an oscillator, they are many. Calibrating receivers and frequency meters, setting up ECO drive circuits and checking crystals are only a few of its more obvious applications.

Electrical and Musical Industries.—We understand that E.M.I., one of the largest concerns of its kind in the world, with vast research and manufacturing resources, may soon be producing certain items of equipment which will be of interest to the radio amateur. G. R. Scott-Farnie, who used to be GW5FI at Merthyr, in South Wales, is representing the amateur angle here.

Denco.—Their Maxi-Q receiver coils, which are a departure in design and give high "Q" with unusually small physical dimensions, as well as the advantages of plug-in mounting, are available in eight sizes for either straight or superhet receivers to cover the frequency range from 150 kc to 130 mc. These coils are now being handled by a number of retailers specialising in amateur equipment.

The latest Denco catalogue also lists several other attractive items, including polystyrene—a British thermoplastic insulating material, glass clear—in sheet, rod and tube, which has excellent electrical characteristics; RF chokes for all frequency ranges, and suitable either for receiving or transmitting; feed-through and stand-off insulators made from polystyrene; IF transformers for 465 kc, and 1·6, 3, 5 and 10 mc; and a range of variable condensers suitable for receivers and low-power transmitters. All this equipment is very moderately priced.

Measuring Instruments (Pullin), Ltd.—They are marketing a specially designed low-consumption meter which, together with its ancillary shunts, series resistors and rectifier, enables a precision multi-range test set to be built up for a total cost of less than £6 10s. The heart of the idea is, of course, the "foundation instrument" already mentioned; its knife-edge pointer moves across three scales, which are respectively 3½ in., 3 in. and 2½ in. in length. The upper two of these scales are subdivided into 50ths, and can easily be read to 100ths by interpolation. The third (2½ in.) scale is suitably divided for resistance readings. The Pullin Test Set is obtainable only from their authorised distributors, who include Tele-Radio and Webb's of London and Birmingham. We hope to give a fuller description of this Test Set in an early issue, together with constructional details.

Taylor Electrical Instruments, Ltd.—Of interest is their Model 110A A.C. Bridge, on which can be measured capacity in six ranges from 10 $\mu\mu$F to 120 μF, together with the power factor of the condenser on test and resistance from 1 ohm to 12 megohms, also in six ranges. The bridge is operated from a standard AC supply, at 50 cycles, and has an adjuster for 110, 210 and 240 volts input. It incorporates a leakage test indicator which can be applied to all types of paper or mica condensers.

Labgear, Cambridge.—An extremely interesting range of equipment, specifically designed for Amateur Radio application, is now being offered by this firm, already known for their specialised test apparatus. The items of immediate interest are plug-in air-spaced type inductances, single or double-ended, PA type; light weight aerial feeder spreaders of distrene, with easy-fixing clips, in two sizes, 6 in. and 15 in.; the "Rotabeam," a kit for making up a rotating beam aerial for 28 and 58 mc, which is claimed to give 12 db forward gain and half-power 20 degs. off centre; a range of variable condensers for all stages of the transmitter; RF transmitting chokes, and neutralising condensers. Labgear also offer instrument dials and verniers, an inexpensive high-voltage power pack giving 250 mA at 1,000 volts—supplied either in a meral cabinet or for standard rack mounting—and a 3-in. tube oscilloscope, with X and Y shift, for modulation checking. Peter Tremaine, G8PB, is in charge of the Labgear Development Dept. We hope shortly to be able to give more detailed information, together with test reports, on all this apparatus.

Useful Definitions

(A pre-war offering from the Edgware and District Radio Society)

SPOUT—An imaginary tube leading from the transmitter out into free space.

SOUP—The almost equally imaginary RF which is either "bunged" or "sucked" up the spout.

BINGE—A delicate way of expressing large audio output.

PACKET—A mysterious parcel which arrives with remarkable celerity on touching HT transformer secondaries, valve anodes, or coils with power switched on.

WALLOP—Applied indiscriminately to both audio and RF power, and not to be confused with amber liquid sometimes known as slosh.

SPITCH—A harsh gurgling noise, sometimes called telephony, that interferes with the reception of CW.

CW—A lousy chirping noise, sometimes said to be Morse, that spoils telephony working. Believed to be connected with the obtaining of the licence.

POWER—A magic figure arrived at by multiplying final plate volts and final plate current and dividing the result by ten thousand. This gives maximum licenced watts.

AN UP-TO-DATE LIST OF

INTERNATIONAL AMATEUR PREFIXES

AC4	Tibet
AR	Syria
CE	Chile
CM, CO	Cuba
CN1	Tangier
CN8	French Morocco
CP	Bolivia
CR4	Cape Verde Is.
CR5	Port. Guinea
CR6	Angola
CR7	Mozambique
CR8	Port. India
CR9	Macao
CR10	Timor
CT1	Portugal
CT2	Azores
CT3	Madeira
CX	Uruguay
D	Germany
EA1-7	Spain
EA6	Balearic Is.
EA8	Canary Is.
EA9	Spanish Morocco
EI	Eire
EL	Liberia
EP	Persia
ES	Esthonia
ET	Ethiopia
F	France
FA	Algeria
FB	Madagascar
FC	Clipperton I.
FD	Fr. Togoland
FE	Fr. Cameroons
FF	Fr. West Africa
FG	Guadeloupe
FI	Fr. Indo-China
FK	New Caledonia
FL	Fr. Somali Coast
FM	Martinique
FN	Fr. India
FO	Fr. Oceanic Settlements
FP	St. Pierre and Miquelon
FQ	Fr. Equatorial Africa
FR	Reunion I.
FT	Tunis
FU	New Hebrides
FY	Fr. Guiana
G	England and Channel Is.
GI	Northern Ireland
GM	Scotland
GW	Wales
HA	Hungary
HB	Switzerland
HC	Ecuador
HH	Haiti
HI	Dominican Rep.
HK	Columbia
HP	Panama Rep.
HR	Honduras
HS	Siam or Thailand
HZ	Saudi Arabia
I	Italy
J	Japan
K4	Porto Rico and Virgin Is.
K5	Panama Canal Zone
K6	Hawaii and U.S. Pacific Is.
K7	Alaska
KA	Philippine Is.
KB6	Guam
LA	Norway
LU	Argentine
LX	Luxembourg
LY	Lithuania
LZ	Bulgaria
MX	Manchuria
NY	Panama Canal Zone
OA	Peru
OE	Austria
OH	Finland
OK	Czechoslovakia
ON	Belgium
OQ	Belgian Congo
OX	Greenland
OY	Faroe Is.
OZ	Denmark
PA	Holland
PJ	Curacao
PK	Indonesia
PX	Andorra
PY	Brazil
PZ	Surinam
SM	Sweden
SP	Poland
ST	Sudan
SU	Egypt
SV	Greece
SV6	Crete
TA	Turkey
TF	Iceland
TG	Guatemala
TI	Costa Rica
U, UE, UK	U.S.S.R.
VE	Canada
VK	Australia
VO	Newfoundland and Labrador
VP1	Br. Honduras
VP2	Leeward and Windward Is.
VP3	Br. Guiana
VP4	Trinidad and Tobago
VP5	Jamaica, Cayman, Turks and Caicos Is.
VP6	Barbados
VP7	Bahamas Is.
VP8	Falkland Is.
VP9	Bermuda
VQ1	Zanzibar
VQ2	N. Rhodesia
VQ3	Tanganyika
VQ4	Kenya
VQ5	Uganda
VQ6	Br. Somaliland
VQ8	Mauritius
VQ9	Seychelles
VR1	Gilbert and Ellice Is.
VR2	Fiji
VR3	Fanning Is.
VR4	Br. Solomon Is.
VR5	Tonga
VR6	Pitcairn
VS1	Straits Settlements
VS2	Fed. Malay States
VS3	Non-Fed. Malay States
VS4	Sarawak, North Borneo
VS5	Labuan and Brunei
VS6	Hong Kong
VS7	Ceylon
VS8	Bahrein
VS9	Maldive Is.
VU	India
VU4	Laccadive Is.
W	U.S.A.
XE	Mexico
XU	China
XZ	Burma
YA	Afghanistan
YI	Iraq
YL	Latvia
YN	Nicaragua
YR	Rumania
YS	Salvador
YT, YU	Yugoslavia
YV	Venezuela
ZA	Albania
ZB1	Malta
ZB2	Gibraltar
ZC1	Transjordania
ZC2	Cocos I.
ZC3	Christmas I.
ZC4	Cyprus
ZC6	Palestine
ZD1	Sierra Leone
ZD2	Nigeria and Br. Cameroons
ZD3	Gambia
ZD4	Gold Coast and Br. Togoland
ZD6	Nyasaland
ZD7	St. Helena
ZD8	Ascension I.
ZD9	Tristan da Cunha
ZE1	S. Rhodesia
ZK1	Cook I.
ZK2	Niue
ZL	New Zealand
ZM	Western Samoa
ZP	Paraguay
ZS	Union of S. Africa
ZS3	South-West Africa

Radar and Amateur Radio

An Authoritative Opinion

By W. L. S.

RADIO amateurs of to-day are divided into two sections: Those who were in radar during the war and those who were not. During the war the communications and radar organisations were described in various frivolous ways such as "straight *versus* crooked," "sine-wave *versus* square-wave boys" and so on, and it is perfectly true that their paths lay far apart. Many of the stalwarts of radar have not had a chance of handling CW for more than six years. If, however, they have temporarily lost their familiarity with it, their daily association with the pulse technique has undoubtedly taught them something.

In the future it will be recognised that radar, with all the urgency behind it in the dark days, was a colossal forcing-school for new technique and new ideas, many of them brilliant. But what effect, if any, will this have on the future of short-wave communication?

It is my opinion that the amateur aspect of radio will probably derive more from it than the commercial, with one exception—the probable supplanting of commercial CW by very high-power pulse transmission. The advantage of the pulse technique, when applied to short-wave communication, is that enormous peak-power can be radiated in the pulse itself for the expenditure of quite small average powers. The CH transmitters, which were the only radar we had at the beginning of the war, used to put upwards of 200 kw out in the pulse itself, and yet the quiescent intervals between pulses were so long that the mean power output was less than 100 watts. Pulse telegraphy, particularly applied to ultra-short-wave beam systems, would appear to have a great commercial future.

But woe betide the amateur if he ever tries it! There is no distinction between pulse transmission and spark —as far as its effect upon the neighbouring part of the frequency spectrum is concerned—and the various possible telephony systems using pulse-width modulation and pulse-amplitude modulation would be poison to our narrow bands.

Influence on Technique

The effect of radar on the *future* of Amateur Radio is quite different—it is mainly a matter of improved knowledge of radio theory, particularly concerning aerial systems, high-efficiency receivers and unusual circuitry of all kinds.

As the constant need for better cover at very low angles was impressed on the radar fraternity, so the scientists' reply was the constant improvement in V.H.F. technique. Better transmitting valves were probably the first step; then better aerial systems; then specialised receiving valves for improving the signal-noise ratio, such as the grounded grid triode. Then came special valves which became an integral part of the lecher system which constituted their tuned circuits. Most of the transmitting valves are probably too large to be of interest to the amateur, but such devices as the "micropups," which handled enormous peak powers right up to 600 mc, will undoubtedly influence future design.

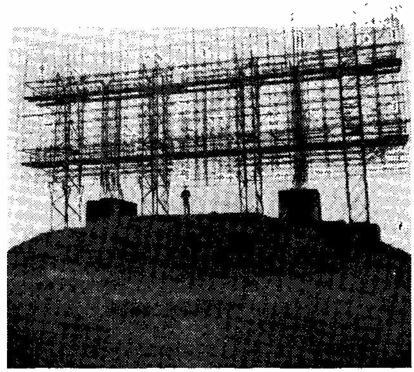
Obviously the rapid growth of knowledge concerning time-base systems, cathode-ray tubes and V.H.F. reception will have a beneficial influence on television; but let us consider the amateur from a more personal point of view.

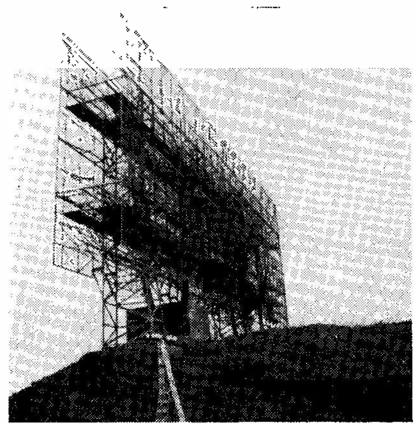
Aerial Design

One of the first things radar taught him was that aerial systems really *do* work according to the book. He saw the vertical and horizontal polar diagrams of the various arrays plotted under working conditions, and, at first, marvelled at the fact that they were the very shape they ought to be. Then he came to accept it. He met dipoles centre-fed through concentric and properly matched; curtain arrays with voltage feed through 600-ohm open-wire feeders; broadside 200-mc arrays properly fed and phased by means of oscillators and standing-wave indicators. And he learned, without any shadow of doubt, the devastating effect of a badly designed or badly phased array. Yes, you will find that any amateur who was in radar during the war will take far more trouble about his aerial than ever before—he will even use some intelligence about the best type to erect if he is confined to one direction or to a particular height.

On the receiving side he will probably be shocked at the poor signal-noise ratio of that superhet that he was so proud of in 1939. He will set about improving the first stage, having realised that the choice of suitable valves and constants in that stage has more effect on performance than almost anything else. We may even find some enthusiasts emulating the excellent series of CH receivers by using push-pull RF stages and push-pull first detectors! And, further, they won't spoil them by feeding them with an unbalanced input, but will use a dipole with a properly balanced feeder system.

The 5-metre enthusiasts will be overcome by the simplicity of a compact rotary beam, compared with those 4-stack 5-bay CHL arrays that they used to maintain! That extremely useful device, the Selsyn motor, will probably be put to work for remote control of a lightly constructed radiator and reflector at the top of a small lattice mast. For the benefit of those who have not met it, sufficient to say that the Selsyn motor is a compact and





Two views of the Mammut, *a German radar equipment known to us as a " Hoarding." The frequency was in the neighbourhood of* 125 *mc, and the aerial curtain consisted of hundreds of dipoles, each separately fed. The Mammut was of particular interest in that the beam produced by this aerial was made to sweep electrically by means of a phase-changing system applied to the feeders. Though Mammuts could scan through a wide sector, there was no physical movement of the array. Effective range was up to* 200 *miles against aircraft at* 20,000 *ft.*

simple method of transmitting torque electrically. It could even be used for remote tuning of a transmitter at the top of a mast or tower.

On the transmitting side there will probably be little change until we are granted the use of frequency-bands in the 200-mc region. Then the simplicity of constructing a medium-powered transmitter with short tuning lechers, feeding a little beam array by means of ordinary spaced open-wire feeders, will not be lost on anyone familiar with 200-mc radar.

It seems conceivable that pure D/F technique will attract quite a few amateurs in the future, although in my opinion there is no future in "Home Radar." Here and there someone may be fascinated with the idea, but we may not be allowed to radiate pulses; and the average amateur hardly lives in a location which would have been chosen as a site for a radar station. Maybe there would be great satisfaction in a "QSO" with an aircraft, but it certainly would not QSL!

The wide-band IF and video circuitry which was developed to give better and better definition of display on the CRT of radar receivers will not have any application to communication, as far as one can see. For television, certainly; and who knows how far Amateur Radio may not ultimately progress in that sphere? Two-way television contacts over long distances may not be so far ahead. But the techniques of television and straight communication are poles apart. Each uses the ether, a transmitter and a receiver, it is true, but the resemblance almost stops there.

Micro-Wave Communication

One particularly fascinating possibility is the use of micro-waves for short-distance amateur communication. Here the progress has been astounding, including, as it does, the development of the magnetron and klystron, and the growth of wave-guide technique. This branch of radar was completely veiled in secrecy in 1942 but is now becoming generally known. Anomalous propagation made ranges of 200 miles possible on a wavelength of 10 cms.—and this was not point-to-point communication, but involved the reception of the minutest fraction of the radiated power, re-radiated not by a tuned reflector, but by a nondescript object somewhere in space. With two-way communication between suitably chosen sites it seems probable that the most surprising ranges will become feasible in time. But here again the application is probably commercial rather than amateur, and one foresees multi-channel telephone links handled by this means.

To summarise, then, it seems that the amateur will be most affected by the increase in his own personal knowledge of the subject of radio technique, and the commercial concern by the development of apparatus capable of handling very high powers at very short wavelengths. Radar, apart from its vital contribution to the winning of the war, has undoubtedly made an incidental contribution to the future of world-wide communication.

A NOTE

Regarding *Magazine* constructional articles. As time goes on and components become more readily obtainable, we shall be publishing a full range of such articles, covering all requirements in the Amateur Station. At present, we are surveying the market in order to determine what are the immediate possibilities, since it is unsatisfactory from the point of view of readers and manufacturers to specify parts which are either in short supply or subject to delayed delivery. Many firms are interested in the Amateur market, and some have got beyond the planning stage, but prevailing conditions in trade and industry are such that the latest equipment may not be available for some months yet.

★ ★ ★

REMINDER

We take the opportunity of drawing attention to the fact that purchase tax is *not* payable on transmitting valves. This does not, however, apply where the valve is of a type that can be used for ordinary reception purposes, such as the 6L6 and similar valves, which can be operated in normal receivers and audio amplifiers.

Puzzle Picture (p. 36). *This is a German radar installation known as a " Wassermann," which we called a " Chimney." It consists of a complex array, some 80 ft. high, used for narrow-beam searching, the whole structure being rotated bodily about the base. The operating frequency was in the neighbourhood of 125 mc: Wassermanns were effectively jammed by our " Window," and also by electronic jamming devices generating noise on the working frequency*

THE MONTH WITH THE CLUBS

FROM REPORTS

In this section, too, we are glad to be picking up the threads again, but we shall miss our old friend S. W. Clark (2AMW), who, before the war, did so much to make this a useful feature.

It is good to know that there are so many active club organisations in being, with more in the process of getting under way. There can be no doubt whatever that there is scope for a Radio Club, whether it consists of six, sixteen or sixty members, in nearly every community in the country, and certainly in all towns of any size. Such local societies, apart from the opportunity they provide for pleasant social intercourse, and the exchange of information among people with the same interests, can do tremendous good in encouraging and advising the beginner and initiating him into the deeper mysteries. While, as we all know, a lot can be learnt from reading, one can progress a great deal faster if there is someone to whom one can talk. Clubs help to break down the barrier which usually discourages the tyro from approaching the expert.

The *Short Wave Magazine* attaches great importance to the Club movement, in the belief that a well-organised and well-supported local radio society can do much for the art of Amateur Radio, and it is our declared policy to do everything possible to encourage and assist all such clubs and societies, irrespective of their size and in whatever part of the country they may be.

The Editor has undertaken to provide space each month for publication of Club news and the discussion of matters of interest to their secretaries. All notes received will be published, subject to the usual editorial attention where necessary, and copy should reach us addressed "Club Secretary, *The Short Wave Magazine*, 49 Victoria Street, London, S.W.1," by the 20th of each month *latest*, for inclusion in the following month's issue. Will secretaries please note that this really is the last date, and that if possible we should prefer to have material much earlier; however, we appreciate that news items of interest to the club, or prospective members in the neighbourhood, may not come to hand till late in the month, so we have set our final date as far forward as we can.

So here goes with the first lot of reports. The names and addresses of the secretaries of the clubs concerned will be found in the panel at the end of these notes.

Radio Society of Northern Ireland.—A nice letter from secretary A. Kennedy, who says that his society continues to make good progress. Six new members were admitted at the last meeting. The transmitting members hope to have their licences back again shortly, and this should help to revive old, and create new, interest. The R.S.N.I. are planning permanent headquarters and in the meantime meetings are held on the last Friday of each month at the Young Men's Society, Donegall Square East, Belfast. Mr. Kennedy remarks that they are looking forward to the reappearance of the *Magazine* in Northern Ireland—we have asked our wholesalers to include that area in their quotas.

Romford and District Amateur Radio Society.—Rowland Beardow, G3FT, also reports rising membership and increasing interest. The society's present activities include talks, brains trusts and junk sales, and it is hoped to resume D/F field days in the summer months. He mentions the difficulty of obtaining lecturers from manufacturing concerns, but says they find they have a good coverage of subjects from amongst their own members. Meetings are held every Tuesday at 8.0 p.m., at the Y.M.C.A., Western Road, Romford.

Stockport Radio Society.—Mr. Wood informs us that this society was reconstituted last December, and now meets every Monday at 7.45 p.m. in the Textile Hall, Chestergate, Stockport. A comprehensive series of lectures has been arranged, and these are given on the second and fourth Mondays of each month, the first and third Mondays being devoted to general discussion. Prospective members are invited to attend any of these meetings. The society has a present membership of about 50, which is good going, particularly as Mr. Wood also remarks that it is expanding rapidly. A specially low subscription rate is paid by junior members under the age of 21 years.

Slade Radio.—This society is fortunate in possessing its own headquarters at Broomfield Road, Slade Road, Erdington, Birmingham, where meetings take place on the fourth Friday of each month at 8.0 p.m. Here, again, membership is on the increase and secretary L. A. Griffiths reports considerable interest in shortwave working. They are thinking about adding 5-metre D/F field days to their summer activities.

Edgware and District Radio Society.—This is another of the strong pre-war organisations which kept going all through the period of hostilities. P. Thorogood, G4KD, the new chairman, describes how a letter budget, which took twelve months to circulate, was used to keep in touch with the membership. It was complete with drawings and photographs and, as G4KD says, makes a good historical record. The society has started a technical library and is full of ideas for the future. Here is another official remarking upon the difficulty of getting really good lecturers ; this society is prepared to pay a small fee for the service.

Edgware has a present membership of 56, and substantial funds, but many members are still in the Services. Activities include a Workshop Night and Morse classes, and the society makes annual awards in the shape of the Enthusiasts' Cup, the Committee Award and the Constructor's Award. Meetings are held every Thursday at the Constitutional Club, opposite the Ritz Cinema, near Edgware Tube Station. All prospective members are welcomed as guests at their first meeting. The programme of future events includes lectures on Short Wave Propagation, VHF Valves, the New Avometer, a Junk Sale and a Quiz Night.

We are interested to notice that, with one exception, all the officers of this society are holders of callsigns.

City of Belfast Y.M.C.A. Radio Club.—Founded as long ago as 1922, Belfast also kept going during the war years, when regular meetings were held. Frank Robb, GI6TK, who is also the operator of the club station GI6YM, reports that their war-time meetings were visited by amateurs from all parts of the world, and that altogether they have the names of over 800 amateurs in their Visitors' Book ; this must be a record of some sort. Anyway, it is a most creditable effort.

The membership, still increasing, is now over 150, and meetings are held every Wednesday, at 8.0 p.m., in the Clubroom, 3rd Floor, City of Belfast Y.M.C.A., Wellington Place. Morse instruction is given on Thursdays at 8.0 p.m., and the Construction Class meets at the same time on Fridays.

A new transmitter is in the process of being built for GI6YM, to operate 'phone and CW on 28 and 58 mc, and the receiver at present in use is a Hallicrafters S20R with pre-selector.

Southend & District Radio and Scientific Society.—G6CT writes to say that this Society, which had a considerable pre-war following and is keen on inter-club contests, has resumed activity, with fortnightly meetings at the Art School, Victoria Circus, Southend. The programme is a varied one, including as it does both formal lectures and general discussions on matters of current interest. Lectures in March will deal with Low Loss Insulators and Valve Manufacture.

Southend is one of the societies possessing a club transmitting licence, G5QK, which has now been restored ; they hope to be arranging some interesting field days during the summer. News from other clubs who before the war joinedt hem in the popular 1·7 mc D/F contests would be welcomed by the secretary.

Following are the names and addresses of the secretaries of the clubs mentioned this month. They will be pleased to give every assistance to prospective members.

BELFAST. F. A. Robb, **G16TK,** 60 Victoria Avenue, Sydenham, Belfast, Northern Ireland.

EDGWARE. P. A. Thorogood, **G4KD,** 35 Gibbs Green, Edgware, Middlesex.

NORTHERN IRELAND. A. Kennedy, **G13KN,** 38 Donaghadee Road, Bangor, County Down, Northern Ireland.

ROMFORD. R. C. E. Beardow, **G3FT,** 3 Geneva Gardens, Whalebone Lane North, Chadwell Heath, Essex.

SLADE. L. A. Griffiths, 47 Welwyndale Road, Sutton Coldfield, Warwickshire.

STOCKPORT. G. Wood, 121 Garners Lane, Davenport, Stockport, Cheshire. (*Tel.* : Great Moor 2650.)

SOUTHEND. J. M. S. Watson, **G6CT,** 23 Eastwood Boulevard, Westcliff-on-Sea, Essex.

Q5/100

A NEW

100 kcs.

Quartz Crystal Unit for Amateur Frequency Standards, with 5 star features.

★ Accuracy better than 0·01%.
★ New angles of cut give a temperature coefficient of 2 parts in a million per degree Centigrade temperature change.
★ Vitreous silver electrodes fired direct on to the faces of the crystal itself, giving permanence of calibration.
★ Simple single valve circuit gives strong harmonics at 100 kcs. intervals over the range 100 kcs. to 20,000 kcs.
★ Octal based mount of compact dimensions.

PRICE **45/-** *Post Free.*

Full details of the Q5/100, including circuit, are contained in our leaflet Q1. Send stamp to-day for your copy.

THE QUARTZ CRYSTAL CO., LTD. (G2NH, G5MA, G2MR), **63-71 Kingston Road, NEW MALDEN, SURREY.** *'Phone : Malden* 0334.

The Radio Amateur's Dream!

Think of all the really good Radio shops you know of ; imagine them all under one roof—and *even then* you'll have only a slight idea of the comprehensive stocks of Components we carry.

Unfortunately we have no lists at present, but detailed enquiries, clearly worded, will be dealt with speedily. Please enclose a stamped addressed reply envelope.

WIRELESS SUPPLIES UNLIMITED

The best Radio Components suppliers since 1925

264-266 Old Christchurch Road

BOURNEMOUTH, HANTS.

VALLANCE'S

PROMPT MAIL ORDER SERVICE in First-class Radio Components

Specialists in precision short-wave equipment for the radio amateur.

RAYMART COMPONENTS

Ceramic Valve Holders.—English types, 4-, 5- and 7-pin, 1/3 ; 8-pin 1/6, 9-pin Loctal, for EF50, 2/-. UX types, 4, 5, 7, and Octal, 1/6 ; Acorn type, 2/6. All the above can be supplied with pillars for baseboard mounting if required.

Ceramic Coil Formers.—Type BTX, 3½. by 1⅝ in., 32 grooves, 4/3 ; type TFX, 5 in. by 2½ in., 5/6 ; type BTXS, ceramic strips for mounting BTX coil formers, allowing for up to 5 CPS plugs and sockets : made in pairs, male and female, per pair 1/9. CPS plugs and sockets, heavy duty, carry 25 a. RF. These can also be used with SX insulators, 7½d. per pair.

Couplers.—Type FC, flexible, 1/- ; type RC, rigid, **10d.**

Stand-off Insulators.—White Glazed, type SX, 3½ in. high, 1/9 ; SM, 1¼ in., **9d.** ; SS, 1 in., **7d.** ; ST, ½ in., **5d.**

Beehive Stand-off Insulators.—Type SL, **8d.** ; SG, brown glazed, **10d.**

HF Pillar Insulators.—Type SP, 1⅝ in. by ½ in. diameter, **10d.**

Feed-through Bushes.—Type FTS 4BA hole, two pieces, **2½d.** per pair ; FTL 2BA hole, two pieces, **3½d.** per pair.

Feed-through Insulators.—Type FTI, two pieces with two cork washers and 2BA ; all threads with nuts, **1/1.**

Lead-in Insulators.—Type DCL, 3 cones, with 2BA all threads and nuts, **2/6** ; SCL 2 cones, ditto, **1/9.**

Feeder Spreaders.—Type FS, 6 in., **7d.**

Transposition Blocks.—Type TB **6d.**, aerial T-pieces, type AT, 1/2.

Transmitting Aerial Insulators.—Type AX, 12 in., highly glazed, 2/-.

Knobs and Dials.—Type TXD, large bakelite knob and skirt with 4-in. dial graduated 0-100, 5/9 ; TXJ medium bakelite knob and skirt with 2¾-in. dial graduated 0-100, 3/11 ; TXO medium bakelite knob without skirt, 2¾-in. dial graduated 100-0, 3/3 ; TXW 2¾-in. special dial graduated 0-100 without knob, but having solid metal boss, intended for use with slow-motion drive and locking device, 3/- ; SMD slow-motion friction drive for use with TXW, with dial cursor and locking device and fitted with medium knob without skirt. This will also work with TXD knob and dial and with TXJ knob and dial if SMD is fitted with small knob instead of the medium, 3/6 ; LSK large knob with 3-in. skirt as fitted on TXD dial, 2/11 ; MSK medium knob with 2½-in. sk'rt as fitted on TXJ dial, 1/11 ; MK medium knob only, no skirt, 1/9 ; LK large knob only, no skirt, 2/6 ; TXT small fluted knob, 1⅛ in. across flutes, no skirt, **9d.**

Short-wave Coils.—4-pin types, CA, 11-25 meters, 3/- ; CB, 20-45, 3/-; CC, 44-100, 3/6 ; CD, 80-180, 3/9. 6-pin types : CA6, 11-25, 3/3 ; CB6, 20-45, 3/6 ; CC6, 44-100, 3/9 ; CD6, 80-180, 3/9 ; CE6, 110-250, 4/6. The coverage is when used with .00016 mfd. condenser (type VC, 160 X).

Coil Formers.—4-pin types : CF4 plain, 1/9 ; CT4 threaded, 2/-. 6-pin types : CF6 plain, fits English 7-pin holder, 1/11 ; CT6 threaded ditto, 2/2 ; CF6S standard plain, 1/11 ; CT6S standard threaded, 2/2. 7-pin types : CF7 plain, fits 7-pin English valve holder, 2/- ; CT7 threaded ditto, 2/3.

Coil Holders.—4-pin type VH4 for CF4, 1/- ; 6-pin type, VH6S for CF6S, 1/6 ; 7-pin type, VH7 for CF6 and CF7, 1/3.

SMU Utility, Micro Dial.—Slow-motion 100-1, dial with epicyclic reduction scaled 0-180, 8/9.

We are always pleased to send goods C.O.D., otherwise cash with order. Please include extra for postage and packing.

Vallance's, 144 Briggate, Leeds, 1

LINAGLOW LIMITED

R.A.F. Portable Transmitters

NEW AND UNUSED, containing a wealth of valuable components useful to the amateur or can easily be converted for use on Amateur Bands

Circuit Diagrams and Parts List supplied with each instrument.

EACH UNIT IS COMPLETE with valves, crystal, Litz wound coils, morse key, variable condenser, relays, portable aerial, resistors, chokes, condensers, etc.

POWER PACK with Hand Generator giving 6 volts and 350 volts.

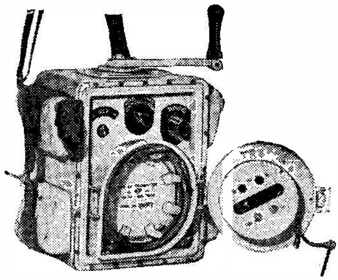
LIMITED QUANTITY (approx. cost to manufacture £39).

PRICE inc. post and packing **£5.5.0**

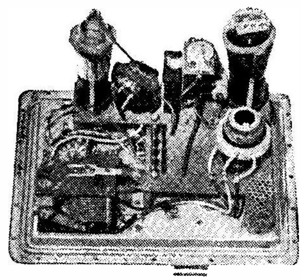
●**POST ORDERS ONLY**

We regret that due to pressure of business we are unable to handle showroom, caller or C.O.D. trade until further notice.

LINAGLOW LTD. Dept. MO/S.W.I
61 Highgate High Street, N.6. *'Phone :* MOUntview 9432.



Complete Transmitter



Top Panel of Transmitter

NEW DUAL TESTOSCOPE •

Ideal for High and Low Voltage Testing; 1/30, 100/850 A.C. and D.C. Allowance made on old models. Send for interesting leaflet L34 on Electrical and Radio Testing, from all Dealers or direct.

RUNBAKEN·MANCHESTER·I

H.A.C.

Short-Wave Equipment

Noted for over 15 years for . . .
Short-Wave Receivers and Kits of quality

One Valve Kit, Model "C" Price 20/-
Two „ „ „ "E" „ 43/-

These kits are complete with all components, accessories, and full instructions. The prices are inclusive of postage and packing. Send stamped addressed envelope for descriptive catalogue

A. L. BACCHUS, 109 Hartington Road, London, S.W.8

THE PARTRIDGE ORGANIZATION

is again at your service.

For six years we have been supplying the Services with our iron cored components. We are now once more accepting orders for ordinary commercial and domestic needs.

Our technical department will again be pleased to assist you in your transformer problems.

We look forward to hearing from our old friends, and welcome enquiries from newcomers.

May we send you our 1946 price list ? This details a comprehensive range of components that can now be despatched from stock.

Telephone: *Abbey 2244*

PARTRIDGE

TRANSFORMERS LTD

76-8. PETTY FRANCE. LONDON. S.W.I

BULLS RAYMART DEPOT

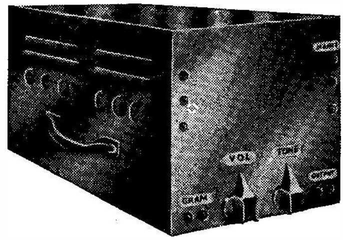
J. BULL & SONS (S/W)
246 High St., HARLESDEN, N.W.10.

Ceramic Valveholders
Ceramic Coilformers
Couplers
Speed Keys
High Note Buzzers
Hand off Insulators
Behive Hand off Insulators
H.F. Pillar Insulators
Feed-through Bushes
Feed-through Insulators
Lead-in Insulators
Feeder Spreaders
Transposition Blocks
Aerial "T" Pieces
Transmitting Aerial Insulators
Toggle Switches
Variable Condensers
Knobs and Dials
S.W. Coils
Coil Formers
Coil Holders
S.M.V. Utility Micro Dials
and all **VALVES** of course

J. BULL & SONS (S/W)
246 High St., HARLESDEN, N.W.10.

Introducing

TOM THUMB



A small compact amplifier, using 6F6's in push-pull, with new linear phase changing circuit. With an ordinary magnetic pick-up it gives 15 watts output. Complete in case, 9 × 8 × 6½ inches. (*As illustrated*)

Ready to assemble, **£8 18 0**
(Carriage and packing, 2/6)

ALSO

The **A.23**, an improved version of famous A.20, still in vigorous demand. **£14 0 0**

Call on your local dealer or write for illustrated literature.

Horn Speakers, 12-inch P.M.'s Mikes and Stands. Every conceivable transformer or component is available from us—Specialists in the design for Home Construction.

RADIO INSTRUMENT Co.,
294 BROADWAY, BEXLEYHEATH, KENT

MORSE CODE TRAINING

There are Candler Morse Code Courses for **Beginners and Operators**

SEND NOW FOR FREE

"BOOK OF FACTS"

It gives full details concerning all Courses.

THE CANDLER SYSTEM CO.
(S.M.), 121 Kingsway, London, W.C.2.
Candler System, Co. Denver, Colorado, U.S.A.

A.C.S. RADIO

for—

Amateur Communications Receivers
Transmitting Gear
Receiving and Transmitting Valves
Radio Components and Sundries
Television, Radio Sets and Radiograms by H.M.V., Baird-Bush, Philips, Marconiphone, Ekco, Cossor, Ultra, etc.

Whilst supplies of most types are very limited until production gets ahead, we invite your enquiries for any definite requirements for which we shall be pleased to quote if available, as meantime we can only offer a preliminary list of radio equipment and sundries, to which we hope to make frequent additions. We have been catering for the Amateur and Short Wave enthusiast for many years, and value our reputation for a fair and square deal. Can we get together?

Open Saturdays until 6 p.m.

44 WIDMORE Rd. BROMLEY, KENT
'Phone RAVensbourne 0156

50 ohm Coaxial, suitable for Television or VHF, 3d. per foot. Transmitting crystals, all 7mcs range, 23/6. Crystal holders 10/-. Carbon microphones, table mounted with transformer, 10/-. Morse keys 5/- and 10/-. Standard 19 inch rack mounting panels and trays, 18 gauge steel, complete 8/6. Modulator kit sets from £5, all carriage paid.

DRURY & BEARDOW, G3CQ. G3FT.
45 Wangey Road, Chadwell Heath, Essex

Printed by Lochend Printing Co., Ltd., London, S.W.9, and published by the Proprietors, The Short Wave Magazine, Ltd., 49 Victoria Street, London, S.W.1. March, 1946. Printed in Great Britain.