THE AUSTRALASIAN

Radio World

Registered at the G.P.O. Sydney, for transmission by post as a periodical.

1/-

VOL. 10 ..... NO. 5

OCTOBER 15 1945

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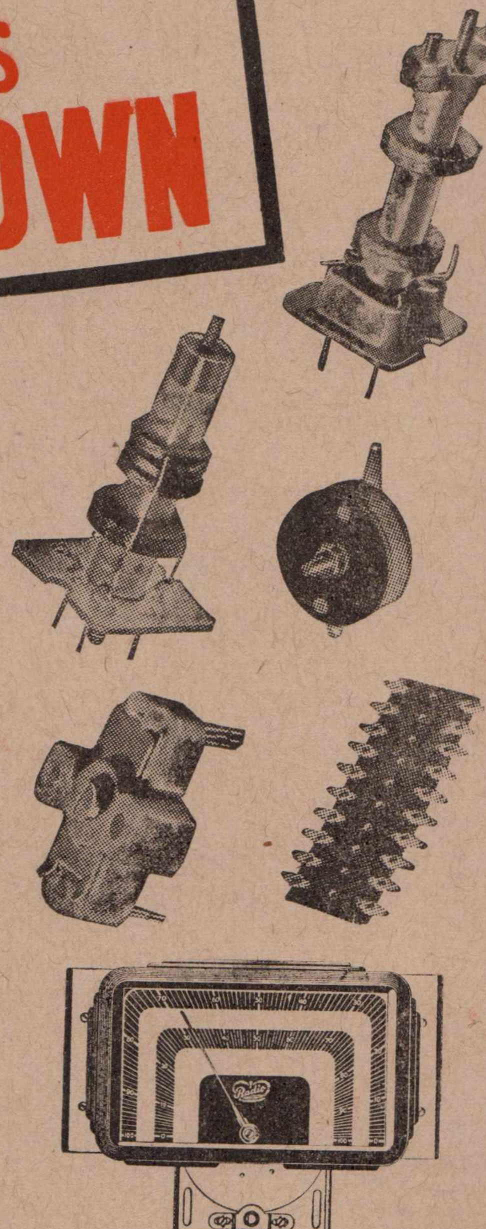

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THE AUSTRALASIAN RADIO WORLD

Devoted entirely to Technical Radio

and incorporating

ALL-WAVE ALL-WORLD DX NEWS

Vol. 10. OCTOBER, 1945. No. 5.

CONTENTS

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EDITORIAL

My editorial in the July issue has drawn sharp criticism from a reader who has just returned from four years service with the R.A.F. He says that he hates to see personal bias creeping into a fine magazine. The subject under discussion, to save you turning up the July issue, was that old one of morse code versus phone for ham licence qualification.

I fail to appreciate the crack about personal bias, as I did not make any effort to disguise the fact that the opinions expressed were my own, carried my own signature at the bottom and were published for the sole purpose of letting readers know what I thought about the subject. I am not unreasonable enough to expect every reader to agree with everything I say, but surely I have just as much right to express my views as anybody else.

To make quite sure that nobody can have cause to grouch I will hand over the editorial column this month to the morse code exponent, Con. A. Stiglish (ZL4DU) of New Zealand.

Amongst many other things this is what he thinks about it: "My experience in the R.A.F. as a wireless operator has proved to me the value of c.w. To my knowledge, the R.A.F. had no overseas radio telephone links. Inter-command circuits were all c.w., some hand speed, some high speed. Spelling out words by phone is slower than sending letters by c.w. For copying through QRM or QRN and on a busy channel, give me c.w. every time. In cases of emergency it is easier to rig up a c.w. outfit and power drain is lower. Using a given power you will get further on c.w. I think that an amateur should be an all-rounder, equally efficient on phone or c.w., as each has its advantages and disadvantages."

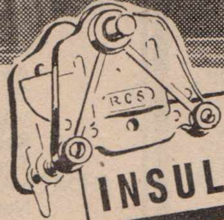
All of which is sound and logical, but doesn't explain the reason why four words per minute greater speed in morse code should be the deciding factor as to whether a ham should be allowed 50 watts or 250 watts.

—A. G. HULL.

RCS Radio Parts and Components

. . . featuring Trolitul

● A view of the modern R.C.S. factory at Canterbury, N.S.W.



THE MIRACLE INSULATING PLASTIC

All over AUSTRALIA

—the name R.C.S. is recognised by both the trade and the amateur set constructor as being the trade mark of quality in precision-built radio parts and components. Contracts with a high defence priority naturally take precedence over civilian requirements at the present time, but the day is not far distant when a full range of both old and sensationally new chokes, transformers, coils and dials bearing this famous trade mark will again be freely obtainable.

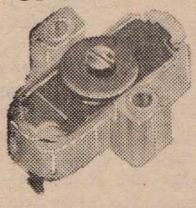
Trolitul — the semi-transparent, light-weight moulded insulating plastic — is exclusive to R.C.S. and wherever possible in the manufacture of R.C.S. quality radio parts and components you will find this modern miracle insulating material used as part of the basic construction. Sealing wires and connections into one solid damp-proof whole, the use of Trolitul guarantees longer life for all R.C.S. parts, maximum efficiency and the maintenance of factory-precision and accuracy for many years after its purchase by the customer.

R.C.S. TRIMMERS

R.C.S. Trimmers – Two-plate coil trimmers mounted on Trolitul base.

CG 15.

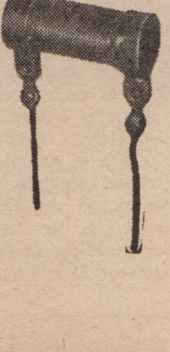
R.C.S. PADDERS



These padders are of a special high grade type. The plate is made of pure nickel and the base is R.C.S. Trolitul.

P 21.

R.C.S. RESISTORS



R.C.S. Resistors wound with nichrome wire and are supplied complete with pigtails.

Ohms to 1500 Ohms 1" x $\frac{3}{8}$" diam.

1500 Ohms to 10000 Ohms 2" x $\frac{3}{8}$" diam.

C.T. Resistors 10 Ohms to 200 Ohms.

R.C.S. COILS

R.C.S. Coils are specially wound on exclusive one-piece Trolitul formers with connecting lugs permanently moulded in.

F. Gang.	H. Gang.
E.282. Aerial Air Core	E.342. Aerial Air Core
E.283. R.F. Air Core	E.343. R.F. Air Core
E.284. Osc. Air Core	E.344. Osc. Air Core
E.279. Aerial Permature	E.345. Aerial Permature
E.280. R.F. Permature	E.346. R.F. Permature
E.281. Osc. Permature	E.347. Osc. Permature
T71. R.F. Reaction	T87. R.F. Reaction
T72. Reinertz	T81. Reinertz

R.C.S.
RADIO PTY. LTD.
174 CANTERBURY ROAD, CANTERBURY.

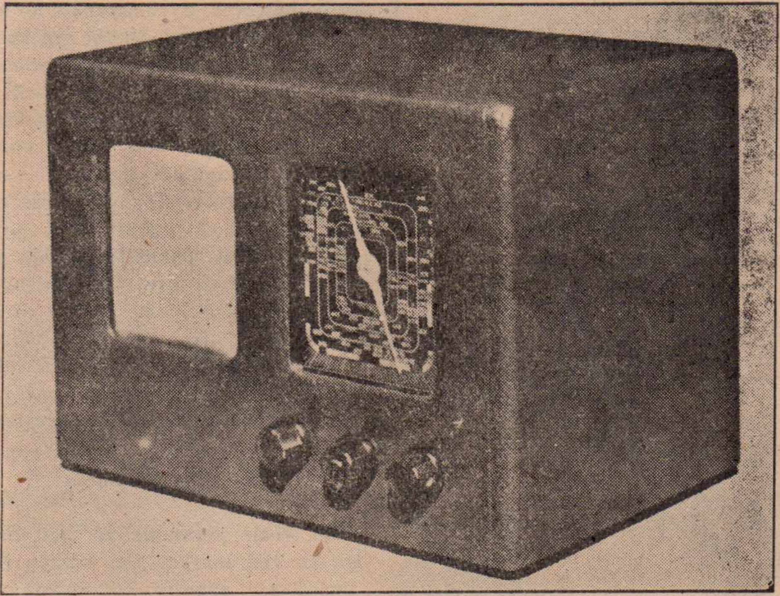
OUR FUTURE POLICY

NOW that the war is over and things are starting to settle back to normal, we feel the time is ripe to let our readers have some idea of what they can expect from "Radio World" in the future.

During the war period we had to operate under the most difficult cir-

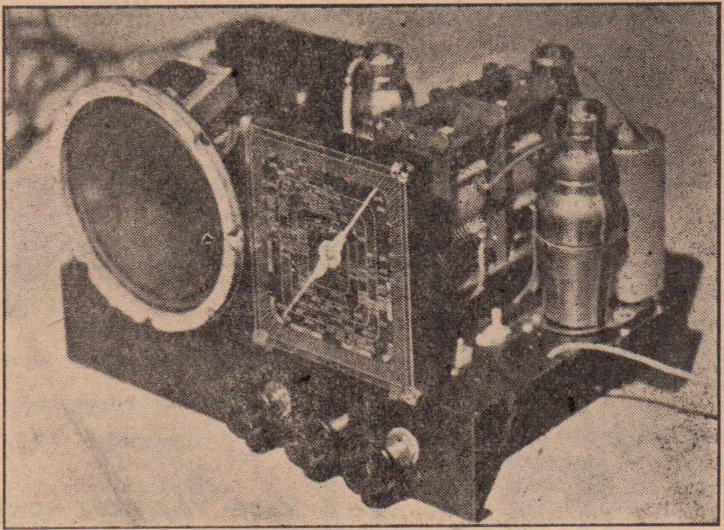
By
A. G. HULL

cumstances. Only the poorest quality paper was available, and mighty little of that, and stirctly controlled by the authorities. We used as much paper as we were allowed and tried to do the best we could with it. We know that the issues were not up to standard, but our subscribers apparently appreciated our problems, although under censorship regulations we were not able to stress them. Both our direct subscribers and those who buy from the bookstalls increased in numbers steadily. Few complained about the quality of the production.



Photograph of the finished set, which can be built from a kit of parts. Full details of how to build this set are to be described in next month's issue.

Manpower problems during the war were also acute, and the Sydney office was operated by a part-time manager, Mr. W. Walter, and a part-time secretary, Miss Vincent. Although it was a tough job keeping track of the many changes of adddresses which subscribers notified, these two hard workers made a splendid job of maintaining efficiency on the business side of the publication. Their efforts allowed the whole of the original pre-war staff to devote themselves to the more serious matters of war.



The chassis of the Aegis "Little Companion" to be featured in next month's issue. It is a dual-wave mantel model using five valves in all.

Loyal Advertisers

Another happy side to the troublesome times was the loyalty of certain advertisers. When the war clouds loomed, a few advertisers withdrew their support, saying that it could not help them to advertise when they did not have goods to sell. But there were others who took a far-sighted view. They determined to support "Radio World" to ensure that it would continue publication and hold together the technical interest in radio. To these loyal advertisers every reader owes a debt of gratitude.

The Future

Now our enthusiasm, banked up

POLICY

(Continued)

over those long years, is just bursting to be up and doing. Unfortunately, however, circumstances do not permit our hopes to be realised. Good paper is still quite unprocurable and even the poor stuff is scarce. Consequently, there is little hope for bigger and better issues from a production point of view. From the editorial angle there are also problems, for although parts are now just about free from restrictions, there are still shortages, and endless problems in this direction. Take, for example, valves. Plans for the use of preferred valve types have been published, but just try and buy a 6SB7GT converter!

Bit of a Scramble

In their scramble to get back on to the market the bigger factories are eagerly buying up the output of the components factories, and in some cases these factories are more keen to please factory buyers than to look after the interests of the enthusiasts and experimenters. Fortunately, we have our loyal supporters. Consequently, we are able to announce that in next month's issue we will be detailing a most attractive little mantel model for which a steady supply of complete kits of parts will be available from distributors in every State. The whole effort is a triumph of co-operation and organisation, and should be of inestimable help to the small dealers and enthusiastic set builders who like to "roll their own."

Circuit Design

The circuit design is not revolutionary and merely embodies the best of accepted practice. The components specified are not revolutionary either, but they do carry the many minor improvements and increased efficiency which came to light under the stress of war requirements. The price of the complete kit is surprisingly low, hardly, if any more expensive than the normal pre-war figure.

The set is a dual-waver with five valves in all, with the conventional line-up of converter, intermediate, detector, power and rectifier valves. A neat lay-out has been arranged to permit compact assembly without crowding. Performance is terrific, and there is so much gain to spare that even if alignment is not one hundred per cent, it is still possible to get every worthwhile station on both broadcast and short wave band.

And Then —

It makes us happy to announce that the loyal support of manufacturers and wholesalers makes it possible to start the ball rolling with this fine little mantel kit, backed by a guaranteed supply of thousands of kits for immediate delivery with nation-wide distribution. It gives us courage to face the problems with assurance that in a few months time we will be swinging along as merrily as before the war, and on a much higher plane.

Honour Roll

The following advertisers gave their support right through the war years. Although they had no need to do so, they advertised in the "Australasian Radio World" to enable it to continue publication, and thereby maintain interest in technical radio. Every reader owes these firms a debt of gratitude.

LOYAL ADVERTISERS

AUSTRALASIAN RADIO COLLEGE
—offering you a sound training in practical radio and theory.

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—Melbourne's leading radio parts wholesaler and sponsor of "Aegis" components.

W. J. McLELLAN & CO
—Sole Australian agents for the reliable "I.R.C." resistors.

MULLARD, AUSTRALIA, PTY. LTD.
—Australian distributors of those fine "Mullard" radio valves.

RADIOKES PTY. LTD.
—Builders of reliable coils and radio components.

R.C.S. RADIO PTY. LTD
—makers of precision-built radio components, featuring "Trolitul" insulation.

ROLA CO. (AUST.) PTY. LTD.
—offering the world's best loud speakers.

STANDARD TELEPHONES & CABLES LTD.
—manufacturers of the British "Brimar" valves.

TECHNICAL BOOK & MAGAZINE CO.
—foremost in Australia for technical books and publications.

TRIMAX TRANSFORMERS
—makers of high-grade audio and power transformers.

"AUSTRALASIAN RADIO WORLD" joins with its readers in offering a hearty vote of thanks to the above advertisers for their loyal support through the troublesome war-time period.

—A. G. HULL.

A PROLIFIC POST-WAR FIELD

THAT most interesting story about "Radio for Model Planes" in "A.R.W." for Agust, 1945, did not carry an author's signature, but I for one, don't need to be told that it was written by one of Australia's top-line exponents of home craftsmanship — A. G. Hull — your Editor.

Nobody in the world has made a fraction of the progress Ross A. Hull has shown in the application of radio to model aircraft control, and his passing in an untimely accident was a grievous loss to the science of radio — and in particular — the "Ham" world of radio. Radio and allied hobbies simply course through the veins of the Hull family — hence the tie-up suggested by the story referred to — that the W.I.A. and Model Aero Association should co-operate.

A Topical Survey

by

DON B. KNOCK
(VK2NO)*

In order to give the layman a verbal picture of just how much scope lies before the hobby of amateur Radio in this post-war era, the following survey is given.

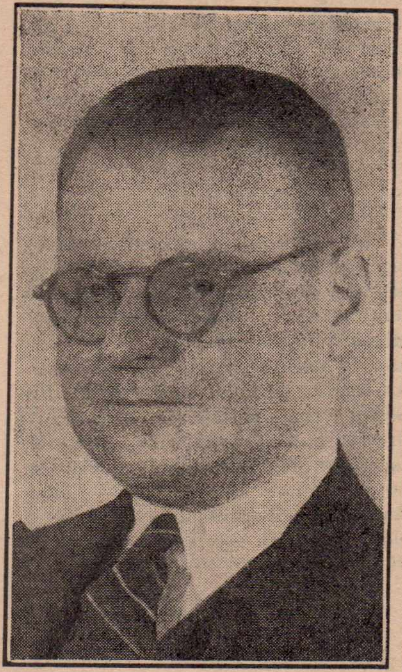
Bright Prospects

During the recent war (nice to think it is in the past tense), ofttimes I would run across people with a "Dismal Desmond" outlook about the future of amateur radio. So many people become so **used** to war they are apt to overlook the inescapable fact that wars, especially the modern variety, must surely end some day — and that with the victory of free nations — the freedom of the air would again be the order of things. In other words, our democratic way of life will see the Ham back calling "C Q", etc.

He has earned that right in no uncertain manner during the war, but that is another story — to be told in full some day. What will the Ham come back to? Will his wings (frequencies) be clipped short? These are topical questions, and the one about frequencies cannot yet be answered, although it might be so before this gets to "A.R.W.'s" press! But even if the Ham **does** have to sacrifice frequency territory in some regions — he looks like gaining it in other directions — V.H.F., for example.

Let's take a look at the field he (and **she**) will have before them. In Sydney recently W.I.A. members were addressed at a lecture by a council member with a wealth of physics lab. experience to draw upon, inclusive of wartime radar development. He was Mr. M. V. Lusby (VK2WN) and from his lecture that night, I draw upon ideas for the world of amateur radio now awaiting investigation.

The whole may be summarised under the heading of EXPERIMENTAL RADIO ACTIVITIES, with three divisions, namely, **Indoor, Outdoor** and **Associated Techniques.** The term "experimental" is more apt for this summary, as will be seen. Naturally, the **Indoor** aspect of radio is the one for first consideration, although the art has long since grown up and gone outside. The first thing that strikes one about radio, is then, **"General Communication"**, which embraces the popular idea of the Ham with C.W. (Telegraphy) and R/T (Telephony) two-way working. This may be on bands with the idea of long distance contact with fellow Hams overseas — no part of **this** planet is immune from the "DX" man. Or, contact inside our own coastline might be the idea, and if you don't think the country Ham likes a yarn on "80" with the city man — and vice versa — you are vastly mistaken.



Don B. Knock

Then under this heading comes purely local contact — cross city — or "short-haul" work by using the V-H-F's. Don't let anyone tell you **they** aren't useful either! The amount of experimental building and rebuilding of V-H-F gear to get receivers and transmitters to "perk" properly is a subject for volumes alone.

Next consideration is **Television.** It hasn't even reached Australia at the hands of the "Big Shots" yet—and the Ham is a resourceful bloke. He's likely to try anything — at least once. So don't sneer at vision possibilities!

A very important indoor phase of amateur radio requirement is that of **Frequency Standards and Measurements.** Here at once is a fascin-

(Continued on next page)

*Member Inst. of Radio Engineers (Aust.)
*Member Wireless Institute of Australia.
*Member Radio Society of Great Britain.
*Ex Major, A.I.F. Signals.
*Engineering Staff—Philips Electrical Industries of Australia Pty. Ltd.

HAM RADIO

(Continued)

ating and valuable field. Pre-war, our VK Ham quartz crystals came from two or three amateurs who made a study of production. Their standards were quite accurate and they didn't charge £6/10/- a pop for a crystal, either. A tip for the big factories — the Ham won't pay that kind of price for a square of quartz, plus or minus point one of one per cent notwithstanding!

Measuring Instruments

There are all kinds of measuring instruments falling under this heading for important use around the "shack." Next come **Hyper-Highs** and therein alone is a veritable world of radio on its own. Associated we find **frequency modulation** (that catch-cry of the lay press) **pulse modulation** and **research,** which just about covers the major indoor phases. But under **Associated Techniques** there is a close link with the indoor variations of amateur radio.

Recording Experiments

For example, **Sound Recording.** The methods of indulging in that satisfying and fascinating hobby are indeed numerous. They include sound-on-film, disc, steel wire, cellophane tape, treated paper (by embossing) and synthetic sound. The latter is a method of photographing drawn wave-forms and literally creating voices that never spoke. Next outlet is the one that prompted this survey — **radio control of models,** and that does not mean aviation alone. There are countless ideas for a lot of fun with model ships — railroads — just limited by imagination only! **Radar variations** we can't say very much about yet, but I remember a ZL Ham aiming 56 Mc/s signs for reflection from the moon. **That** might be a different story today with radar technique to draw upon.

Now for the great **Outdoor** world. The first consideration here is that of **portable low power equipment** in conjunction with field days organised by clubs. Pre-war amateurs enjoyed many a day's outing with portable gear in a competitive spirit, and **hidden transmitting** hunts could be a lot of fun; along with this goes **mobile** gear for use in cars or watercraft. Some of my most enjoyable pre-war amateur week-ends were put in driving over a fair amount of territory and working with stations as far as 60 miles away on 56 Mc/s (5 metres).

Emergency Networks are really a combination of the indoor and outdoor aspects, and this sub-heading is one of great importance. Amateurs have been the corner stone of safety in many disastrous situations such as flood, fire, gale, distress. Wrapped up in emergency work is also provision for radio networks for more serious national needs. War for example. Operator training for the fighting services is also something to be borne well in mind. Nobody was more apt than the late Lord Baden-Powell with his Boy Scout motto of "Be Prepared."

Next on the list is **direction finding,** which has a number of obvious application. **Mobile Air** radio for amateurs is no inapt idea because in this air-minded world — not a few will own their personal aircraft. The keen Ham owner pilot will probably make his own gear for flying the Radio Range (Beacons). **Remote Relay** is an application with certain possibilities for amateur radio, where V-H-F's are desirable, but line-of-sight working not possible. "Satellite", or reflector areial arrays on intervening hilltops can work wonders in putting a signal into a required spot, which brings me to the last, but probably one of the most discussed and important fields for experimental radio activity — that on **Antenna Research.** Every Ham with pretensions to **reliable** DX QSO's is at heart a research worker on aerial design and application. He doesn't usually string a wire anyhow and hope for the best. In these enlightened times he most likely sports a rotary beam array, or a comprehensive affair with a curtain of reflectors and directors. If he is a V-H-F addict he is likely to sprout weird looking contraptions in the rear garden. But if he is a dyed-in-the-wool Ham — his "contraptions" won't stay put for long — he will try to improve upon them. And that my son — is Ham Antenna **Research!**

ECLIPSE RECORDED BY RADAR

A Radar set used in the Battle of Britain formed part of the apparatus used in an elaborate series of experiments conducted in many parts of the country early in July to ascertain what effect, if any, the eclipse of the sun would have on radio transmission and reception.

For several days before the eclipse the staff of the research station at Datchet, of the Department of Scientific and Industrial Research, had been making preparations. With the aid of various precision instruments and cathode-ray tubes various members of the staff checked up every few seconds and took readings which later, when examined in detail, will tell experts whether or not the eclipse affected their instruments.

★

CULTIVATED CRYSTALS

Due to the present difficulty in obtaining natural quartz in Switzerland, the firm of Brown-Boveri, of Baden, are "growing" artificial piezo-electric crystals. The manufacturing process used was developed by Prof. Scherrer, of the Swiss Federal Insitute of Technology. It is stated that the artificial crystals differ only slightly in their properties from those of natural quartz.

Another development of the Swiss firm, described in the "Brown-Boveri Review", relates to the "Turbator" valve, designed for the generation of centimetre wave-lengths. Formerly, the output frequency was fixed solely by the internal valve characteristics, but means have now been devised for introducing variable external tuning by a Lecher wire system.

★

BROADCASTING ON LARGE TROOPSHIP

The 27,000-ton motor ship Georgic is now the finest and best-equipped troopship in the world. It has recreation rooms, cinema, up-to-date and well equipped sleeping quarters, spacious troop mess halls, and an elaborate system of broadcasting involving the laying of miles of new wiring, and the installation of hundreds of loudspeakers.

THE TRANSITRON OSCILLATOR

MUCH has been written in the past, and probably more will be in the future, about negative resistance oscillators. This article proposes to deal with probably the most simple and the most reliable of all negative resistance oscillators, e.g., the transitron.

The forerunner of the transitron oscillator was the dynatron, which also falls into the category of a negative resistance oscillator, but for several reasons cannot be said to possess as many desirable features as the transitron. One reason being that it relies largely on secondary emission properties in a valve for reliable operation, but as only certain types of valves exhibit this characteristic, it then should be obvious that only certain types of valves are satisfactory for dynatron operation. Again we find that secondary emission in a valve deteriorates rapidly with age, subsequently giving rise to erratic operation. While discussing the merits and demerits of valves as dynatron oscillators, it is the writer's experience that very few American-type valves are satisfactory for dynatron operation; in fact, the only two types that seem to possess the desired characteristics are the old 35 and the 24A, which in these enlightened days seem to be dying a natural death. Before discussing the transitron oscillator, which is of comparative recent vintage, a brief comparison between the two types may be briefly summed us as follows. The transitron oscillator retains all advantages of dynatron, while suffering none of its disadvantages, in that it does not rely on secondary emission for its operation and retains its negative resistance property throughout the life of the valve, and further more, does not deteriorate with age.

By

CHARLES MUTTON

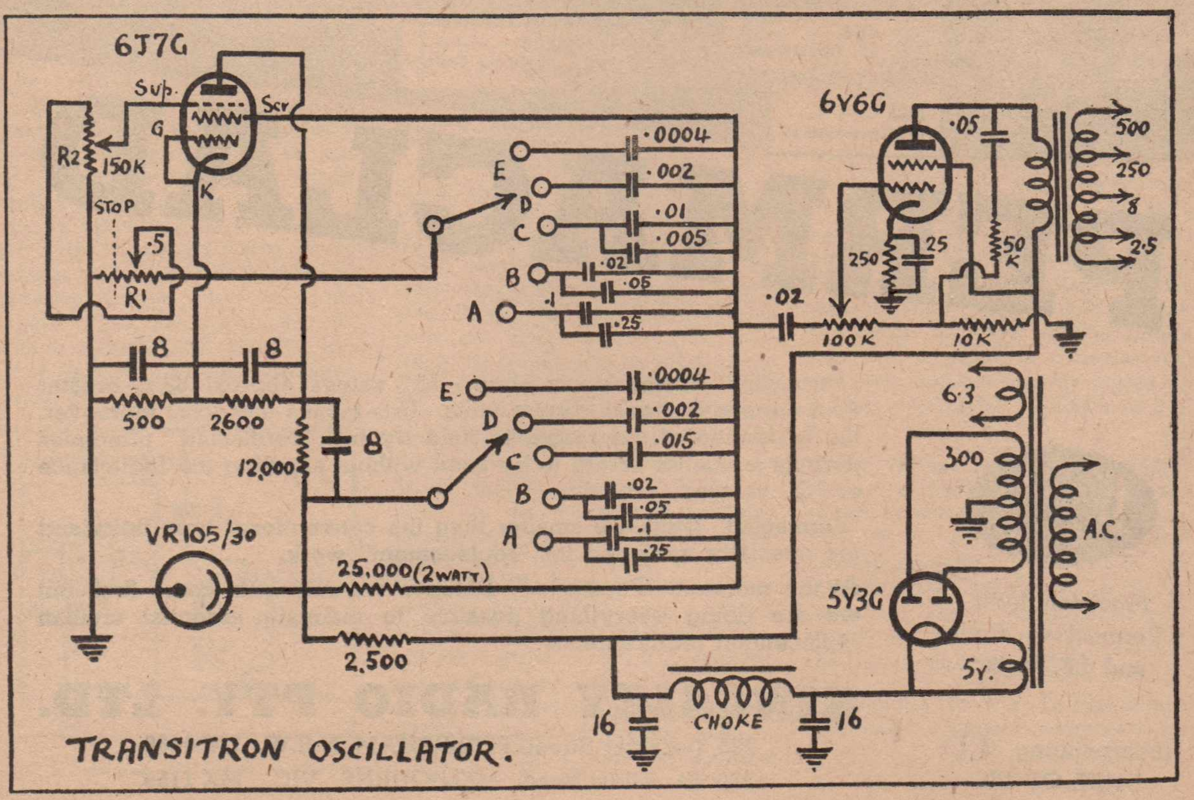
1 Plow Street

Thornbury, N.18., Vic.

No Feedback

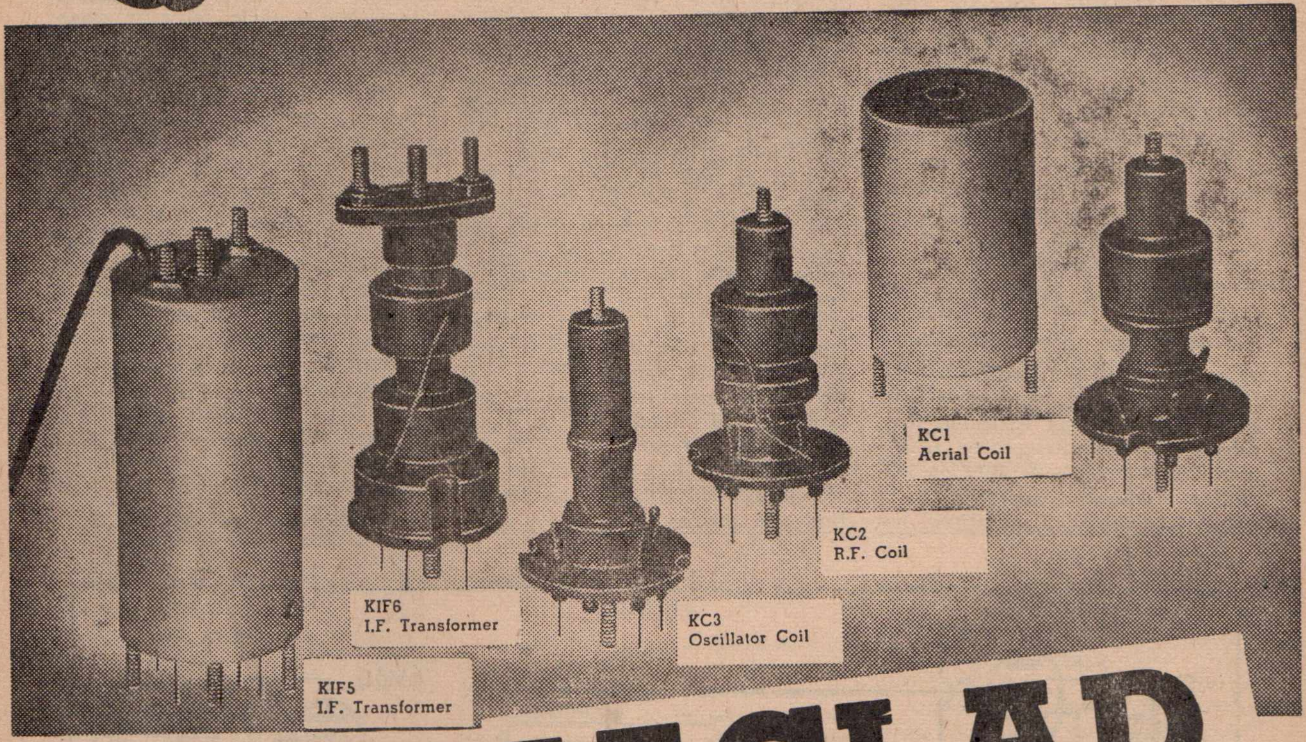
Negative resistance oscillators of this type possess the tremendous advantage that oscillation may be set up within a single valve by means of a simple resonant circuit comprising an inductance and capacity. Which means that a feedback winding or tapped inductance is not necessary to produce oscillation. In fact, oscillation can readily be obtained with even a simple resistance-capacity combination. Added to this fact, the transitron will oscillate at a screen voltage of 4.5 volts and a plate voltage of 3 volts. It makes an extremely attractive proposition to most experimenters. Admittedly the output voltage under these conditions is small, but amplification is no problem these days, and at these voltages the output wave-form is extremely good. As regards stability, Brunetti states in his paper, de-

(Continued on page 13)



"Q"

VALUES APPROX. 33% GREATER THAN CONVENTIONAL TYPE UNITS



PERMACLAD

"Permaclad" Components show "Q" values approx. 33% greater than the conventional type of units. This means less loss; moreover, the restriction of the magnetic field by the "Permaclad" principles permits a smaller shield to be used without affecting the inductance or "Q" values.

"Permaclad" Units are smaller than the conventional type units and are specially designed for "replacement" work.

At the moment, "Permaclad" Defence commitments come first, but we are doing everything possible to maintain essential civilian replacement requirements.

Kingsley RADIO

Precision built "Permaclad" Coils and I.F. Units.

Incorporating I.R.N. DUST CORES.

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380 St. Kilda Road, MELBOURNE, VIC. MX 1159

KR 552

TRANSITRON

(Continued)

livered before the I.R.E., on the transitron oscillator. "The stability of the transitron negative resistance oscillator compares favourably with the crystal oscillator without temperature control." The writer, in his own experiments, has found no reason to doubt the veracity of Brunetti's statement, in fact the stability obtained even without voltage regulation applied is astounding, and leaves little to be desired.

It is not proposed to discuss the negative resistance oscillator from the academic angle; in fact, experience shows that most of our readers are not interested in the purely academic approach. But at the same time the writer firmly believes in a semi-technical discussion of the main problems to be encountered before approaching the matter from the practical angle. So let us first examine the term "negative resistance."

Negative Resistance

It may be stated that, in general, by increasing the positive potential on say, the plate or screen of valve, we usually increase the plate or screen current, in which case the internal resistance is said to be positive. But if we create a set of conditions whereby an increase in positive potential produces a corresponding decrease in current, the device is said to possess negative resistance.

As we are going to be concerned only with a pentode valve in our pentodes which are suitable for our discussion, let us select the usual purpose. These are mainly 6J7, 57, 58, 6C6, 6D6, 607, 78, 77, 6K7, etc., any of these may be used with equal success, preference being given, perhaps, to the 6J7G, which seems to be a handy valve for lots of purposes, and is comparatively of recent origin.

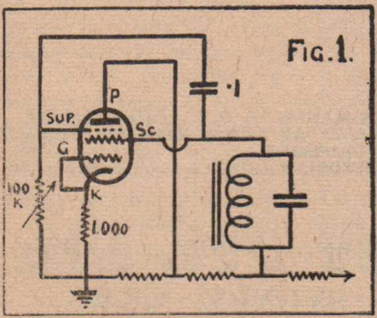


Figure 1, showing the basic transitron circuit.

Theory of Operation

When a change of potential is applied to the suppressor grid of a pentode, it appears in amplified form without phase reversal, on the screen grid. This is brought about in the following manner:

If the plate current of a pentode is interrupted, electrons continue to pass between the wires forming the screen grid, but are no longer collected by the plate, and must, therefore, return towards the screen: therefore the total cathode current in a pentode is constant, provided the screen grid and control grid potentials remain steady. As a result of this the screen current is increased when the plate current is reduced. However, by connecting the screen to a high potential source of supply through a high resistance, the change in screen current will be

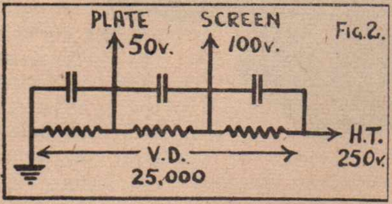
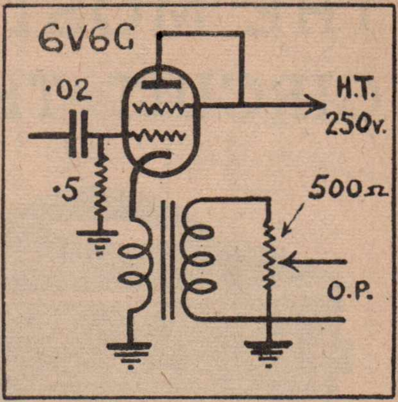


Figure 2, showing the recommended voltage feed system.

much smaller than the change in plate current, but there will be considerable change in screen potential.

By varying the potential of the suppressor grid the plate current is controlled, and this, in turn, controls the screen potential, so that when the suppressor is made negative the screen becomes less positive. A pentode which is provided with a high resistance in series with the screen may be, therefore, used as an amplifier, the input being applied to the suppressor (suitably biased) and the output, in the same phase as the input being taken from the screen. An amplifier of this type becomes an oscillator if a feedback circuit is arranged between the input and output circuit I.C. suppressor and screen.

The circuit of the transitron oscillator in its most simple form is shown on Fig. 1, and was identical to the one used by the writer in



Suggested revised output circuit to use cathode-follower system.

his experiments. The tube used was a 6J7G, the power supply was utilised from an old receiver, and the tuned circuit consisted originally of a small filter choke shunted by various values of fixed condensors. At first difficulty was experienced in obtaining oscillation until certain precautions in the power supply were taken. All attempts to feed the plate and screen by series resistors met with failure. This is due to the fact that all negative resistance devices require a supply which has a low internal impedance, this was proved by swinging over to a battery supply; under these conditions no trouble was encountered in getting to the tube to oscillate, due, no doubt, to the fact that a battery supply, provided the batteries are in perfect condition, has almost zero impedance. This trouble was quite easily overcome in the case of the power pack by the simple expedient of using a 25,000 voltage divider scheme which wastried out in con- and across each tap used to supply fact that all engative resistance de the plate and screen was placed an 8 mfd. electrolytic as shown in Fig. 2.

The voltage supply requirements are not critical, and as long as the screen potential remains higher than that of the plate, the circuit will oscillate readily. In fact, in the writer's case, trying 20 volts on the screen and 10 on the plate produced oscillation quite readily and the waveform was perfect.

Referring to Fig 1, the screen suppressor coupling condenser for

(Continued on page 15)

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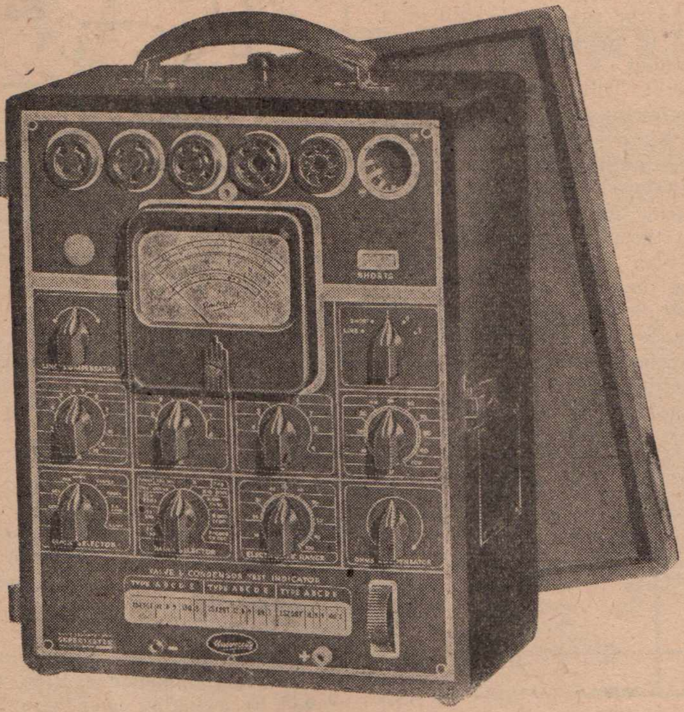

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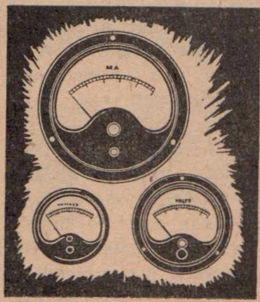

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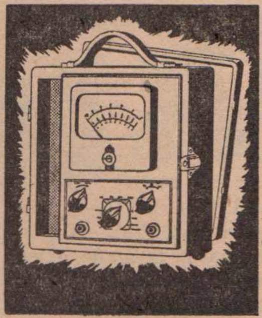

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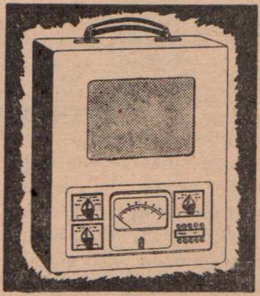

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RE 947.

TRANSITRON

(Continued)

all general work seems to be round about .1, I.C. For most audio work and frequencies up to about 50,000 cycles. If this circuit is used as an R.F. oscillator, then naturally the coupling can be reduced to about .001. The resistance from the suppressor to ground needs to be about 100,000, any great increase above this value the sine wave output starts to suffer, which has an adverse effect on the frequency stability. This is only to be expected, as distortion of a sine wave means presence of harmonics, in which case the frequency stability will not be good. For frequency stability in any oscillator it is very desirable to keep the harmonic content as low as possible.

C.R.O. Handy

A word here regarding the cathode ray oscilloscope. It is inconceivable to the writer how any experimenter can go very far on any test equipment dealing with signals of either audio or R.F. without using or possessing a C.R.O. Now that supplies of the 902 two-inch cathode ray tube are readily available, the writer urges all those who can afford same to make haste and build the complete job up. The whole set up, complete with time base, horizontal and vertical amplifiers, shouldn't cost much more than £15. The uses for such an instrument in the lab are a hundredfold, and its big advantage is it outs all guesswork and speeds up your work.

Bias Arrangements

Getting back to the "transitron" oscillator, it will be noticed that the writer has tied the grid to the cathode, and that the cathode has the normal bias resistor inserted, which means that the control grid is at a positive D.C. potential, equal to the voltage developed across cathode-bias resistor, where in a lot of similar circuits the grid is shown directly earthed. The only difference is that with the grid earthed directly the writer found difficulty in getting the oscillations to start. But with the other way no difficulty at all was had, the main difference being that with the latter way the current drain of the plate and screen is almost twice as much as with the grid directly earthed. In this connection it is desirable not to exceed 100 volts for the screen and 50 volts for the plate, under this condition everything is ideal. The tube keeps cool, the waveform is good and the stability is good, the drain being about 4 to 5 milliamperes, and the output voltage is somewhere in the region of 30 to 40 volts.

For R.F. Work

After having established a circuit to work on, all various inductances were tried, such as the primary of about 7 different speaker transformers, shunted by various condensers from 1 mf to 100 uuf; these were then replaced by an R.F. coil with a variable condenser shunted across it, and it was found that it made an admirable R.F. oscillator also. A check was kept at all times with the C.R.O. and the waveform in all cases left little to be desired.

Adding Modulation

In Fig. 3 will be seen another scheme which was tried out in connection with the R.F. oscillator. It is essentially two tuned circuits in series, one R.F. and the other audio, in this way we have a variable R.F. oscillator modulated by an audio note, the frequency of which may be varied by shunting various values of condensers across the primary of, in this case, a Rola 7,000 speaker transformer. The inductance of the R.F. oscillator was merely the secondary of a standard R.C.S. broadcast aerial coil. With suitable modifications this arrangement could be used to make up a handy service oscillator. It will be realised how simple the scheme is when all inductances used are of the single winding type, no reaction or tapped windings are necessary to produce oscillation.

After all the experiments were carried out with inductances it was decided to try out a different scheme.

For Electronic Music

The writer wanted a number of fixed frequency oscillators for an experiment in electronic music, in which connection a large number of fixed inductances was a big disadvantage due to space, weight and expense, so it was thought desirable to use or apply resistance tuning if possible. This worked out quite well in practice, the only difference being that the available output voltage was down, but having the advantage that the frequency could be changed quite readily by using a variable resistor or a 100,000 volume control from the suppressor to earth. The only other change was to replace the tuned circuit in the screen to a resistance of 25,000 ohm, 1 watt carbon type in place of the inductance. On hooking the job up it performed quite satisfactorily, the potentiometer from the suppressor to earth was used for fine frequency adjustment and by shunting the 25,000 screen resistance with odd values of condensers, a coarse frequency or frequency band adjustment was obtained.

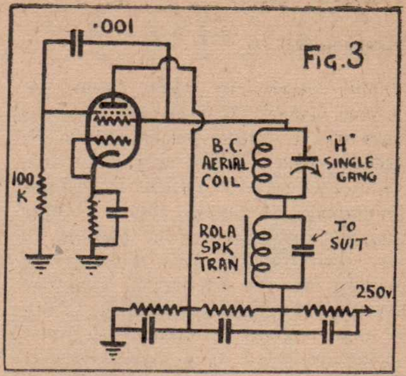


Figure 3, suggesting an experimental r.f. oscillator with modulator.

Frequency Factors

The effects noticed were as follows. Increasing the amount of resistance from suppressor to earth decreased the frequency, and at maximum resistance the waveform was slightly distorted and the output voltage was greatest. On going the other way and decreasing the resistance the frequency started to rise, the output voltage drops off gradually, and the waveform assumes perfect shape. This continues until a point is reached where the tube is just oscillating, the output is small and the waverform very stable and free from harmonic content, decreasing the resistance any further from this point, causes the tube to stop oscillating, due to the fact that there is not enough resistance in the suppressor circuit to keep oscillation constant.

(Continued on page 16)

TRANSITRON

(Continued)

The output is taken from the screen circuit through an .01 condenser. As would be expected, direct loading of the screen in this manner causes the output to change frequency; to avoid this a buffer stage is desirable before feeding to an output device. This removes the loading on the oscillator itself by keeping everything isolated, which is only normal practice with most oscillators used as a signal source.

Variable Frequency

The writer came across a circuit of a complete audio oscillator using the "Transitron" resistance tuned oscillator principle in an old "Radio", August, 1942. It is republished here for those interested. The circuit is simple and uses few components and has the advantage that no inductances or variable condensers are used. The frequency is varied by a 500,000 potentiometer, shown R1 in the circuit. Inverse feedback is used from plate to grid in the output circuit.

The VR105-30 is used to stabilise the voltage from the power pack; a desirable feature but not essential, because of the inherent stability of the "Transitron" itself. The potentiometer marked R^2 is used only to set the output waveform correctly, after this is done it need not be touched again. The frequency ranges covered are: A, 12—100 cycles; B, 100—400; C, 400—2,000; D, 2,000—10,000; E, 10,000—20,000.

The two gang five position switch changes the capacities in the screen and suppressor circuits simultaneously, which helps to retain constant output voltage and is used also as the band switching arrangement, fine tuning being accomplished by R1, which, incidentally, is only used over portion of its travel: the stop should be put in at about 150,000 ohms from the earth end. The shaft of this potentiometer should have some sort of calibrated dial attached for calibration purposes.

An improvement to this circuit is suggested by the writer. In view of the fact that the output voltage of the 6J7G oscillator is far in excess of that required to fully load the 6V6 output stage, only half of the 100,000 ohm gain control on the 6V6 grid is usable. The worst feature, however, is that this control severely loads the oscillator circuit in certain positions, this should not happen, so in the writer's case, when trying this circuit out, all the trouble was obviated by cutting the feedback network out, using a fixed .5 meg resistance from the 6V6 grid to earth and then put the output transformer in the cathode of the V6, thus converting it into a cathode follower stage with all its attendant advantages, high input impedance, low output impedance, and no overloading effects. The output control was then shunted across the secondary of the transformer and consisted of a 500 ohm potentiometer wire wound job. After doing this, no trouble was observed as before. The output control was smooth, had no effect on the frequency of the oscillator, and was satisfactory in every way. The available output voltage on all bands was approximately 25 volts with the output control set at maximum.

VIBRATORY POWER SUPPLIES

Their Theory and Operation

UNTIL recent years battery receivers obtained their high-tension supplies from dry batteries consisting of numbers of 1.5 volt cells connected in series producing the required potential, such units being rather expensive, heavy and short-lived. With the advent of vibratory power supplies the need for separate H.T. batteries was eliminated and was specially suitable where there were facilities for accumulator charging.

Vibratory power supplies had been in use for some years in environments as telephone exchanges, such units being unsuitable for radio work, particularly in the portable field, as they were relatively fragile and expensive to replace. Modern vibrators are compact, capable of withstanding mechanical jarring, operate in any position and over a range of varying conditions, and have the advantage of being quiet both mechanically and electrically.

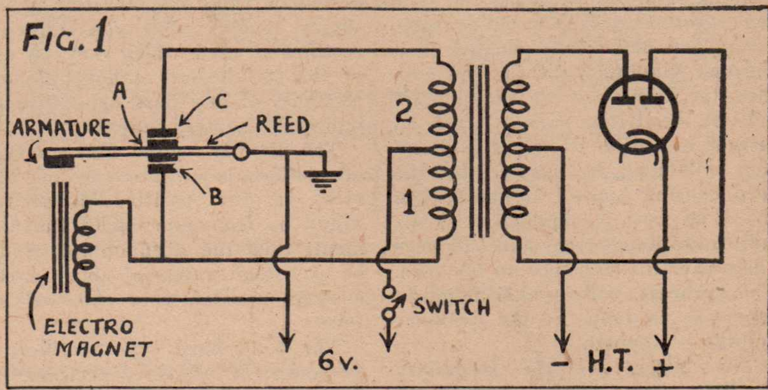


Figure 1, showing circuit of vibrator power supply with valve rectifier.

Fundamental Theory

The fundamental theory of the vibrator is simple — varying magnetic lines of force induce an E.M.F. (voltage) in a conductor under its influence. If a source of DC, say a 6-volt accumulator, is applied to the primary winding of a transformer and some method is used to pulsate

By

CHARLES ASTON

(make and break) this current, a varying magnetic flux will be developed in the core of the transformer. Briefly, the reason for this is when the circuit is made the current in the primary winding will increase until it reaches maximum value and when the circuit is broken the current will decrease to zero, the cause of this rising and falling effect is the inductance of the winding. Thus, by making and breaking the current circuit a magnetic flux that increases and decreases has been produced which satisfies the condition for transforming, and an E.M.F. will be induced in the secondary winding.

The Vibrator

The actual vibrator consists of a springy metal reed fixed at one end, the other end is free and positioned to come under the influence of the electro-magnet, consisting of an iron core on which is wound a coil of wire suitable for use with the primary voltage it is desired to operate at. On the reed is attached one or two contacts, each with a pair of staionary contacts fixed each side, so that when the reed is made to vibrate it will make contact first, with the contacts on one side and then the contacts on the other.

Not only does the vibrator perform the operation of pulsating the primary current, but also acts as a commutating switch, reversing the direction of the current flow through the transformer. This is shown in Fig. 1 and will now be considered.

Vibratory Operation

It should be kept in mind that the primary winding is centre tapped and for the purpose of explanation each half is regarded as a separate winding, as they are used alternately. The common connection or centre-tap is connected to the positive of the primary current, and when winding 2 is open-circuited and there is a current flow through 1, the magnetic field will be of a certain polarity. When 1 is open circuited and 2 closed, the current flow will be in an opposite direction, producing a magnetic field of opposite polarity, the total result being that produced by an alternating current applied across the whole primary windng.

When the switch is closed there will be a current flow from the positive to the centre tap through winding 1, then through the electro-magnet which attracts the reed closing contacts A and B. As contact A is earthed there will be a current flow through winding 1. The reed will only remain in this position for an instant, for when the contacts close the terminals of the electro-magnet are short-circuited, thus losing its attraction for the reed, its tension "springing" it away from B and its momentum will cause it to fly past the position of rest and onto contact C. Now contacts A and C are closed, thus a current will flow through winding 2. This reversing of the direction of current flow through the primary winding is the commutating action of the vibrator.

(Continued on page 18)

VIBRATORS

(Continued)

When contacts A and B were broken there was once again a current flow through the electro-magnet winding, but the path for the current through winding 2 and contacts C and A is of lower impedance than through winding 1 and the EM coil, thus the excitation of the magnet will be relatively small. After an instant a tension of opposite direction will now be exerted by the reed, causing A and C to break, then the E.M. coil is supplied with its full excitation current and will once again exert its influence on the reed. This process will be continuously repeated as long as the primary voltage is applied.

The output of the secondary winding is of alternating character and a rectifying device must be used in conjunction with a suitable filter, as with similar types of AC power supplies. Two methods are used to obtain rectification of the output, one is by the use of a power rectifying valve, and the other by using a second set of contacts, the vibrator acting as a synchronous rectifier.

Non-Synchronous Vibrator

The power supply shown in Fig. 1 is the non-synchronous, or asynchronous type of vibrator power supply and a valve type full-wave rectifier is used which may be one of the self heated cathode gaseous rectifiers of any hard type with an indirectly heated cathode.

The directly heated filament type of rectifier is unsuited in this service, as the positive connection would be from one leg of the filament, thus the accumulator would be at a high poteneial above earth, a very unsatisfactory state of affairs.

The 6X5, hard type rectifier, is designed for use as a rectifier for vibrator power supplies where the demand for rectified current is low. In order to obtain satisfactory output and regulation, careful attention should be given to correct filtering. It is unlikely that the AC input voltage will be of pure sinewave form, so peak values may be considerably greater than 1.4 times the R.M.S. value and the filter condensers must be capable of handling the possible peak values.

Where economy of operation is desirable, type OZ4, full-wave gaseous rectifier, may be used. No heater supply is required, as this valve is of the ionic heated cathode design. This type will handle high peak current in service with a constant drop. Care should be taken that an efficient earthed metal shield is provided, as otherwise R.F. interference may be radiated.

Wave Form

When the unit is in operation and the primary circuit closed, the accumulator is connected across one half of the primary winding and a counter E.M.F. is induced, which is in opposition to the battery potential. During the brief period the contacts are closed the counter E.M.F. remains substantially constant. When the contacts open, the induced potential (counter E.M.F.) starts to reverse owing to the collapse of the magnetic field and an E.M.F. develops of opposite polarity to the original counter E.M.F.

It is now obvious that a damped oscillatory current has been developed in the primary, also the secondary, which comes under its influence, and several oscillations may occur during the period the reed is passing from one stationary contact to the other, which is itself capable of causing considerable interference.

A more serious effect will occur if the contacts close at the instant when the oscillatory current in that half of the primary winding is in opposition to the polarity of the battery, such a condition being conducive of serious sparking.

The corrective for this effect is to reduce the frequency of oscillation by connecting a condenser in shunt to the secondary winding. The capacity of this "buffer condenser" is reflected into the primary circuit and is of such value that the induced potential in the primary winding has reversed but does not exceed the battery voltage when the alternate set of primary contacts close.

The buffer condenser is, therefore, for the purpose of correcting the electrical resonance of the transformer so it will be in time with the mechanical resonance of the vibrating reed. Many factors must be taken into consideration when choosing the value of this condenser, and for most satisfactory results should be done with the aid of a cathode ray oscillograph.

With a correct value of buffer condenser the potential wave form in the windings consists of half-cycles of alternate polarity with flat tops, each flat top being connected to the next by a sloping line terminating in a sudden voltage change when the contacts close.

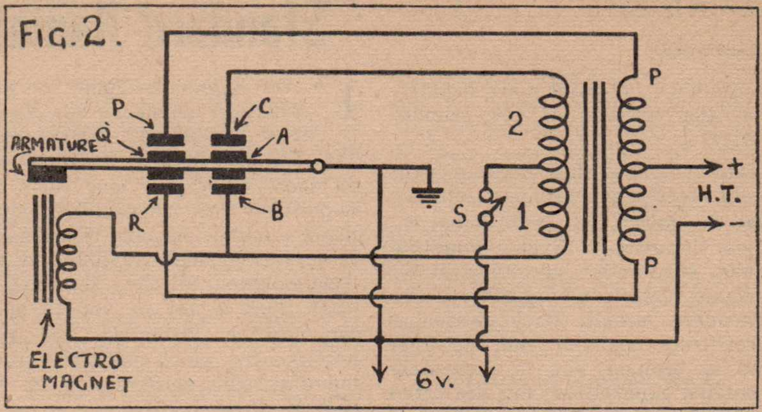


Figure 2, showing circuit of vibrator power supply of the self-rectifying type.

Synchronous Vibrator

Synchronous rectification of the secondary winding output is made possible by the addition of another set of contacts to the vibrator represented in Fig. 2 by P. Q and R, and are the secondary contacts which operate in synchronism to the primary contacts; thus the name "syncronous vibrator." The action of such an instrument will now be considered.

When switch S is closed there will be a current flow through primary winding 1, through the electro-magnet, which then attracts the reed closing contacts A,B and Q,R. This results in winding 1 being connected to the primary battery, inducing an E.M.F. in the secondary winding due to the varying magnetic flux. This induced E.M.F. will be in such a direction that the centre tap will be positive to end r of the winding. The half of the winding between the centre tap and p will have no effect as p is open circuited.

End r is connected through the closed contacts R, Q to earth, thus the centre tap is positive to earth. When the reed is in this position it also short circuits out the electromagnet, thus losing its influence on the reed, its tension causing it to spring back, closing contacts A, C and Q, P. The primary current will flow through winding 2, then through contacts C and A, causing a magnetic flux of opposite polarity to previously, thus end p of the winding will be negative to the centre tap, and as it is connected to earth through contact P and Q, so the centre tap is once again positive to earth which, as usual, is the negative connection: this full-wave rectification of the secondary winding output has been accomplished.

The secondary contacts are arranged so as to close after and open before the corresponding primary contacts. The object of this is that when the primary contacts close or open, the transformer is in the condition of no-load, as a result the primary current flow at these instants will be reduced to a minimum, with a consequent reduction of destructive arcing at the contacts.

The fact that secondary contacts close after the primary ones causes no adverse results of the secondary winding output, as the input filter condenser is charged to the same potential that is developed across the operative half of the secondary winding, and the greater portion of this charge is retained when the reed is swinging to the alternate contact. Thus, when the secondary contacts are either making or breaking no great differences in potential are involved, reducing undesirable sparking.

In the domestic receiver the synchronous vibrator is almost universally used, as they eliminate the need for a rectifying valve; cost no more than the non-synchronous type; have a higher efficiency, as no heating current for a rectifier valve is required and there is no potential drop as across a rectifier valve; and for reasons given suffer less deterioration due to sparking at the contacts than the non-synchronous type.

Split-Reed Vibrators

A disadvantage of the synchronous type just described is that with directly heated valves it is necessary to provide a separate bias battery for the grid bias of the output valve, the reason for this being that the negative connection of the secondary winding and a terminal of the primary battery are at a common potential as they both utilise the reed of the vibrator as a common conductor, so it is not possible

(Continued on page 20)

to obtain a potential more negative that the negative of the primary battery.

To overcome this deficiency the "split reed" synchronous vibrator was developed and, as its name implies, the reed is divided longitudinally, one section operating in the primary circuit and the other in the secondary circuit. Each section is electrically insulated from the other and is brought out to separately insulated connections, but are fitted with a common armature, a piece of metal that is fixed to the free ends of the split reed and is influenced by the electro-magnet.

It is now possible to connect the high tension output to the receiver irrespective of it using back-bias or not, due to the complete isolation of the low and high tension supplies.

In other respects this type of vibrator follows the same principle as the ordinary synchronous vibrator.

Interference

The use of the vibrator type power supply introduces greater interference problems than encountered with other types of power supplies and special precautions must be taken to prevent this interference being excessive.

For convenience the interference produced has been resolved to four main headings:

(1) **Direct Pick-up,** by either unshielded coils, exposed grid leads, or the aerial lead itself.

(2) **Plate Modulation** of the radio-frequency or detector valves, due to improper filtering of the plate supply voltage.

(3) **Heater or Filament Modulation** of any of the R.F. amplifier or detector valves, due to insufficient filtering of the direct current source to the filaments and power supply.

(4) **Voltage Pick-up** in any of the high frequency circuits (usually grid circuits), due to the chassis base being used as a common carrier of current of the desired frequency and also the interfering frequency.

It will be noted that the buffer condenser and filtering devices have been omitted from both illustrations.

Standard Radiotrons for 1945-1946

In the September issue we published an article on the Radiotron preferred valve types. This has been slightly misunderstood by some readers to give them the impression that the preferred types listed would be the only types manufactured and made available by the Amalgamated Wireless Valve Company. This is not so, and to make the position absolutely fool-proof here is a list which shows the actual manufacturing programme of the A.W.V. factory.

1.4 Volt GT

The following will continue to be available for new equipments and replacements until the 1.4 volt miniatures are available and thereafter for replacement purposes only:—

1A7-GT Converter.
1H5-GT Second Detector.
1P5-GT R.F. and I.F. Amplifier.
1Q5-GT Power Amplifier.

1.4 Volt GT

(For replacement purposes only.)

1D8-GT* Diode-triode-power amplifier.

1.4 Volt Miniatures

(For 1946 new equipment.)

1R5 Converter
1S5 Second Detector.
1T4 R.F. and I.F. Amplifier.
3S4 Power Amplifier.
3Q4 Power amplifier for sets using 90 volt B. Batteries.

2 Volt Preferred Types

(New equipment types for both 1945 and 1946.)

1C7-G* Converter.
1K5-G R.F. Pentode.
1K7-G Second Detector.
1M5-G R.F. and I.F. Amplifier.
1L5-G Power Pentode.
1H4-G Triode Driver.
1J6-G Class B. Amplifier.

*With the addition of an improved converter to take the place of type 1C7-G for 1946 new equipment.

2 Volt Old Types

(For replacement purposes only.)

1A4-P R.F. and I.F. Amplifier.
1C4 R.F. and I.F. Amplifier.
1C6 Converter.
1D4 Power Pentode
1D5-GP R.F. and I.F. Amplifier.
1H6-G* Second Detector.
1K6 Second Detector.
19 Class B. Amplifier.
30 Triode Driver.

*Type 1H6-G may be used to replace type 1B5/25S, which is not at present in production, the two types being electrically identical, but having different sockets.

A.C. Range

The following will continue to be available for initial equipments and replacements until the single- ended GT series is ready, and thereafter for replacement purposes only:—

6A8-G Converter.
6J8-G* Converter.
6J7-G R.F. Pentode.
6U7-G R.F. and I.F. Amplifier.
6G8-G Second Detector.
6B6-G Second Detector.
6V6-GT Power Amplifier.
5Y3-G Rectifier.
6X5-GT Rectifier.

*To continue to be available for new equipment as well as for replacements.

A.C. Single-ended GT

(For 1946 equipment.)

6SB7-GT Converter (a high-slope version of type 6SA7-GT now in development, but not yet standardised.)
6SJ7-GT Sharp cut-off R.F. pentode.
6SK7-GT Super-control R.F. Pentode.
6SF7-GT Diode Super-control R.F. Pentode.
6SQ7-GT Duo-diode high-mu triode.
6V6-GT Power Amplifier.
6X5-GT Rectifier.
5Y3-GT Rectifier.

For large amplifiers there will also be types:

5R4-GY Special Rectifier.
807 Beam Power Amplifier.

A.C. Miniature Types

It is proposed to develop two miniature A.C. types, both high-slope R.F. pentodes, one with a super-control characteristic and other with sharp cut-off.

A.C. Special Types

For special studio and public ad-

(Continued on page 29)

RADAR'S WORK WITH THE NAVY

WHEN Radar, Britain's "Magic eye," was first fitted in ships of the Rayol Navy, it was received by the uninitiated as "another new gadget." That phase did not last long, for its potentialities were quickly recognised. Although its primary function was to warn of approaching aircraft, part of the blessing of having a Radar set, in those early days of World War II, was the help it gave in navigation.

To be presented suddenly with picture of everything one **cannot** an invention which produced a clear normally see at sea — everything which had hitherto been too small or too far away, or too obscured by rain or fog — this was a fantastic luxury for seamen.

by

Lieut-Cmdr. LANCE DALZIEL, R.N.V.R.

Giving, as it did, a clear picture of a whole convoy, and its outlying escorts, Radar was a tremendous help in station-keeping at night or in bad weather; and it revolutionised, overnight, the whole practice of gunnery. At the turn of a knob, the Gunnery Control Officer could now pass to all guns an **exact** range and bearing of the target, and keep track of the smallest changes as they occurred.

Navigation Problems Solved

Ships made port with some very tall yarns of what their Radar sets had done. "I use it to come alongside the oiler," said one corvette captain, "but it starts to blur as soon as the heaving lines go across." As operating skill grew and the sets themselves were improved, the results in action overtook or surpassed these earlier claims. Not only this clear picture of a convoy; not only the picking up of conning-towers and periscopes at fantastic distances — these became commonplace; but echoes from rain-squalls, floating boxes, seagulls, small dan-buoys which might otherwise have been missed — began to appear in ship's Radar logs, testifying both to the skill and alertness of operators and the amazing sensitivity of the new sets.

In the realm of navigation, of course, Radar solved a dozen problems which had worried seamen ever since ships put to sea. Fog and poor visiblity could now be neutralised—the Radar screen showed what was moving ahead and round about, no matter how thick the weather.

Buoys could be "picked up" on days when their lights could hardly be seen 50 yards away, days when a vital turn of the channel might have been missed. Now they came on the screen at several miles distance, simplifying coastal navigation to a very great degree.

Indeed, anything which was likely to "get in the way" — a big piece of wreckage, a rock, another ship — showed up in good time, in any weather, and unaffected by anything except the worst rolling, when the "echo" might become intermittent.

Land could be seen as a contour which could be matched to the charts, to establish the ship's position: the whole shore line could be plotted, an opening such as a river mouth or bay found in the worst weather, a lighthouse or other solid landmark, a lightship, an off-shore beacon.

Assault Landings

This navigational side of Radar came into its full flower in the most important task of all — the assault landings in North Africa, Sicily, Italy and Northern France. On countless occasions Radar cut through all guesswork, all bad luck and bad weather, and led Britain's landing parties ashore at the exact spot at the exact time. The immense superiority and quantity of Radar fitted in almost every type of ship made possible the accuracy and concentration of the D-day assaults, and stultified the subsequent enemy attacks on Allied shipping and on the vulnerable "Mulberry" harbours.

Radar saved many lives, too, in the realm of "air-sea rescue," picking up airmen sitting in rubber dinghies or perched on the wreckage of their machines; and, of course, in the Atlantic and elsewhere, scores of survivors from merchant ships owned their lives to Radar, which detected, two or three miles away, the ship's boats and rafts which otherwise might have been passed in the darkness.

Benefits of Applied Radar

To these general benefits of the new invention must be added those of "applied Radar" — the application of this scientific device to other branches of fighting and sea-going, and the changes and developments it brought about. In broad survey, these may be listed under four headings: Gunnery Surface Vessel Hunts, Air Plotting and Warning and Anti- U-boat Warfare.

Optical instruments previously used for gunnery and torpedo fire were now supplemented or supplanted by Radar instruments of great precision, which enabled guns to straddle the target frequently and virtually eliminated the former guesswork in range measurement. Guns could effectively open fire at greater ranges; and fire against unseen targets was now possible, both against surface ships and aircraft, ranges being accurate to within a few yards.

The successes in the Battle of Matapan owed much to Radar control of gunnery. Indeed, in this decisive action, which resulted in the sinking of three cruisers and two destroyers, Radar played a great part from the beginning. The early warning which it gave enabled our ships to be brought to instant fighting readiness long before the enemy knew of their presence; in fact, the Italian ships were hopelessly caught out, and when they were finally illuminated, at close range a few second's before H.M.S. Warspite's opening broadside, their guns were still trained fore and aft. This first broadside secured hits with five out of six 15 inch shells — a striking

(Continued on page 22)

RADAR

(Continued)

tribute to the accuracy of Radar reports of the enemy's range and bearing.

Detected Scharnhorst

In both the Scharnhorst and Bismarck actions, Radar was of inestimable value both in finding the enemy, and in determining ranges and bearings when the time came to join battle — the "find, fix, and strike" which is the basis of war at sea. In the case of the Scharnhorst, the enemy was first detected by the cruiser Belfast at a range of 35,000 yards (17½ miles), and this early detection and the gun-engagement which it led to, undoubtedly saved the North Russian convoy which the Scharnhorst was threatening. For a time contact was lost, but was re-established by Radar at 30,500 yards; and for a considerable period, until the arrival of the Duke of York, the Scharnhorst was shadowed by our destroyer force relying entirely on Radar and keeping outside visibility distance. The Duke of York first picked up the enemy at the extreme range of 45,500 yards (22¾ miles) and closed it to 12,000 before opening fire; there is evidence that the Scharnhorst was completely unaware of her presence until her first salvo.

A valuable convoy might have met disaster and the Scharnhorst escaped entirely after the first gun-action, if Radar (of a type far superior to anything the enemy carried) had not been available to detect and shadow her in the twilight of those far Northern waters. As it was, this formidable enemy unit was hunted, engaged and sent to the bottom, in a classic Fleet action, with a minimum of damage and casualties to the Royal Navy.

The sensitivity of these sets is such that the actual fall of shot can be plotted by Radar; the water thrown up by a falling shell gives a sizeable "echo" which can be plotted in relation to the target. The whole system of "spotting" in gunnery can thus be taken over by Radar, with a consequent elimination of guess-work and the errors and uncertainty of visual judgment.

Nor does this apply only to the bigger ships. Small craft, such as torpedo and gunboats have their Radar sets, specially adapted for their size. They have made a vital difference in out-manoeuvring and defeating E-boats in those swift-running actions and in attacks on enemy convoys which might otherwise have slipped through in the bleak and murky weather off enemy coasts.

Without the help of Radar, it is possible that the Bismarck's final dash south-east to the protection of Brest, might have been successful; again it was Radar which enabled the British warships to keep in touch with the Scharnhorst, which would otherwise, in the semi-darkness of the North Cape, have been able to slip away and escape punishment. Weather in both these actions would normally have made it impossible either to find the target or to engage it with any degree of certainty and accuracy; Radar supplied the "eyes" in the first place, and Radar gave to the subsequent gun-actions a formidable degree of accuracy.

Eyes of the Air Arm

In the air, Radar has been a potent aid. To the aircraft carriers of the Fleet Air Arm it has been invaluable, enabling them to plot their aircraft, to direct them to their targets, and to land them on in weather which would, a few years back, have forbidden flying altogether. Fighters have been able to intercept hostile aircraft, and ships to be at Action Stations and ready to give the raiders a hot reception. By means of that ingenious instrument, I.F.F. (Indicator Friend or Foe) it is now possible to determine whether an approaching ship or aircraft is hostile or not — an extension of Radar which would, in the early days of World War II have seemed to be in the realms of the supernatural. This detection of hostile aircraft was of especial value to the English East Coast, with its many tip-and-run raiders, and also on those Malta convoys which had to run the gauntlet of attack all the way from Gibraltar to their journey's end. Russian convoys, too, found the immense value of this early warning of attack; many men and ships owe their lives to being closed up at Action Stations instead of being caught by cloud-hopping aircraft which were invisible until they started their torpedo and bombing runs.

Vital Ashore, Too

The use of Radar ashore, in coastal areas and for the defence of harbours, has also been a naval undertaking of great importance. In the early days of World War II, a few special Radar sets which were being built for the Royal Air Force were taken off production, modified, and installed by a party of naval enthusiasts and a few scientists at key points in the approaches to Scapa Flow. They were the first Radar sets used ashore for surface watching.

The defence of harbours was advanced in 1941 by the installation of special naval apparatus to provide a close watch over the entrance to certain vital ports, and in particular to spot enemy mining by aircraft and other means. These sets were closely linked to the defences of the ports and would have proved invaluable had a German invasion materialised.

From 1942 onwards there was a steady improvement in the "Coastal Chain," as it came to be called, of surface-watching stations.

As the power of the apparatus increased, the range of cover extended and these shore stations (by 1944 manned almost exclusively by R.A.F. or W.A.A.F. under inter-Service agreement) were enabled, in conjunction with Naval Plotting Rooms, to play a very important part in the defence of East Coast Convoys again E-boat and air attack and to control the vast amount of shipping needed for D-day. The organisation provided a continuous plot at the principal ports of all ships and aircraft in the vicinity of British ports. Indeed, ships came to rely on them to quite a large extent in those areas, for example, on the East Coast, where fog might interrupt convoys and run ships into danger from sandbanks and sunken wrecks. On a number of occasions ships which have strayed from the swept channels have sent the simple signal, "Where am I?" to the shore Radar plot. In all cases they have been told.

Inter-Service Co-operation

It has been mentioned that these coastal sets were in a large degree manned by the R.A.F. An interesting example of inter-Service co-operation was provided in 1943 when the enemy's low-flying attacks by aircraft against South Coast towns had reached serious proportions. By flying low the aircraft managed to evade the existing Radar sets, and owing to lack of warning many casualties resulted. Fortunately, about this time a high-power naval set, capable of detecting ships at long ranges and also low-flying aircraft had been developed.

When a bomb fell on a school at Ashford, in 1943, 300 school children were saved by the four minutes warning given by one of these exclusively naval sets at Dover, which enabled them to proceed to shelter, just in time.

Finally, Mobile Naval Radar equipment, landed in North Africa, Sicily, Italy and Normandy, assisted in the defence of anchorages against surface attack, and in the control of the enormous masses of shipping which arrived and assembled at the beach-heads.

Beating the U-Boats

The fourth, and last, section of Radar development, its application to anti-U-boat warfare, is probably the most important of all: Radar was the greatest single factor in ensuring the defeat of the U-boats and consequently in winning the vital battle of the Atlantic. With its aid the U-boats were **kept down** — the most important thing of all, ensuring that they could be outdistanced by convoys and could not catch them up.

Radar enabled escorts to detect, instantly, the appearance of any U-boat on the surface near a convoy; they could be watched as they came in to attack, and intercepted; they could be detected by patrolling aircraft far from the convoy, and forced to submerge and lose touch with their prey.

Schnorkel, the underwater breathing apparatus, was Germany's reply to Radar. Detection of so small an object as a submarine periscope or conning-tower presented a very difficult scientific problem, and the solving of it in so short a time, at such a vital stage, was one of the major events of the whole war.

The technique established by the development was later applied by all the Services and by the U.S.A. to nearly all other Radar problems affecting the size and accuracy of equipment and the ability to detect and distinguish small targets. It is with the help of these devices that Britain and the U.S.A. far outstripped the enemy in the precision both of their attack and their defence.

THE THEORY BEHIND PROPER

Part 3 — THE OUTPUT STAGE

Distortion is more distressing to the musically trained ear than the average one, which is usually unable to detect the presence of five per cent second harmonic distortion, the odd harmonics are more displeasing, the higher ones being even more so.

Intermodulation causes another unpleasant form of distortion and occurs when one frequency modulates another, producing frequencies equal to their sum and difference which tend to be discordant. If one is 2,000 cycles per second note, and the other a 100 cycle one, frequencies of 1,900 and 2,100 cycles per second will be set up.

Harmonic distortion causes the output to sound "tinny" as the undesired frequencies introduced are multiples of the natural frequencies. Intermodulation distortion produces unnatural reproduction that sounds discordant.

Triode, Class A

A triode is the least sensitive of any of the A.F. power valves requiring a large signal input and a high negative bias.

The value of the plate circuit load of a triode is not very critical, but worth while improvements can be made if carefully chosen. The load that gives maximum power output will contain not only the input signal frequency, but also a number of its harmonics. It is more usual to utilise the load giving maximum undistorted power output, this term is used in a broad sense as harmonic distortion, mainly second and third, is still present which may total five per cent, but is still covered by the term.

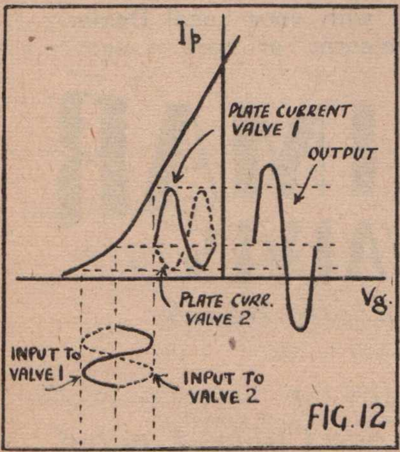


Figure 12, showing the operation of class AB push-pull amplification and the manner n which the distortion is cancelled.

Power Output

For maximum power output the load of the triode should equal its plate resistance, and for maximum undistorted power output the load should be about double the plate resistance.

The power triode is more likely to have an impedance as its plate load than a resistance and 400 cycles per second is usually the frequency at which the valve is matched to the load.

Modern broadcast receivers are designed to have a power output several times in excess that which will be normally used, this is due to the considerable variation in the strength of the audio signals. If the design is for an undistorted output of one watt, which is sufficient for the average room, it would perform well on the low and medium sound levels, but when a loud sound is to be amplified the valve would be overloaded and introduce considerable distortion. It is desirable to have an output valve that is capable of at least four times the average level of the undistorted power output required. This at first may seem extravagant, but is necessary if freedom from distortion is required.

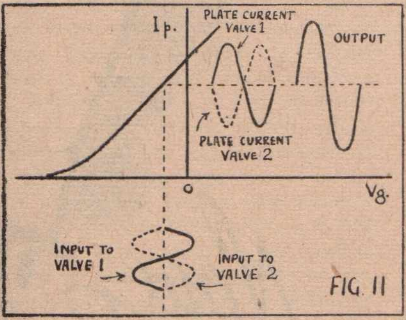


Figure 11, showing the curves of class A push-pull linear amplification.

Plate Dissipation

The current flowing through a power amplifying valve is quite large compared to a voltage amplifying valves which introduces another problem, that if dissipating the heat generated at the plate by great numbers of electrons hitting it at exceedingly high velocities. If the heat cannot be radiated or dissipated quickly the plate temperature will soon become excessive, ruining the valve by causing the electrodes to exclude occluded gas.

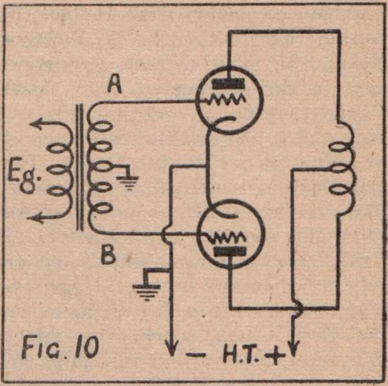


Figure 10, showing the connections for push-pull amplification.

As we have seen, the average plate current in a class A amplifier is steady and constant, and as power is the product of current and volts the power dissipated at the plate is equal to EI, and care should be taken this with the power output of the valve.

Manufacturers place a maximum rating on the plate dissipation of each valve, and this should not be exceeded.

Pentode, Class A

The power pentode was developed to provide an output valve with higher efficiency, better power sensitivity than obtained with a triode without reduction of power output.

The plate circuit efficiency obtainable from a class A triode is about 20 or 25 per cent, while that from a pentode is around 30 or 35 per cent, quite a large increase.

The pentode has the advantage that its amplification factor is greater than the triode, resulting in less signal voltage to be applied to the grid to produce the same output as a triode. These advantages have resulted in the pentode power amplifier being used in the output stage of broadcast receivers for a period of some years.

The pentode, unfortunately, brought with it considerable harmonic distortion and the requirement of a critical value of plate load up which the degree of the distortion and the power output are strongly dependent, and even when correctly chosen will produce large values of distortion. When the plate load is a speaker the effect of its inductive reactance is that an increase in the frequency will produce an increase in both harmonic distortion and power output developing considerable amplitude and frequency distortion.

This type of amplifier is essentially a constant current valve and a reactive load will tend to maintain this constant current and the plate resistance is always high compared to the load impedance.

Pros and Cons

The pros and cons of triodes and pentodes will now be considered:

(a) Triodes provide a practically distortionless output. A pentode may be operated with special circuits to reduce distortion, but reduces its advantage of a higher amplification factor.

(b) The triode load impedance is not critical and will operate from a power supply where the voltage may fluctuate without introducing distortion.

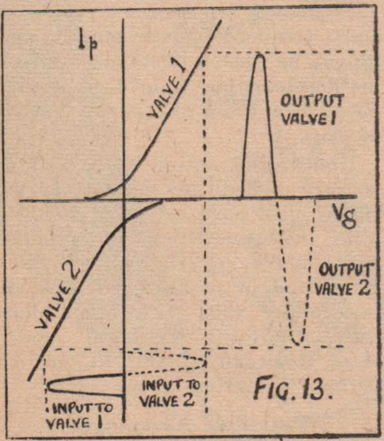


Figure 13, showing the curves of class B push-pull.

(c) Pentodes possess a higher amplification factor, thus requiring less signal input voltage, which may eliminate a stage of voltage amplification.

(d) The power efficiency of a pentode is about 50 per cent higher than a triode.

Parallel Class A Amplifiers

This type of amplifier is seldom used owing to the advantages of push-pull operation, but in modern radio transmitters parallel connection of class C power amplifiers is quite common.

The power output obtained from this type of amplifier is twice that of a single valve, and calls for nothing extra in pre-amplification as the control of the grid is electrostatic. The plate current requirements and distortion are doubled

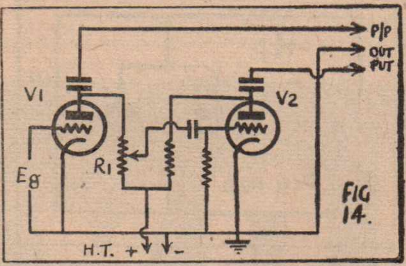


Figure 14, showing the paraphase method of obtaining push-pull operation.

and the impedance of the plate load halved.

The large plate current may cause core saturation of the output transformer unless it is of ample proportions, and such a unit would be costly.

Push-Pull Amplification

To produce an output greater than that obtainable from a single amplifier, two valves are used in "push-pull", the circuit of which is shown in Fig. 10; its operation may be described as follows:—

Across the secondary winding of the input transformer the signal voltage will be induced in it, the output of this winding is connected to the grid of each push-pull valve, and it is obvious that when the alternating signal input causes end A of the winding to become positive, B will be negative. Somewhere in the winding between these two potentials a zero or "earthy" potential will exist, and this is at the centre of the inductance where a tapping is made and connected to the common input circuit (cathodes). The signal voltages applied to the grids will be equal and 180 degrees out of phase, for when the grid of one valve is becoming negative the other will be coming more positive and vice versa. Due to this reason the current through one valve is decreasing, while that through the other is increasing, thus the 180 degree phase relationship will also exist across the output transformer, the primary winding being such as to cause the outputs to be additive.

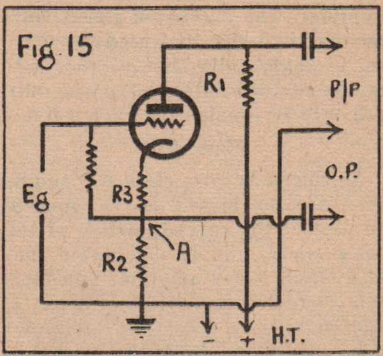


Figure 15, showing the simplicity of the "concertina" phase splitter.

Class A Push-Pull

Class A push-pull amplification is illustrated in the curves shown in Fig. 11; it can be seen that the two inputs are 180 degrees out of phase and are biased so as to operate on the straight portion of the IpVg characteristic curve — only one curve is shown, but as the valves are matched, will apply equally to each valve. The outputs are shown as being 180 degrees out of phase, but are additive due to the effect of the plates load resulting in an output twice the amplitude of either valve, the arrangement for obtaining this result is known as "differential connection."

The load impedance of each valve is the same as required for a single valve amplifier, so the plate to plate load resistance will be double that of a single valve. The efficiency will

(Continued on page 26)

AMPLIFIERS

(Continued)

be the same as for a single valve amplifier. The maximum signal voltage may be twice that used for driving a single valve, but as the voltage is divided into two parts only half will be applied to each valve.

Class AB

As shown before, class AB amplifiers are so biased as to operate on part of the curved portion of the IpVg curve, and it was stated that as a single valve amplifier considerable distortion is introduced, but if operated as a push-pull amplifier this distortion would be considerably reduced by cancellation, and how this occurs will now be shown (Fig. 12).

The valves are now biased so they operate in the curved region and the input voltages are shown as being 180 degrees out of phase and produce plate currents with similar phase relations, and it can be seen that the bottom half of each curve is of less amplitude than the top half and when valve 1 is producing is half of high amplitude, valve 2 is producing its half of small amplitude and, due to the differential connection, will be additive and will produce the top half of the output curve. Now, when the plate current of valve 2 is producing its half of high amplitude, valve 1 is now on its low amplitude half, added will produce the bottom half of the output cycle equal in amplitude to the top half, thus producing an undistorted amplified output of the input. It perhaps can be made clearer by letting the high amplitudes of both cycles be equal to two units each and the halves of low amplitude equal to one unit each it should be evident that the two halves of each cycle will both equal 3 units, so producing an output cycle of undistorted output.

If one of the valves were operated as a class AB amplifier, and the other in class A, there would be no cancelling effect owing to the symmetry of the class A output and the result would be considerable distortion. As the grid is based more negative with this type than class A, the steady plate current is, as a result less, so the anode dissipation is reduced, and also permits the application of a larger input signal. It has the advantage over class A that with suitable valves it is possible for a great increase in power output with only a very small increase in plate voltage, but the input signal usually requires greater pre-amplification owing to the necessity of using a stepdown audio transformer, as said earlier, to prevent distortion if there is a flow of grid current during very large signal inputs.

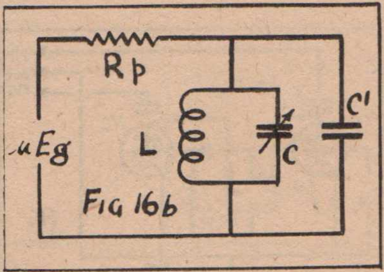


Figure 16b, showing the equivalent circuit of the r.f. transformer-coupled stage.

Push-Pull Class B

The operation of this type of amplification is depicted in Fig. 13 and it can be seen that the conditions outlined previously for class B are fulfilled — the grid is biased nearly to cut-off and the two valves work on alternate halves of the input signal.

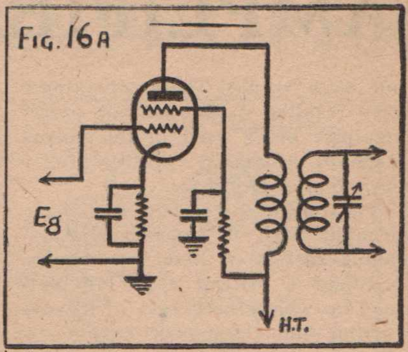


Figure 16a, showing a typical r.f. transformer-coupled stage with tuned secondary.

The two halves of the output valves are additive due to the differential connection producing in the output an amplified version of the input signal.

By examination of the curves it will be seen that when one valve is amplifying its half of the cycle, the grid of the other is so biased that it will have not plate current flow — or very little — and when there is no signal input the plate current of both valves is practically zero; from this it should be noticed that plate dissipation is kept low and has a direct relation to the input signal and as plate dissipation is the factor limiting the output of a valve this is a very desirable feature.

The efficiency of class B is particularly good and the theoretical maximum is round about 78 per cent and it is this feature that makes its use common in the output of radio receivers when economy of operation is required with a large audio frequency power output, and it can be shown that for a given plate dissipation class B will give about five times the power output of class A.

Undistorted output with class B is very difficult to obtain as the valves must have very similar operating characteristics to produce equal halves of the output wave form, and in practice are difficult to produce this, with other difficulties outlined previously under class B usually limits its use to battery operation.

Push-Pull Advantages

The most outstanding advantage of push-pull operation is its ability to eliminate, by cancellation, second

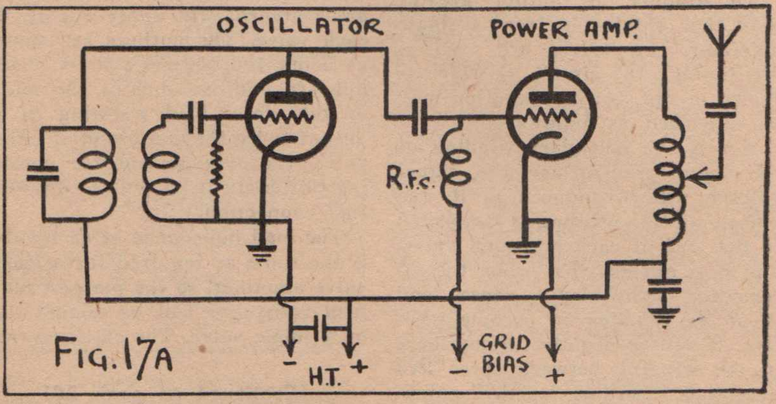


Figure 17a, showing circuit of a simple transmitter.

harmonic distortion, and for that matter all the even harmonic distortion and this represents practically all the distortion in the output of a triode power valve. It also permits a larger input signal, which produces a larger output power without any increase in the content of harmonic disortion, due to this cancelling effect.

Owing to the opposite flow of steady plate currents in the primary winding of the output transformer their magnetic fields cancel, thus preventing core saturation.

Push-pull amplification reduces the effects of hum from the AC power supply, as they are also cancelled in the output.

Valve Methods

Due to the expense of a high fidelity push-pull transformer, other methods have been devised for obtaining signal voltages 180 degrees out of phase of equal amplitude. The two most common types are "para-phase" and "phase splitter."

Para-Phase

The basic circuit for a paraphase system is shown in Fig. 14, and can be explained as follows:—

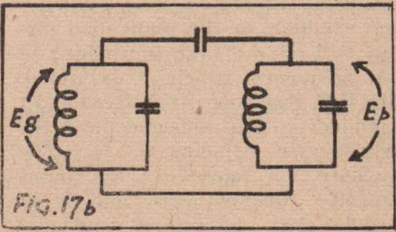


Figure 17b, showing the coupling that is caused by the feedback capacity.

The signal voltage can be noted to be applied in the usual manner, and the output developed across the late load resistance R1 and, due to the phase reversal properties of the valve, this will be 180 degrees out of phase with the signal input. A suitable portion of this is tapped from R1 and applied by the resistance-capacity coupling method to the input of V2, which will likewise reverse the phase so in its plate circuit will appear a signal voltage 180 degrees out of phase with the output of VI, thus an output suitable to drive a push-pull amplifier has been produced.

The tapping on R1 is such that the amplitude of the output of V2 will equal the amplitude of the output of V1. After this is set and there is any alteration of the characteristics of V2 due to age, distortion will result and the balance is upset.

Phase Splitter

An example of the valve operated as a phase splitter is shown in Fig. 15, and its operation is as follows:

The load resistance of the valve is divided into two parts, one in the plate circuit, R1, and the other in the cathode circuit, R2; R3 provide the grid bias. If the signal voltage of the grid goes negative the plate current falls, so the voltage drop across R1 is reduced and the plate becomes more positive with respect to earth; at the same time

(Continued on page 28)

AMPLIFIERS
(Continued)

the voltage drop across R2 plus R3 is reduced, making the cathode and the point A at the junction of the resistance less positive with respect to earth; opposite results occur when the signal input is positive. The result being the plate and cathode signal output voltages are 180 degrees out of phase and suitable for driving push-pull amplifiers.

If the cathode and plate load resistors are equal, the output of the phase splitter is balanced, so requires no adjustment.

The stage gain of this circuit is less than unity, the reason for this being the large amount of negative feedback, due to the resistance of R2 which is common to both the input and output circuits. This disadvantage has not restricted the use of the circuit, owing to its simplicity and inherently good balance.

Receiver H.F. Amplifier

Radio frequency amplifiers are of two main types — transmitting and receiving. The former may be of class B or C, voltage, or power amplifier, while the latter is invariably a class A voltage amplifier.

Due to the feedback capacity (see "Valves in Theory and Practiice", November, 1944, issue) triodes are unsatisfactory as high frequency amplifiers. Modern practice is to use pentodes in this service, owing to their overwhelming advantages.

A typical H.F. receiving amplifier, either R.F. or I.F., is shown in Fig. 16a; it can be seen transformer coupling is used and is most common, although choke coupling could be used but is not as satisfactory as the transformer. The transformer illustrated has an untuned primary with a tuned secondary the equivalent circuit shown in Fig 16b.

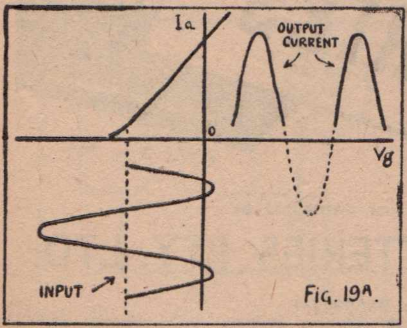


Figure 19a, showing the portion of the cycle (dotted) that is caused by the flywheel effect in Class B amplification.

On examination it will be seen that the transformer is represented as a single inductance because, in practice, it almost acts as one. The reflected capacity of the condenser C causes a tuning effect of the primary winding, so the plate load circuit will have a high impedance to the frequency which it is tuned. The R.F. resistance of the secondary winding is also reflected into the primary, so reducing its Q. The capacity C1 represents the input capacity (grid-cathode) and is in parallel with the tuning condenser C.

Transformers for use as an I.F. amplifier has both the primary and secondary separately tuned. The selectivity and amplification are effected by the coupling, which is very critical — if the coupling is decreased the selectivity is increased at the expense of gain; when the coupling is increased greater amplification results, but with a loss of selectivity. The resulting transformer is usually a compromise of these two factors. It is an easy

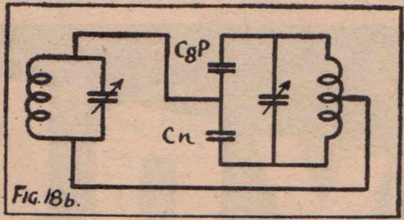


Figure 18b, showing the effects of feedback capacity with the Hazeltine neutralising.

matter to obtain a stange gain of 40 in a H.F. amplifier.

H.F. Distortion

Modern equipment has made the producing of a distortionless H.F. a simple matter, but one or two points must be watched if this characteristic is to be retained.

Modulation Distortion

The type of distortion is caused by not operating the valve on the straight portion of its characteristic, and results in one half of the output frequency having a greater amplitude than the other, or it may also be caused by the signal input overloading the valve.

Side-Band Cutting

If the H.F. amplifiers are made sufficiently selective, the band of frequencies passed will be reduced. The modulation may swing the carrier 10 kc/s. on the high audio frequencies, and if the selectivity is high enough it will not be capable of passing this band width, so when

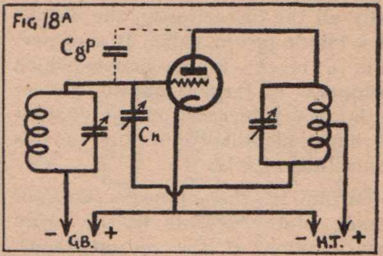


Figure 18a, showing the Hazeltine method of neutralising.

the signals are detected portions of the higher audio frequencies and the reproduction will sound lifeless.

Cross Modulation

Cross modulation is the modulation of the desired signals carrier by an undesired one at the input of the valve. For this to occur it is necessary that the total of the two signal voltages is sufficient to drive the grid into the curved portion of the IpVg characteristic curve, and the two signals will be reproduced in the receiver's output.

If the desired signal is the carrier without modulation, the only output will be that of the interfering signal, as there has to be two modulations for cross modulation to occur. Of course, if the desired signal's carrier were turned off, nothing would be reproduced as there is no carrier for the interfering signal to modulate.

For overcoming cross-modulation the selectivity of the first input circuit is of the most importance, and if this is sufficient to prevent the potential interfering signal from reaching the input of the valve, distortion will not occur.

Transmitter R.F. Amplifiers

The requirements of radio frequency transmitters are in several ways different to the receiver type. Firstly, much greater powers are involved and the emphasis is laid on efficiency and is obtained by the use of class B and class C amplifiers.

The oscillator provides the exciting voltage which is applied by a coupling system to the input of the amplifying valve, which output may either feed the aerial or another stage of amplification, the first shown by a simple circuit, Fig. 17a, suitable only for low frequencies. The grid circuit of the amplifying valve is connected to the bias voltage through a radio frequency choke which has a high impedance at the frequencies to be amplified and also performs the purpose of keeping the R.F. out of the grid bias supply. The output circuit is tuned to resonance and loosely coupled to the aerial.

It will be noted that a triode valve is used as a power amplifier, and at radio frequencies the feedback capacity (grid plate) must be taken into consideration, as this may cause the amplifying stage to oscillate, generating spurious frequencies and although this effect may be overcome by the use of pentode or tetrode valves it is quite common practice to use a triode in this service, and how the feedback capacity effect is elminiated will now be considered.

Fig. 17b illustrates the equivalent circuit of a power amplifier the input and output being coupled by the feedback capacity, the output voltage Ep will drive a current completely through the circuit, thus overcoming the effects of the smaller input voltage Eg producing a potential difference across the input, this is then amplified by the valve, thus conditions for self oscillation have been produced.

Hazeltine developed the method of overcoming the feedback effects; this is shown in Fig. 18a, and its equivalent circuit Fig. 18b, a portion of the output voltage that is 180 degrees out of phase with the feedback voltage is fed through a "neutralising condenser" to the input (grid) of the valve and the neutralising voltage will be of equal amplitude to the feedback voltage. We now have two voltages, at the same point, of equal amplitude and 180 degrees out of phase, and will thus cancel out. Several other methods of neutralising have been developed, but will not be considered here.

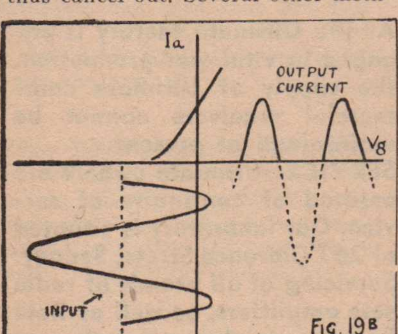


Figure 19b, showing the portion of the cycle (dotted) supplied by the flywheel effect of Class C amplification.

The flywheel effect, as described in class B, is shown in Fig. 19 where the dotted portion of the output curve is caused by this effect, thus completing the cycle in both class B and C amplifiers, and it was shown that the tuned tank circuit in the output acted as a filter to the harmonic frequencies that were produced and would only respond to the required frequency.

A class C amplifier delivers current from the output of the valve at the correct instant to develop and act with the flywheel effect the voltage drop across the valve will be relatively low, then so the energy dissipated at the plate is low, but the efficiency under conditions may be as high as 85 per cent. Normally a class C amplifier is biased so the plate current will flow for about 12 degrees of the 360 of the input cycle.

Class B is capable of providing larger power gains than is possible with class C, but suffers from a lower efficiency, about 65 per cent. As a linear amplifier, class B is only capable of about 30 per cent efficiency and is only used where very high power outputs are required.

Frequency Multiplication

Another use of the R.F. amplifier is to produce in the output circuit a frequency that is a multiple of the input frequency.

As we have already discovered in the output of a class B or C amplifier, there is not only the fundamental frequency but also a range of harmonic frequencies, and by tuning the output tank circuit to one of these it will be developed in the output and the fundamental with the other harmonics will pass through the circuit; it is not unusual for the tank circuit to be tuned to as high as the fourth harmonic, thus the output frequency is four times that of the input.

Frequency multiplication has the advantage that the stage does not have to be neutralised, as the frequency of the input and output are different.

STANDARD RADIOTRONS FOR 1945-46

(Continued from page 20)

dress amplifiers, initial equipment and replacements.)

1603 Non-microphonic pentode.

6SN7-GT* Twin triode.

*Available from stock.

A.C. Old Types

(For replacement purposes only.)

5V4-G	Indirectly-heated Rectifier.
6A7	Converter.
6B7*	Second Detector.
6B7S	Second Detector.
6B8-G*	Second Detector.
6C6	R.F. Pentode.
6D6	R.F. and I.F. Power Amfier.
6F6-G	Power Amplifier.
6H6-GT*	Twin diode.
6K8-G*	Converter.
42	Power Amplifier.
75	Second Detector.
80	Rectifier.
83V	Indirectly-heated Rectifier.

2.5 Volt A.C. Types

2A5
45
47
57
58

*Future local manufacture uncertain.

ELECTRONIC PROCESS TIMER

Designed for the control of all types of industrial processes and machine tools, including rubber moulding presses, bar twisters for concrete reinforcing rods, etc., this unit makes use of a single thyratron valve and gives a range of timing intervals from 0 to 25 seconds with an accuracy of 5 per cent. It can be employed also as a time delay switch.

Contactors are fitted to handle up to 5 amps AC at 230 volts; larger contactors can be fitted to order. The instrument requires a mains input of 200-250 volts, 50 c/s, and is contained in a case measuring 6-in. x 6-in. x 3-in. The makers are G.G.C. Development Co., 109 Belgrave Road, London, S.W.1.

Shortwave Review

CONDUCTED BY L. J. KEAST

NOTES FROM MY DIARY—

NOW IT CAN BE TOLD

One of the stations heard regularly during the Japanese occupation of Java was Radio Djokjakarta. Using the frequency of our old friend YDA, Batavia, viz., 18.135 m.c., or a wave-length of 16.54 metres, they were heard at various times during the day with programmes directed to Australia, and signal was generally good. This station will be well worth watching, as also JANS, Djokjakarta on 12.27 m.c. 24.45 metres, who had a nightly programme directed to the Allied Forces in the Pacific.

Incidentally, in passing I might mention various spellings of Djokjakarta have been noted; in fact, I have 6 different ones in front of me, taken from maps, an Atlas and a Globe in my den they are: Djakarta, Djockjokarta, Jokjakarta, Jogjakarta, Jogyakarta and the one that I used above, which I fancy can be considered correct as it is taken from a booklet sent to me in 1937 by The Netherlands Indies Broadcastiing Company Ltd., N.I.R.-O.M. Batavia-Java. The pronunciation as supplied by the C.B.S. publication, War Words is JOHG-YAH-KAHR-TAH.

OCTOBER

October 3 was the third coldest October 3 in Sydney on record, but summer is just around the corner, judging by the behaviour of the daylight overseas stations. Already there is a sign that the night transmitters are anxious to be heard. Maybe we will shortly find Germany and Italy again regularly. But this time the English we will hear will be the truth, if news casts are made, and the announcements will be in decided contrast to the distasteful stuff that punctuated and spoilt a programme of beautiful music.

MONITORING

The BBC Monitoring Service has grown in five years to a highly organised and professional news service, comprising six hundred employees and listening to every audible broadcast from all over the world. Before the end of the war in Europe it was listening to about one and a quarter million words a day in thirty-two languages. Some three hundred thousand words are daily transcribed into English, of which approximately one hundred thousand words were daily published in a Daily Digest of World Broadcasts, and twenty-five to thirty thousand words a day were flashed as an urgent service on teleprinter to nineteen war, Government, and BBC departments. All recordings are filed in numbered containers for at least forty-eight hours after they are made, so that they can be produced for reference purposes.

THE VOICE

So "Tokyo Rose", as the Yanks styled the girl we knew as Anne, and who was the "feature" of the Zero Hour over the Jap stations directed to Australia, is Iva Ikuko Toguri, aged 30, and by no means as attractive as her seductive broadcasts had suggested. She is a former resident of Los Angeles and student of the University of California.

. . . —

And the name of a still further voice has been revealed. That is "Colonel Britton", who popularised the V (. . . —) campaign in occupied countries. He joined the BBC's European section in March, 1939, and made his first broadcast in June, 1941. He told the invaded countries of the V for Victory campaign, he tapped out on the table of the studio from where he was broadcasting the now famous . . .—, and he played the opening bars of the Beethoven Symphony No. 5. This rhythmic "V" spread like wildfire. And the man responsible for this campaign which roused the invaded countries and greatly helped to keep up their nerve and morale was Douglas E. Ritchie, a former South African farmer, reporter, sub-editor and literary critic, who joined the BBC in 1937 as assistant to the Overseas News Department. He is now Director of European Broadcasts.

●

Printing difficulties prevent the inclusion this month of a specially prepared list of U.S.A. East Coast schedules, but here are some late changes in Australian shortwave overseas transmissions:

VLG-6, 15.23mc, 19.69m: 12 p.m. —2 p.m. (Sundays 2.30).

VLG-5, 11.88mc, 25.25m: 1.15 a.m. —1.45 a.m.

VLG-4, 11.84mc, 25.34m: 2 a.m. —2.45 a.m.

VLG-10, 11.76mc, 25.51m: 6.58 p.m.—8.15 p.m.

VLG-3, 11.71mc, 25.62m: 3.10 p.m.—3.45 p.m.

SAYS WHO?

New York closing Stock Quotations can be heard over KCBF, 17.85 m.c., 16.81 metres at 9.15 daily, except Mondays.—L.J.K.

CBFX, Montreal, in addition to announcing their broadcast band call CBM, now also mention VE9FM, their frequency modulation outlet —Gillett.

Here's a chance for the boys whose sets go down to 11 metres. GSK, London, 26.10 m.c., 11.49 metres, is broadcasting from 9.15—11.45 p.m. in General Overseas Service.—L.J.K.

KU5Q, Guam, has been my chief source of information of late. He is usually to be found somewhere on the dial—Gaden.

●

Columnists of America are heard at 10.45 p.m. over KNBA, 7.56 and KNBI, 9.49 mc.—L.J.K.

An interesting note from VX 104374, R. H. Baker, of Camberwell, Victoria, written from his location, between Maprik and the Sepik River, mentions that the only frequencies worth using range from 14.8 to 19.3 mc., the higher frequencies improving steadily as the night goes on, falling off from about 2 a.m. The 9 and 12 megacycles are only workable in the middle of the day, but are badly mauled by static and hash, and even then are very unstable. But this, of course, may be due to the set I am using, which is not the best.

●

The BBC General Forces programme can be heard on 6 locations ranging through the 13-25 metre bands all night, and the best Australian is VLA-6, 15.2 mc. Which simply roars in day and night.

●

Lindsay Walker, of Applecross, W.A., is swotting hard for an engineering exam, and consequently DX gets little, if any, attention. Here's hoping he gets his degree soon and that we will again have the benefit of his ether combing.

●

Dr. Gaden writes: "Something wrong with Burma. Maybe I listen to a relay of this fellow and not the master station, as I hear him on about 11.85 mc., whereas the announcement is 11.845 mc., so I think. Singapore is on about this 11.845 mc., or a shade higher. 11.865 would be very near his frequency, but does not sound like a "6" to me. Very good signal, whereas the nearby Singapore is not so good." (Burma has been variously on 11.88, 11.845 and 11.855 mc., and I figure they have selected the latter.—L.J.K.)

●

Miss Sanderson writes: "Many stations are making a re-appearance with the fall of Japan, and I think Singapore is better listening than it was before the invasion. One of my early verifications came from Singapore and I value it very much. PCJ, Holland, is to be heard in the 19 metre band at 11 p.m. most evenings; this apparently is the old frequency, (L5.22 mc.). Announcements on opening are made in Dutch and English and a good programme of music follows. They sign off at midnight after asking for reports as to modulation, etc. I have sent one on, so hope to receive verification in the not too distant future."

●

S/Sgt. Clack, writing from Labuan Island, says: "My work during the last couple of weeks has prevented me doing much listening, but new ones, or those which I was most pleased to hear were Singapore Rangoon and Hong Kong. They could hardly be called new, but the fact that they are one more in British hands makes hearing them memorable."

●

Rex Gillett has received an acknowledgment from The Post and Telegraph Department, New Zealand, for his report on ZLM-5, Wellington, 15.50 mc., 19.36 m. and from Dutch Guiana, he has a card for his report on PZC, Paramaribo. Particulars given show that station has a power of 5000 watts and the session he heard, eight months ago was beamed to Holland. (The call PZC is interesting, as at the time there were two calls shown in most magazines, viz., PZX-5 and PZC, both on 15.40 mc., 19.48 m. The former was the one we all took to be the call, and even the latest frequency lists from U.S.A. show only PZX-5.—L.J.K.)

●

A fair signal at 9 a.m. from WWV, Washington, permits of a frequency check on 15 mc.,—L.J.K.

●

Arthur Cushen, with justifiable pride, advises he received a verification from Radio Andorra in the form of a postcard thanking him and asking for further reports. Card was signed, Emisiones "Radio-Andorra," Andorra la Viela, Andorra. Unfortunately, Mr. Cushen does not say to what frequency his report referred, but according to my records, Andorra transmits on 5.997 and 9.33 mc. from 8—8.30 p.m. Andorra is one of the smallest republics in Europe (area 191 sq. miles) situated in the E. Pyrenees, between France and Spain, and has a population of 5,500.

●

U.S.A. will drop War Time and go back ONE hour from September 30 (U.S.A. time). It is quite likely Canada will follow suit.

●

Have received verification from Post and Telegraph Department, New Zealand for my report on ZLN-4 9.876 mc., heard on August 29.—L.J.K.

●

WWV, Washington, on 5 mc., at 5.30 p.m. gives all particulars for standard frequency check—fair signal.—Gaden.

●

Sgt. Ray Clack from Labuan Is. says: "For several days I wondered what the station interfering with Macao 7.5mc could be. It turns out to be Hanoi, Indo-China, on 7.54mc. Hanoi is on this frequency at 8.30 p.m. Closes, I believe, at 9. That is when the interference ceases, anyway. Hanoi is also on 9.66mc, announcing as 9.56 (definitely interferes with VLQ-3) with an R6 distorted signal in Annamite from 1 p.m. and English programme from 2—2.30. Modulation is poor on the latter frequency. It reminds me of Chungking in the good old days before they began using modern equipment."

The MONTH'S LOGGINGS

OCEANIA

Australia

VLC-4, Shepparton 15.315mc, 19.59m: Much better than VLA-6 in service to Pacific Fleet (Gaden).

VLA-6, Shepparton, 15.20mc, 19.74m: Heard around 2.30 p.m. (Cuchen). Not as good as VLC-4, (Gaden).

VLA-4, Shepparton, 11.77mc, 25.49m: Knocks spots off VLR-3, which would be classed as R9—is still better at night (Gaden).

VLR, Melbourne, 9.58mc, 31.22m: Good night station (Gaden).

VLW-7, Perth, 9.52mc, 31.51m: One of the best in the mornings (Gaden).

Guam

KU5Q, 13.39 mc, 22.40m: Heard calling KUIM at 10.15 p.m. (Miss Sanderson).

KU5Q, 17.83mc, 16.83m: As good as any of the Guams (Gaden).

KU5Q, 12.265mc, 24.46m: Heard calling KES-2 from 9—10 p.m. (Edel).

Philippines

PY-6, Manila, 10.74mc, 27.93m: Signal R7 from 9.30—10 p.m. (Perkins).

New Caledonia

FK8AA, Noumea, 6.208mc, 48.39m: Schedule 10—11 a.m.; 5.30—7 p.m.; 7.30—8 p.m. (Cushen).

New Zealand

See "New Stations."

ZLT-7, Wellington, 6.715mc, 44.68m: In good form till signing at 7.40 (Gaden).

Okinawa

KGIF, 15.53mc, 19.31m: Very loud in afternoon (Gaden).

AFRICA

Belgian Congo

RNB, Leopoldville, 9.75mc, 30.77m: Opens at 3.30 p.m. and overpowers KCBF. Excellent after KCBF closes at 4 p.m.—L.J.K.

French Equatorial Africa

FZI, Brazzaville, 9.44mc, 31.78m: Fair at 10.30 a.m. (Young). (This is beamed to Sth America from 9.45—11 a.m. —L.J.K.)

Kenya Colony

VQ7LO, Nairobi, 10.73mc, 27.96m: Good around 11.45 p.m. (Young).

THE EAST

Burma

Radio Rangoon, Rangoon, 11.845mc, 25.33 m: Heard from 8—8.30 p.m. (Perkins). (Has been variously on 11.88, 11.845 and 11.855mc, and I figure the latter is his present choice—L.J.K.).

China

XGOO, Shanghai, 11.695mc, 25.65m: Sometimes fair at 2 p.m. (Clack) Good Signal at 8.30 p.m. (Young, Clack). News in English at 9.15 p.m. (Gillett).

XMEW, Kunming, 16.54mc, 18.14m: Heard about 7.45 p.m. (Gillett). Fair in a.m. at times (Gaden).

XGOY, Chungking, 9.805mc, 30.58m.: Very good signal from 8.35 p.m. (Clack). This is my favourite Chinese at night (Gaden).

ZBW, Hongkong, 9.459mc, 31.60m: Opens at 8 p.m. with news in English, closing at 8.30 re-opening at 10 o'clock (Cushen). A great success at night from 7 (Gaden).

XMEW, Kungming, 8.70mc, 34.48m: Heard around 9.30 p.m. (Gillett). Hear this nightly, but morse makes it difficult to decide if second letter is M or N (Gaden).

XGOY, Chungking, 7.15mc, 41.95m: British Interlude at 10.15 p.m. (Edel).

India

VUD-8, Delhi, 15.35mc, 19.55m: News and music 1.45 p.m. (Miss Sanderson). Excellent at 8.30 p.m. A.I.R. is also heard on 19.62 and 25.27m.—L.J.K.

Japan

JLU-2, Tokyo, 9.525mc, 31.51m: Generally good when working KEB/KER from 7.30 p.m. (Clack).

JLS,, See "New Stations."

Malaya

Radio Singapore, 11.86mc, 25.29m: Very good from opening at 8.30 p.m. Is in parallel with 9.555mc and 7.22mc—L.J.K. Delighted to hear the new announcements from this area (Perkins). Find this frequency the best of the lot —(Gaden).

Radio Singapore, 9.555mc, 31.40m: Very good from opening at 8.30 p.m.—L.J.K.

Radio Singapore, 7.22mc, 41.55m: Only fair at 8.30 p.m. generally overpowered by VLQ-2, 7.21mc.—L.J.K.

GREAT BRITAIN

BBC, London

GSJ, 21.53mc, 13.93m: Heard for a few nights giving higher hopes for summer (Gaden). (I hear GSJ around 9.30, but very surgy, although it is on a beam from 7—11.45 p.m., calculated by the BBC to be favourable to Australia, but a few warm nights will doubtless make all the difference—L.J.K.)

GVO, 18.08mc, 16.59m: Very fine signal at 10 p.m.—L.J.K.

GSV, 17.81mc, 16.84m: Excellent at 9.15 p.m.—L.J.K.

GVQ, 17.73mc, 16.92m: Opens at 4.30 p.m. with splendid signal—L.J.K.

GSI, 15.26mc, 19.66m: Heard well in Pacific service (Cushen, Gaden, Miss Sanderson).

GWC, 15.07mc, 19.91m: Excellent at 9 p.m. (Gaden).

AFN, 12.095mc, 24.80m: Heard from 11.45 a.m.—12.45 p.m.—L.J.K.

GRF, 12.095mc, 24.80m: Excellent with news at 5 p.m.—L.J.K. Good at 10 p.m. (Clack).

GVY, 11.955mc, 25.09m: Relays U.S.A. at 10 p.m. for Europe.—L.J.K.

GSD, 11.75mc, 25.53m: News at 11 a.m. —O.K.—L.J.K. Good at 5 p.m.; fair at 10 p.m. (Clack).

GVX, 11.93mc, 25.15m.: Excellent signal at 4.45 p.m.—L.J.K.

GRH, 9.825mc, 30.53m: News at 2.30 p.m. (Miss Sanderson).

GRI, 9.41mc, 31.88m: Good signal at 1.30 a.m. (Edel).

GRM, 7.12mc, 42.13m: Perhaps the best of any BBC in the afternoon (Gaden).

AFN, London, 6.09mc, 49.25m: American Forces Network is heard at good strength at 4.30 p.m.—L.J.K. Good at 6.15 p.m. (Miss Sanderson). 6

GRR, London, 6.07mc, 49.42m: Heard well at times, usually noisy spot (Gaden).

U.S.A.

'Frisco, unless otherwise mentioned.

KCBR, 15.27mc, 19.65m: News at 10 a.m. for ten minutes, then into Eastern language. News at dictation speed at 2.05 p.m. Excellent signal.—L.J.K. Good in programme to Far East 11 a.m.—2.45 p.m. (Clack, Miss Sanderson).

KLL, Bolinas, 13.72mc, 21.87m: A very nice signal in the afternoon (Gaden, Young).

KKL, Bolinas, 15.475mc, 19.39m: Heard well at 10 a.m. (Young), and again at 4.15 p.m.

KWIX, 11.89mc, 25.23m: Excellent signal at 1 p.m. and till closing at 2.30 p.m. (Miss Sanderson, L.J.K.).

KGT-7, Los Angeles, 10.01mc, 29.97m: Heard contacting Manila at 9.20 p.m. (Gillett).

KCBF, 9.75mc, 30.77m: Badly heterodyned by RNB, Leopoldville, from 3.30 p.m. till closing at 4 p.m.—L.J.K.

KCBR, 9.70mc, 30.93m: Good at 6.30 p.m. till closing at 7.45 p.m. (Clack). Good signal at 8 p.m. (Perkins, Clack).

KGEI, 9.55mc, 31.41m: Now difficult to hear with Singapore back (at increased ? strength) on 9.555mc, and especially from 10 p.m. to 10.45 when VLC-5 is on.—L.J.K.

KNBI, 9.49mc, 31.61m: One of the best Yanks at night—quite a treat to listen to (Gaden).

KJE-8, Los Angeles, 9.39mc, 31.95m: Generally heard from around 10.30 till midnight.

KMI-2, 8.63mc, 34.76m: Very good from 5 p.m. (Gaden).

KROJ, 6.10mc, 49.10m: Now closes at 9.30 p.m. Is badly heterodyned by XGAP, Peiping on same frequency—L.J.K.

U.S.A.

Other than 'Frisco

WNRX, New York, 14.56mc, 20.60m: Very nice at night (Gaden). Excellent at 9.30 p.m. in Foreign language—L.J.K.

WNRI, New York, 13.05mc, 22.97m: Good signal at 8 a.m. (Young). (Closes 9.15 a.m.—L.J.K.) Very good at 10 p.m.—L.J.K.

WOOW, New York, 11.145mc, 26.92m: Good signal with news at 10 a.m. On Thursdays "Command Performance" is heard at 10.30 and station closes at 11—L.J.K.

WLWL-1, C'nnati, 11.81mc, 25.40m: Heard at 10.03 a.m. R7 (Perkins). Quite a good signal at 9.45 a.m., news is read at 10 —L.J.K.

WJQ, New York, 10.01mc, 29.97m: Has been heard calling Sydney (Gaden).

WCBN, New York, 11.145mc, 26.92m: Good at 7.45 a.m. (Miss Sanderson).

WNRA, New York, 9.855mc, 30.44m: News at 8 a.m. (Young, Miss Sanderson).

WNRA, New York, 9.75mc, 30.77m: Scheduled to open at 8 p.m., but not audible at my listening post till about 9, when is badly heterodyned by KCBF. Closes at 10—L.J.K.

WRUW, Boston, 9.70mc, 30.93m: Closed at 4 p.m. with R7 Q4 signal—L.J.K.

WBOS, Boston, 9.57mc, 31.35m: Is good some afternoons, especially about 4 (Gaden).

WGEO, New York, 9.53mc, 31.48m: The pick of the Easterners in a.m. (Gaden).

WOOC, New York, 7.82mc, 38.36m: Fair signal at 5 p.m.—closes at 6. Reopens at 6.15, closing at 8 and is on from 9.30 a.m. till 11 o'clock—L.J.K.

WOO-4, Ocean City, New Jersey, 8.66mc, 34.64m: Fair signal at 7.30 a.m. (Young)

WOOW, New York, 6.12mc, 49.02m: Good at 4.45 p.m.—closes at 6.—L.J.K. Good at 5.45 p.m. (Miss Sanderson).

SOUTH AMERICA

Ecuador

HCJB, Quito, 12.455mc, 24.08m: Good signal at 8a.m. (Clack). Heard closing at 1.31 p.m. in parallel with 9.958mc, 30.11 m.—L.J.K.

HC2ET, Guyaquil, 4.720mc, 63.56m: "Radio El Telegrapho" has moved to here from 9.195mc. Signs ate 2.30 p.m. (Cushen).

HC2AK Guyaquil 4.655mc, 64.44m: "Radio Ecuador" has moved to here from 9.42mc—signal is fair, but the harmonic on 9.310mc, is received well, signing at 2.30 p.m. (Cushen).

Brazil

ZYC-8, Rio de Janiero, 9.61mc, 31.22m: Very good signal 8—9.30 or 10 a.m. then disappears within half an hour. (Clack).

PRL-7, Rio de Janiero, 9.72mc, 30.86m: Good signal 8—10 a.m. and fair from 8 p.m. Lasts for only 30 minutes at night then fades (Clack).

U.S.S.R.

Moscow unless otherwise mentioned.

—, 15.75mc, 19.05m: Very good with news in English at 10.35 p.m.—L.J.K.

—, 15.33mc, 19.57m: News in English at 4.30 p.m.—L.J.K.

—, 12.26mc, 24.47m: News in English at 9.40 p.m.—L.J.K. Heard in Russian at

10 p.m. Sig. R6 (Edel).
—, 9.65mc, 31.09m: At midnight R7 in Russian (Edel)
Khabarovsk, 9.566mc, 31.36m: News at 9.40 p.m.—L.J.K.
—, 9.045mc, 33.17m: News at dictation speed midnight (Edel).
—, 7.46mc, 40.21m: Also gives news at midnight and dictation speed (Edel).

MISCELLANEOUS

* **Indicates carried over from September issue.**

Canada

CHTA, Sackville, 15.22mc, 19.71m: Great signal at 9.15 p.m. (Miss Sanderson). Splendid signal with news at 9.45 p.m. At 9.59 stated next International news would be at 1445GMT (12.45 a.m. Syd.) —L.J.K.
CKCX, Sackville, 15.19mc, 19.75m: Heard testing 8.45—9.30 p.m. (Cushen)
CKEX, Sackville, 11.9mc, 25.21m: Testing 6—8 a.m.
CHOL, Sackville, 11.72mc, 25.64m: The only good Canadian heard in a.m. (Gaden).
CBFX, Montreal, 9.63mc, 31.15m: Very good at 9.35 p.m.—L.J.K. (Miss Sanderson).

Czechoslovakia

***OLR-3A, Prague, 9.55mc, 31.41m:** "The Voice of Czechoslovakia calling from Prague" has been heard at good strength when in English session from 6.30—7 a.m. Station opens at 2.45 and closes at 8 a.m. (Gillett, Cushen).
—, Prague, 6.01mc, 49.92m: Heard at 3 p.m. what I take to be Czech language (Cushen). (Call sign of this station during German occupation was DHE2A.—L.J.K.)
OLR4A, Prague, 11.84mc, 25.35m: Heard in English till sign off at 8 a.m.—"Universalite."

France

***—, Paris, 11.73mc, 25.58m:** Heard opening at 8 a.m. with "Marseillaise", and again at 3 p.m.—L.J.K.
—, Paris, 9.62mc, 31.19m: Opens at 8.30 a.m. in French and also heard closing at 4.15 p.m. (Gillett).
—, Paris, 11.845mc, 25.33m: Heard closing at 8.15 a.m. (Gillett).

Holland

PCJ, Hilversum, 9.59mc, 31.30m: Testing till 6 a.m. and asking for reports (Cushen).

Italy

HVJ, Vatican City, 17.84mc, 16.82m: Bells precede opening at 12.30 a.m. in Italian. (Gillett). (This is a new frequency I think—L.J.K.)
HVJ, Vatican City, 15.12mc, 19.84m: Opens at 4 p.m. with very good signal—L.J.K.
HVJ, Vatican City, 9.66mc, 31.06m: On Tuesdays good signal with French at 4 a.m.; news in English at 4.15 (Cushen, Matthews).
"AES-Milan", Milan, 6.125mc, 49.01m: Broadcasts programmes for Allied Forces in North Italy; news at 7 a.m. and more AFRS features — strong signal, but morse interference (Cushen). Not heard lately (Gillett).

Luxembourg

***Radio Luxembourg, 7.265mc, 41.30m:** Opens at 2 p.m., but suffers interference from GRU (Cushen).
***Radio Luxembourg, 6.02mc, 49.83m:** Opens at 2 p.m. (Cushen).
United Nations Radio, Luxembourg, 6.02 mc, 49.83m: Very good at 6 a.m. (Cushen).

Mexico

XEQQ, Mexico City, 9.68mc, 30.99m: Good at 10 a.m. with announcements (Matthews).
XEWW, Mexico City, 9.50mc, 31.58m: Very nice in afternoon (Gaden).
***XEUW, Veracruz, 6.025mc, 49.83m:** Heard opening at 10 p.m. — noisy—L.J.K.
***XEOI, Mexico City, 6.015mc, 49.88m:** Heard closing a little after 4 p.m. (Gaden).

Palestine

JCKW, Jerusalem, 7.22mc, 41.55m: Schedule on this new frequency is 1.30 p.m. —6 a.m. (Cushen).
Radio Palestine, Jaffa, 6.135mc, 48.90m: French till 6 a.m. (Cushen).

Poland

Radio Warsaw, 66.115mc 49.05m: News in English at 6 a.m.—good signal. (Cushen, Gillett) (L.J.K.)

Portugal

CSW-7, Lisbon, 9.735mc, 30.82m: Fair 10—11 a.m. (Matthews).

Rumania

***Radio Bucharesti, Bucharest, 9.253mc, 32.43m:** Heard well just after 1 a.m. (Edel).

Sweden

SBP, Stockholm, 11.705mc, 25.63m: O.K. at 4.30 p.m. (Young).
SDB-2, Stockholm, 10.775mc, 27.83m: Good at 7.30 a.m. (Young).
SBU, Stockholm, 9.535mc, 31.46m: Fairly good at 7.15 a.m. (Young).

Switzerland

***HER-5, Berne, 11.96mc, 25.08m:** Opens at 6.45 a.m. with bells (Cushen).
***HEI-2, Berne, 6.345mc, 47.28m:** Exercises at 3.30 p.m.; still good at 4.15 p.m. (L.J.K.).

Turkey

***TAP, Ankara, 9.465mc, 31.7m:** Excellent from 1 a.m.; news at 2.45 (Matthews). Post Bag series still on from 6.30—6.40 a.m. on Mondays and Fridays. New announcer and signal is louder, if that were possible.—L.J.K.

Yugoslavia

Radio Belgrado, Belgrade, 9.42mc, 31.85m: Heard English at 5.15 p.m.—lady announcer (Gillett). Excellent with announcements at 2 a.m. (Edel, Matthews).

NEW STATIONS

SEAC, Rangoon, 11.855m, 25.31m: "This is Headquarters South East Asia Command calling from Rangoon." This welcome call was heard the last week in August. Station opens at 8 p.m. with music, followed by news in English at 8.15, and closes at 8.30. Short and decidedly sweet to hear real English once more from Burma.
ZBW, Hongkong, 9.495mc, 31.60m: Here is another welcome return. News in English was heard on September 5, at 10 p.m. and station closed at 11.30. During the occupation by the Japs, under the call JZHA, Hongkong was, for a long while, on 9.47mc, 31.67m, but latterly, although still announcing as 9.47, were on 9.495mc. At one time for a few nights they wandered away down to 9.50mc.
KMI-2, 'Frisco, 8.63mc, 34.75m: Not a new station, but an old-timer now on a regular schedule and beam. With a "Voice of America" programme for the Pacific and Far East from 5 till 11 p.m., is being heard at good strength. News in English is given on the hour and balance of programme is mostly Japanese.
Radio Singapore, 11.86mc, 25.29m; Radio Singapore 7.22mc, 41.55m; Radio Singapore, 15.36mc, 19.53m.: These transmitters have been added to 9.555mc, and are heard in parallel from 8.30 p.m.
ZLM-5, Wellington, 15.50mc, 19.36m: This further outlet of The Post and Telegraph Dept. of New Zealand has been testing at 5.15 and 11 a.m. and at 1 p.m. Hope to have schedules before this paper goes to press.
PCJ-2, Hilversum, 15.22mc, 19.71m: This further and old-time outlet of the Philips station was heard in a test on Tuesday September 18. They opened at 7 p.m. was a Sousa March, followed by announcement in Dutch, then the same in English. At 7.06 orchestral item, but a bad surge and fading made listening difficult, and by 7.15 they had faded right out. Mr. Edel heard an announcement the previous night through PCJ on 9.59mc, 31.28m, that the test was to be made, he phoned me but at his location he could not hear them at all. They also said they would test again from 11 p.m. till midnight, but the conditions were against this on that night. However, since then conditions at 11 pm have improved, but unfortunately a bad heterodyne is caused by CHTA, Sackville, on the same frequency, but PCJ is the stronger and can be copied. Doubtless as reports arrive and summer approaches "The Happy Station" will select a time and frequency that will permit of the splendid signals and programmes reaching Australia which gave such a fillip to overseas listening before the war.
VLZ-3, Sydney 9.76mc, 30.74m: Heard calling New Zealand on this new frequnecy on Tuesday September 25, at 2.50 p.m. and later on 13.34mc, 22.48m. New Zealand was replying on 10.98mc, 27.32m.
—, Hanoi, 9.66mc, 31.05m: S/Sgt. Ray Clack writing from Labuan Is. mentions hearing this French Indo-China station from 1—2.30 p.m. with an R-7-8 signal. English from 2—2.30, but modulation is bad.
—, Hanoi, 7.504mc, 39.98m: Another outlet also reported by S/Sgt. Clack. He says it is audible with difficulty from about 9 p.m., but interference from Macao on 7.5mc makes it impossible to copy.
JLS, Tokyo, 7.48mc, 40.11m: S/Sgt. Clack says: "This is a new one heard from 10.30 p.m. with an R8 signal calling KEB and broadcasting news dispatches." (This is certainly a new frequency for JLS, as during the war it was frequently heard on 9.652mc, 31.08m, from 6—11.30 p.m.—L.J.K.).

'FRISCO CHANGES AND NOTES

KROJ, 11.74mc, 25.55m: Has ceased to transmit to SW Pacific, Pacific Ocean Area from 5—6.45 p.m. the transmission being taken by KGEX 11.73mc, 25.57m.
A new session for KGEI, 11.73mc, 25.57m is 4—6.45 a.m.
KWIX, has given up transmitting to SW Pacific, Pacific Ocean area from 7—8.45 p.m. on 9.85mc, 30.44m (unfortunately) and is now heard on 7.23mc, 41.49m. from 6.45—11.45 p.m. directed to China and Japan.
KROJ, 6.10mc, 49.10m, transmits on Sth Pacific, Mid-Pacific area beam from 7—9.30 p.m.
KCBR, 19.65m and KRHO, 16.85m give news at dictation speed at 2.05 p.m.
KRHO, Honolulu 17.80mc, 16.85m opens at 12.30 p.m. on all Pacific-China beam with AFRS programmes, closing at 2.30.
KROJ, 17.77mc, 16.88m, has been replaced from 5—8 a.m. by KNBA on 17.78mc, 16.87m.
KWIX, 11.87mc, 25.29m, broadcasts to New Zealand from 5.45—6.15 p.m.
AFN, London, on China-Burma service from 11.45 a.m.—12.45 p.m. which was coming in here at such great strength and clarity announced on September 27 that the session would be withdrawn on September 30. That's a pity, as it was a fine station.
News at dictation speed is heard at 2.05 p.m. through **KWIX, 11.89mc, 25.23m,** and further news at slow speed may be heard over **KNBI, 9.49mc, KCBR, 9.70mc KNBA, 13.05mc** and **KGEX 11,79mc,** at 5.05 p.m.

Important Morning Alterations:
KCBA, 11.77mc, 25.49m: 4—6.45 a.m.
KCBF, 9.70mc, 30.93m: 4—6.45 a.m.
KGEI, 11.73mc, 25.58m: 4—6.45.
KNBI, 15.24mc, 19.69m: 5—8 a.m.
KNBA, 17.78mc, 16.87m: 5—8 a.m.

Speedy Query Service

(Conducted under the personal supervision of A. G. Hull)

G.H.F. (Geelong) asks about the new valve types detailed in the September issue.

A.—The types mentioned are those which have been chosen by the Amalgamated Wireless Valve Company as their preferred or recommended types and they will use their influence to have these types used wherever possible. This does not mean, however, that all other types of valves will be withdrawn from the market, or anything like that. In fact, the new types will not be available immediately, and present production will continue with the ordinary type valves, which have been popular for some years past. To explain the point we might mention that even some of the 2.5 volt valves such as the 2A5 and 45 will still be retained on the A.W.V. list of standard valves and will be kept in production as required.

* * *

E.S.H. (Willoughby) recalls that we mentioned in the May issue that tolerances were permissable even with meters, and asks us to elaborate.

A.—The ordinary run of meters which are sold for radio servicemen to use in the repair of sets are not especially accurate and do not need to be. Any well-designed set will stand voltages with a tolerance of plus or minus 10 per cent or more, and that goes for the resistance and capacity values, too. Even the roughest of the meters at present on the market are likely to be correct within a similar tolerance, except, perhaps, on the a.c. ranges. It is safest to buy the best meter you can get, or afford, for accuracy is not a detriment, in fact is almost sure to be an indication of the general standard of quality of the meter, the care with which it was built and the likelihood of getting trouble-free service from it over a long period.

* * *

J.L. (Newcastle) sends a list of the odd parts about the house and asks us to forward him a circuit for a high-quality power amplifier to use these parts.

A.—It is really very trying (or should we say a darn nuisance?) to get letters such as yours. Surely if you have been a reader as long as you say, you should, by now, have grasped some of the fundamentals, such as (1) you can't use a mixture of obsolete battery valves, converters, and r.f. amplifiers to build an audio amplifier; (2) you cannot get high power from an old-style B battery eliminator; (3) it is quite beyond the scope of our service to attempt to handle queries such as yours. Even if the parts you list had been suitable, it would still be a job taking hours of time, and hours of time are worth pounds of money; if we had the time, which we haven't, and after all to be fair to each and every reader we would have to be prepared to put in many thousands of hours to give everybody like treatment. In a nutshell, the whole things is unreasonable. We can only suggest you study up the present series of articles on amplifier design and then go ahead and make use of the knowledge gained, in other words design yourself an amplifier.

W.B. (Kirribilli) built the set for which a circuit was given on page 21 of the August issue, but added a 6J7 stage of audio and used a 6V6G. He complains of hum trouble.

A.—Yes, you could expect to get hum trouble as the audio gain is excessive. In practice it is found that one stage of audio amplification is any amount to have before the grid of a valve such as a 6V6, which will accept only a small signal voltage. You do not let us know the way in which the 6J7 is connected, but probably it has a gain of more than a hundred, so that the slightest hum on its grid will mean a roar by the time it is amplified and fed to the output valve. We can only suggest that you cut back the audio gain and revert to the original circuit as designed.

* * *

General.—Can anyone explain this?

A reader states: "Recently, whilst servicing a superhet, autodyne type, which used to go out of oscillation, I noticed that a high voltage built up on the padder, on both sides, which was in series with the gang and oscillator coil. The voltage pushed a 1,000 volt meter (D.C.) hard over, although the set's high tension was only about 230 volts. In fact, with only one test prod connected to the meter about 500 volts D.C. was indicated at the padder.

The trouble was cured by putting an 8,000 ohm resistor in series with the oscillator plate load. I assume that feedback between the oscillator and other stages was taking place through the h.t. line, causing the oscillator to build up, but fail to see why there should be such a high voltage shown on a D.C. meter, and why a voltage should be indicated with only one meter lead connected."

* * *

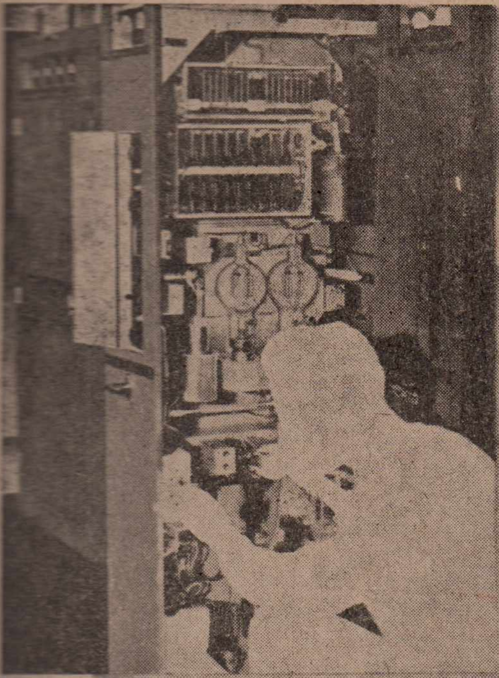
J.E.J. (Eastwood) writes about the Hammond organ.

A.—Sorry, but the Hammond organ details are beyond the scope of our ordinary query service. Your letter, however, will be forwarded to the author of the article to which you refer, Mr. Charles Mutton, who is at present working on a further article on the Hammond organ and also experimenting with other means of obtaining electronic music.

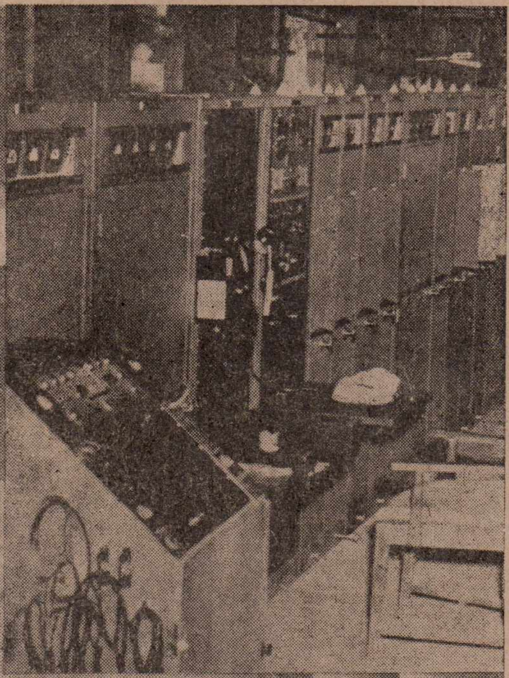
WHO'S WHO

(Continued from Page 31)

Dr. Gaden writes: "The other night heard Daventry state they were using an 11 metre band transmitter for South Africa and asked for reports. Think figure given was 26.10mc. I am not hopeful of getting an 11 metre at night, but as it would be an all daylight to South Africa, they might hook it. When working the 11 metre Yank, I found that about 11 a.m. was best time; latest heard was about 5.30 p.m. a fluke reception, I think, that afternoon. Used to hear a harmonic on 8.4mc, of Rome on 16.8mc, when they were testing with Tokyo, prewar — the "dim and distant past." (I have referred to the 11 metre BBC elsewhere. I have not heard it, as the set of mine that takes in that band was loaned by me to a pal a couple of weeks ago, but I have my doubts about 11 metres at 11 p.m.—L.J.K.).



AACS Domestic Station showing a pair of Eimac 450-T valves



AACS Ground Station China-Burma-India Theatre

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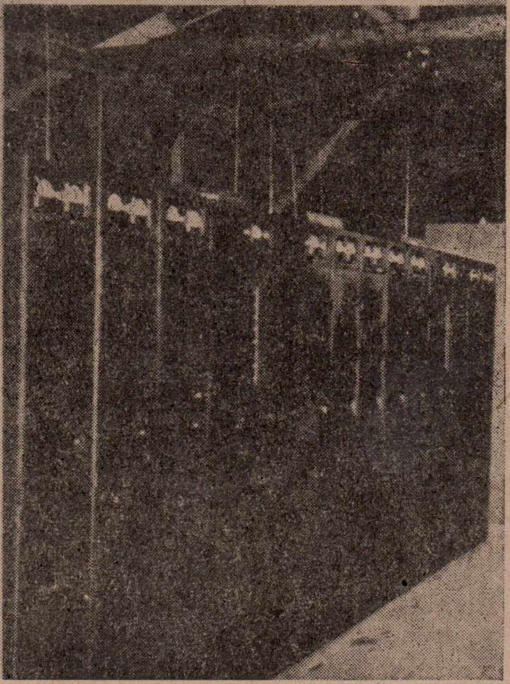
AACS Station on an island in South Pacific



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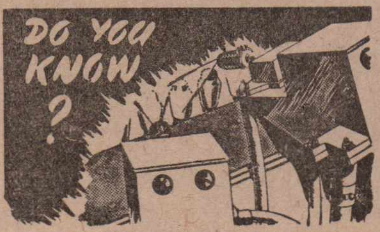

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