Every U.I.C. Condenser is subject to the most thorough mechanical and electrical inspection, and is tested for:

- CAPACITY: Tolerance can be made as close as ± 0.5%
- LOSS FACTOR: Average 0.05% (maximum 0.2%) at 1,000 Kc/s.
- TEST VOLTAGE: As specified, but normally 1,000 v. D.C.

Constant production check measurements are made on the effect of repeated cycles of HEAT & HUMIDITY on DIELECTRIC STRENGTH - INSULATION RESISTANCE - NOISE, etc.

Approved as satisfying all current official specifications.

Send for interesting Technical Brochure.

CONTRACTORS TO GOVERNMENT DEPTS.
On A.I.D. APPROVED LIST.

UNITED INSULATOR CO LTD
The Pioneers of Low Loss Ceramics
12-16 LAYSTALL STREET, LONDON, E.C.1
Tel: TERMINUS 4118-9
Grams: CALANEL.SMITH, LONDON
FROM years of intensive research in the design and manufacture of electrical testing equipment has grown the range of world-famous "AVO" Instruments. To-day, wherever rapid precision testing is demanded, there will be found the meters that matter—"AVO" Meters.

In spite of greatly increased production, most of our output of "AVO" Instruments is being taken by the Services. Delay in delivery of Trade orders is consequently inevitable, but we shall continue to do our best to fulfil your requirements as promptly as possible.

Sole Proprietors and Manufacturers:
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT Co. Ltd.
RAF wants Radio Enthusiasts

SKILLED & SEMI-SKILLED TRADESMEN—

the R.A.F. needs your knowledge and ability. You can be enrolled as:

- Wireless Mechanics  (18 to 50)
- Radio Mechanics  (18 to 50)
- Electricians  (18 to 38)

UNTRAINED MEN WHO ARE KEEN ON RADIO—

the R.A.F. will quickly train you and add to your knowledge. Recruits are now wanted for training as:

- Radio/Wireless Mechanics  (18 to 32)

(THese are all GROUND DUTIES)

Men are wanted NOW to maintain and operate the wireless installations without which the grand work of the R.A.F. would not be possible. These jobs are interesting, the pay and conditions are good, and you have the satisfaction of doing work of first-rate importance.

Please send me details of Wireless Trades in the R.A.F.

NAME

ADDRESS

To Air Ministry Information Bureau, Kingsway, London, W.C.2.
speed up and simplify assembly and cut down costs. They are available in a wide range of standard types, but our Development Department is at the service of Manufacturers whose particular needs call for special designs.
New and Improved

TAYLOR VALVE TESTERS

The Taylor range of Valve Testers, all of proved performance, now incorporate a circuit which enables accurate measurements of mutual conductance to be made on at least 99% of British and American receiving valves.

By means of the illustrated directions provided with every instrument, it is also possible for the user to work out the correct switch setting for any new type of receiving valve which may be produced.

NOTE THE SCOPE OF THIS—

TAYLOR MODEL 45

MUTUAL CONDUCTANCE. Measures mutual conductance of at least 99% of British and American receiving valves.

17 VALVEHOLDERS. The 17 different types fitted include the new American Bantam, Loktal, Mazda Octal and Midget Deaf-Aid types.

TESTS EVERY VALVE under correct working conditions.

MULTI-ELECTRODE VALVES. Each section can be tested independently.

CATHODE LEAKAGE. Calibrated scale shows leakages as high as 10 megohms.

"GOOD," "?," "REPLACE." The Taylor 4½-in. square type moving coil meter has a scale for indicating the slope of valves.

FILAMENT CONTINUITY AND SHORTS. These are indicated by a lamp mounted on the panel.

NOTE: MODEL 47 also includes provision for the measurement of D.C. volts, amps, and ohms.

MODEL 45 £14-3-6
Portable Model £14-19-0 (No purchase tax payable on any of these models.)

MODEL 47 £16-16-0

Every Taylor Valve Tester is supplied complete with a grid connecting lead—comprehensive book of instructions and an up-to-date Valve Manual.

Fully descriptive brochures are available on request.

BRITISH MADE AND GUARANTEED 6 MONTHS.

TAYLOR Electrical Instruments Ltd.,
419-422, Montrose Avenue,
SLOUGH, Bucks.
Phone: Slough 21881.
PREMIER RADIO CO.

PLEASE NOTE—ALL KITS ARE NOW SUBJECT TO PURCHASE TAX.

PREMIER RADIO CO.

PREMIER SHORT-WAVE KITS

INCORPORATING THE PREMIER 3-BAND S.W. COLL. 11-86 METRES WITHOUT COIL CHANGING. EACH KIT IS COMPLETE WITH ALL COMPONENTS, DIAMAGS AND 2-VOLT VALVES.

1-V, S.W. RECEIVER KIT 24/6
2-V, S.W. RECEIVER KIT 35/6

DE LUXE S.W. KITS

COMPLETE KIT, INCLUDING ALL VALVES, COILS, WIRING DIAGRAMS AND FULL INSTRUCTIONS FOR BUILDING AND WORKING. EACH KIT IS SUPPLIED WITH A STEEL CHASSIS, PANEL AND PLUG-IN COILS TO SUIT FROM 13 TO 170 METRES.

1-V, S.W. RECEIVER KIT 24/6
2-V, S.W. RECEIVER KIT 35/6

SHORT-WAVE CONDENSERS

TROLIET INSULATION. CERTIFIED SUPERIOR TO CERAMIC. ALL-BRASS CONSTRUCTION. EASILY GANGED.

15 M. M. D. 2/4 100 M. M. D. 3/4
25 M. M. D. 3/4 40 M. M. D. 2/4
40 M. M. D. 2/4 250 M. M. D. 4/4

SHORT-WAVE CONDENSERS

7.5 V. 3 A.
220 V. 1/4 A.
220 V. 1/4 A.
220 V. 1/4 A.

NEW PREMIER S.W. A.C. RECEIVER

IN RESPONSE TO MANY REQUESTS WE HAVE NOW PRODUCED AN A.C. VERSION OF THE POPULAR PREMIER SHORT WAVE 5G3 KIT. CIRCUIT: CENTRE-TAPPED, BASE AND BRASS MOVEMENT, F.W. RECTIFIER, 200-250 V. A.C. OUTPUT, BUILT-IN POWER PACK, HUM-FREE OPERATION.

BATTERY VERSION KIT ALSO AVAILABLE.

FREDERICK HART, LONDON, S.W. 2

ALL ENQUIRIES MUST BE ACCOMPANIED BY 2/2D, STAMP.

ALL POST ORDERS TO: JUBILEE WORKS, 167, LOWER CLAPTON ROAD, LONDON, E.5 (AMBURST 4723).

CALLERS TO: JUBILEE WORKS, OR 169, FLEET STREET, E.C.4 (CENTRAL 2813) OR 50 HIGH STREET, CLAPHAM, S.W.4 (MOCODAY 2381).
Proven for long life and reliability under war conditions (in all services, on land, sea and in the air).

Size only 5½" x 4½" x 5½" high and weighing only 6 lbs. approx.

Write for details:—

MMASTERADOR LTD.

WHARFEDALE WIRELESS WORKS

SOLE PROPRIETOR: D. E. BRIGGS.
HUTCHINSON LANE, BRIGHOUSE, YORKS.

PHONE: BRIGHOUSE 50.
GRAMS: "WHARFEDAL.

M.R. SUPPLIES, 68, New Oxford St., London, W.C.1
Telephone: MUSENUM 2598.

JUNE, 1941.
Owing to heavy Government demand we have considerably increased our range of Micro-Variable Condensers and Precision Dials. All have features not found in competitive makes. In the case of the Condensers—heavy all brass construction, ball-bearing spindle (electrically shorted) Ceramic (RMX) insulation, smooth operation with freedom from end or side play.

The Dials are noted for their fine appearance, accurate workmanship, and non-reflecting satin finish, graduations being deeply engraved and clear and easy to read. In addition a range of Knobs both skirt and otherwise to match these Dials are available. Full description of these instruments are available on receipt of a stamped addressed envelope.

**STANDARD (VCX) SERIES CONDENSERS**

VCX

The VCX series condenser can be mounted by means of the three holes where both rotor and stator are required to be insulated from panel.

**MIDGET (MCX) SERIES CONDENSERS**

MCX

Special condensers can be made with intermediate capacities. The ganging feature may also be omitted with a consequent saving in length. Such alterations, however, can only be considered where the quantity justifies the resetting of machines to make the special parts required.

**PRECISION DIALS AND KNOBS**

Our range of specialised short wave and communication equipment is the most comprehensive manufactured in this country.

Every necessary component for the construction of short and ultra-short wave Transmitters, Receivers, Oscillators and other scientific instruments are available. Your enquiries are solicited. Where the material is for use on Government Contract, delivery dates can be given if the priority and service is mentioned at the time of writing.

44 & 48, HOLLOWAY HEAD, BIRMINGHAM, 1. *Phone: MIDLAND 3254*
THE OUTSTANDING properties of Frequentite—Low Loss and High Mechanical Strength—led to a demand which even before the war severely taxed our productive capacity. The needs of the fighting services have inevitably led to restriction in supplies for general industry, but we can now meet all requirements promptly. Extensions to our plant, the employment of specialised new equipment, and progressive improvements in our manufacturing technique made during the past seven years, now enable manufacturers to obtain bulk supplies of the most intricate designs. Please write for Catalogue No. SP.10.

STEATITE & PORCELAIN PRODUCTS LTD.
Head Office and Works: STOURPORT-ON-SEVERN, WORCS. Telephone: Stourport 111. Telegrams: Steaitain, Stourport.
Address your staff through a

CELESTION LOUDSPEAKER

— with a volume sufficient to overcome local noise.

The same speaker will carry music to your staff—true music, not just a volume of sound.

The Celestion method of suspension enables the sound to be directed wherever you want it.

Celestion Limited, Kingston-upon-Thames, Surrey

Acoustical Engineers

Telephone: KINGston 5656-7-8.
The paramount importance of high selectivity has long been recognised by radio engineers, but it is only comparatively recently that bandpass filters employing quartz crystal resonators have been made commercially available. After considerable research work our radio laboratory has evolved a new type of crystal bandpass filter employing a pair of quartz crystals, which will be found invaluable in many branches of radio tele-communication. Standard filters are available for frequencies within the range of 440-480 Kcs., having bandwidths of 300 cycles or 3 Kcs. Filters for other frequencies can be made to order. Simmonds crystal filters have an outstanding performance, including a very sharp cut-off and readily adjustable characteristics which make them very suitable for use in the Intermediate Frequency stages of super-heterodyne receivers.

SIMMONDS AEROACCESSORIES LTD
GREAT WEST ROAD, LONDON.
Presentation of Broadcast News

Is a Change of Technique Overdue?

WHAT most technical wireless people call the "programme side" of broadcasting is little concern of ours. In conformity with the clearly expressed wishes of the vast majority of our readers, we confine ourselves to the other side of wireless—to the means rather than the end. But, although we leave the details of programme organisation and make-up severely alone, it is our duty to keep a watchful eye on the broader and more fundamental issues, especially when it seems that our medium of communication is not being used to best advantage.

Now the dissemination of news is the most important function of broadcasting at the present time, and it has long been our opinion, confirmed by careful observation of the reactions of listeners of different types, that there is room for improvement in the technique of news presentation. In the first month of the war, when the Press of this country showed signs of resenting B.B.C. competition, we urged that there was no real foundation for antagonism, and that Press and broadcasting should be complementary channels of distribution, only needing to find the right techniques for changing conditions. We said "the trouble at present is that broadcasting is too much like the newspapers, and the newspapers are too much like broadcasting."

No Basic Change

That trouble still persists after nearly two years of war. One often reads long passages in the morning papers that contain not only the substance but very often the exact phrasing of something that has been heard during the previous evening's news bulletin. The make-up and style of the broadcast bulletins has undergone little fundamental change since 1939—or, for that matter, since 1922.

As compared with the Press, broadcasting enjoys the advantages of extreme speed and living actuality. It suffers under the handicaps of being unable (in the present absence of a television service) to employ such graphical aids as pictures, maps and diagrams to explain and amplify the news; in addition, the listener, unlike the reader of the printed page, cannot absorb information at his own pace. Consequently, news bulletins must be read at a compromise speed—too slow for some listeners and too fast for others.

These inherent advantages and disadvantages should obviously be taken into account in devising an improved technique of news presentation, and as a first step we suggest a sharp line of demarcation should be drawn between real news on the one hand, and commentary, exposition or speculation on the other. News proper might be broadcast in almost telegraphic phrasing, with the utmost economy in words. Change of speed in reading is a dramatic trick that is perhaps not to our national taste, but, skilfully done, it makes for easy assimilation of facts by the listener. The telegraphic trick of repeating numbers and extremely significant words or phrases might be helpful; the time spent in repetition would be more than offset by savings effected elsewhere. The interlarding of bulletins with "geography lessons" and passages from reference books annoys the well-informed listener, and belongs more properly to a commentary. Intuition, skill and a sympathetic outlook are needed for the arrangement of the items of a bulletin in their proper order, and pains should be taken to see that the burning question of the hour (in the estimation of the average intelligent listener) is dealt with first—even if there is "nothing to report."

New-style Newspapers, Too?

Although there has been little change in the Press so far as the fundamentals of news presentation are concerned, there seems to be a growing realisation of the fact that its function is changing. The newspaper cannot compete with broadcasting in speed of reporting events, but it has advantages in explaining and commenting on the news. This, we think, is now being realised by the Press, and we look forward to the time when the two channels of news distribution will be more nearly complementary.
Making the Most of

Short Waves

Improving the All-wave Receiver

By L. A. MOXON, B.Sc.,
A.C.G.I.

During recent years, SW broadcasting has made rapid strides. Great improvements have been made on both the transmitting and receiving sides. The number of stations operating has greatly increased; the use of beam aerials and higher powers has made better signals available; and the development of the "all-wave" superhet has extended the circle of SW listeners far beyond the select few.

There remains, however, a long way to go. Short waves still fall far short of the standard of reliability desirable, or even that to which we are accustomed on medium waves. An American station which provides excellent entertainment one evening may the next be submerged by noise, distorted by selective feeding, jammed by morse interference, or perhaps not audible at all. The reasons for this are various. In the first place, of course, we have to rely entirely on the various reflecting layers for long-distance reception, and these layers, though extremely useful, are very capricious servants. They sometimes go more or less on strike; at others they pass the signal on to us in a distorted, badly fading or noise-ridden condition.

It is unfortunate that the receiver tends to introduce further elements of unreliability. It adds more noise, which may entirely swamp the signal. Second-channel and other forms of interference are added by the frequency changer. It is possible for the AVC circuits to operate in such a way as to render distortion produced in transit more obtrusive, or even to produce similar distortion in a synthetic manner. In addition, the simpler receivers provide little encouragement to the listener wanting to tune in a short-wave signal, and he may be compelled to exercise great skill and patience.

All these deficiencies in the receiver present serious problems to the designer, and it is the purpose here to show how they can be overcome or minimised. The value of an RF stage for improving the ratio of signal to noise, and reducing second-channel interference is well known, and some design considerations for making the best use of it will be outlined. Band-spreading will be considered in some detail as it is essential to a solution of the tuning problem; the latter also demands a very high degree of "staying put" on the part of the oscillator circuits, and the very accurate scale calibration that this makes possible. The uses of double frequency changing will be discussed, and finally a number of minor design points which repay attention will be considered.

Importance of an RF Stage

Engineers, yielding to public demand, have evolved what might almost be called a standard receiver; the familiar three waveband, four-valve superhet with frequency changer, an IF stage operating at about 465 kilocycles, double-diode triode for detection, AVC and AF amplification, and a high-slope output pentode. This design can give quite good results, but requires elaboration if a maximum of short-wave reliability is to be approached. Probably the first essential is to increase the signal-to-noise ratio by addition of an RF stage.

There are two main sources of noise in receivers, the tuned circuits and the valves. Assuming adequate gain from the first valve, only this and the preceding circuits need be considered, since other sources of noise will have much less amplification following them. In any constructor a certain amount of noise is generated by thermal agitation of electrons, and the voltage produced is proportional to the square root of the impedance of the conductor. In the case of SW tuned circuits, low impedances are the rule and circuit noise can usually be neglected in comparison with valve noise. The latter can be taken as proportional to the square root of the anode current, \(_I\). Although not strictly true when applied to different types of valve, this has been found a useful guide in practice. As amplification of the signal is proportional to the effective conductance \(_G\), we can state

\[
\text{Signal-to-noise ratio } = \frac{G}{\sqrt{I}} \times \text{a constant.}
\]

Mains RF pentodes and hexodes all take very roughly the same anode current. The advantage of having, as first valve, a variable-mu pentode with a \(_G\) of 2.4 over a frequency changer with a conversion conductance of 0.8, is obvious, and measurement confirms the expected improvement of 3 to 1. A television type of RF pentode used with a working slope of 7 gives a further reduction of 2 to 1 in valve noise which is then comparable with the circuit noise. This limits the additional improvement to about 2 to 1. If a high-slope RF valve is fitted, its use is best confined to short waves. Such valves are not in general suited to medium wave use on account of their very limited signal-handling capacity and the large signals likely to be applied. They offer no compensating advantage, since thermal noise on medium waves limits signal-noise ratio to that obtainable with a low slope valve.

The gain of the RF stage may be regarded as just adequate if it is equal to the improvement in signal-noise ratio expected from the stage. Under these conditions a quota of noise will be added by the frequency changer equal to that which the
Making the Most of Short Waves—
signal has collected from the RF
valve. The RMS addition of the
two components gives an increase of
3 db. in total noise, and this is only
just appreciable. It may be possible
to get greater gain, but noise level
sets a limit to the amount of sensi-
tivity which can be usefully em-
ployed. This limit can be achieved
in practice (with or without an RF
stage) by making the FC, IF, AF
and output stages as efficient as pos-
sible. Unnecessary RF gain is
harmful for the following reason.

Over a range of a few hundred
kc/s on either side of the frequency
to which the set is tuned, little
attenuation can be expected from the
signal circuits, and all stations within
this range will reach the frequency
changer. If two signals which
happen to be spaced by a frequency
equal to the IF of the receiver are
present in sufficient strength, they
will beat together to produce an
appreciable IF component, which
may cause interference with all weak
stations over quite a wide tuning
range. The RF stage amplifies not
only the wanted, but both the un-
wanted stations, and the interference
tends to be increased in proportion
tough some help is afforded by the
selectivity of the usual extra circuit.
Those who like " gadgets " may find
a variable gain control useful.
Otherwise slightly more than the
"just adequate" gain is quite a
good compromise. Some increase in
gain may be permitted on the longer
SW bands in view of the greater
signal selectivity, but it is desirable
to avoid extreme variations over the
frequency range. This argument
does not apply to receivers with
double frequency changing and a
high value of first intermediate fre-
quency.

Battery valves have much lower
values of both G and I than mains
valves, and are about the same from
the noise point of view. On account

of the low slopes it appears essential
to use tuned anode couplings in order
to get adequate gain. With mains
valves some form of transformer or
tapped coil coupling is usually more
satisfactory.

The additional tuned circuit that
an RF stage brings with it is some
help with image rejection. In an
average design, with an IF of 465
kc/s, it contributes some 12 db. to a
total of 20 db. rejection at 15 mega-
cycles. This is not a very satis-
factory improvement, and in one
receiver* a further 10 db. was ob-
tained by using a band-pass inter-
valve coupling.

Image Rejection

In a later receiver a total of 40 or
50 db. rejection was obtained by
means of a simple image rejector of
which Fig. 1 shows the principle.
This circuit, used as an anode
coupling impedance, would give
maximum gain at the resonance of
LC. At some lower frequency the
circuit LC, looking like an induct-
ance, forms a series resonance with
Cs and produces a very low imped-
ance. This can be utilised for image
rejection by suitable choice of Cs.
The practical application of the cir-
cuit is illustrated by Fig. 2. Its
working is somewhat modified by
the capacity CP consisting of various
strays—the interelectrode capacities
of the RF and FC valves, the self-
capacity of the HT feed choke,
wireing, and possibly switch capaci-
ties. These must be kept as low as
possible, since their effect is to reduce
the effective impedance, and there-
fore gain by the factor

\[
\frac{CS}{CS + CP}
\]

An average value for Cs may be
about 25 \(\mu F\), and CP can be kept
down to about 30 \(\mu F\). At 16 metres
a coupling impedance of more than
1,000 ohms is unlikely, but this is
adequate if a high-slope valve is
used. From 25 metres upwards the
gain may then be excessive unless
Rs or C is increased.

Fig. 2. Showing application of
image rejector to a practical design:
switching complications omitted.
CP represents the stray capacities
across the coupling impedance.

For band-spread-
ing a section Cv
of the gang con-
denser is connec-
ted, in series with
a small capacity
Cs, across the
circuit LC.

* The Murphy Model A76.

Wireless
World

Fig. 3. Measured selectivity of image
rejector at 15 Mc/s. The estimated
curve for a simple tuned circuit with
similar losses is shown in dotted lines.
Some additional selectivity is given by
the aerial circuit.

JUNE, 1941.
Making the Most of Short Waves—

Cs could be replaced by an inductance and the oscillator tuned high, but in practice difficulties arise over stray capacities.

This circuit was developed for use with a band-spread receiver using switched inductances pre-set to each of the short-wave broadcast bands (the Murphy A92). The value required for Cs depends on C, Cr and the IF. It was not found to be very critical, but had to be changed for each band, with the exception of 25 and 31 metres, which were able to share one value.

Most short-wave broadcasting stations lie within seven narrow bands, all less than 300 kc/s in width and centred around 6.1, 7.25, 9.6, 11.8, 15.22, 17.8 and 21.6 megacycles respectively. It is standard practice to cover the entire frequency range, or at least up to 18 Mc/s, by capacity variation and a single set of tuning inductances. As each station's share of the tuning scale is less than a thousandth part, it is not surprising that tuning tends to be difficult.

The useful portions of the tuning range constitute only a small proportion of the total. It is the function of band spreading to open out the wanted parts of the scale and make it easy to adjust the receiver to the desired frequency. There are many possible means to this end, as illustrated in Fig. 4. Referring to this family tree, the left-hand side requires little discussion; slow-motion drives and mechanical or optical magnifying scales are very useful devices, but the very high mechanical standard required by the ideal is not readily achieved in mass production. Some American communications receivers employ very successful precision drives and geared-up scales which enable the receiver to be tuned accurately to any desired frequency within a wide range. For broadcast reception there is some advantage in being able to switch rapidly from one band to the next without tuning through a lot of intervening noises, and this is most readily achieved by electrical band-spread methods.

One interesting method is to provide means of arresting the tuning own scale must be employed to cover the bands thus selected. This method was employed some years ago on the Murphy A36 receiver, which employed double-frequency changing. SW signals were converted to an inter-mEDIATE frequency in the medium-wave band, and tuned-in as medium-wave signals. The medium-wave tuner, therefore, provided the auxiliary means. An alternative would be to vary the oscillator inductance about 8 per cent. by means of an iron dust core or piece of non-ferrous metal moving inside it. A small auxiliary tuning condenser can be used, but is not satisfactory over a wide tuning range. A given spread at 6 Mc/s, compared with 18 Mc/s, would require 27 times as much charge of capacity, so that full cover of the former would severely cramp the latter. The inductance method possesses the same fault, but only to the extent of 3 to 1, which is tolerable. The double-frequency changing method described has the advantage of a constant band-spread scale calibration in terms of frequency differences. That is to say, a difference of 100 kc/s on the band-spread scale remains 100 kc/s whatever the
Short-wave Receiving Conditions

PROSPECTS FOR JUNE

ALTHOUGH somewhat more settled than during the preceding month, short-wave receiving conditions during April were, nevertheless, not as favourable as those during the corresponding month of 1940.

Ionosphere storms occurred on fifteen days of the month as follows: On four consecutive days commencing April 10th and 18th and, in addition, on the 3rd and 7th (first week) and on the 24th, 25th, 26th, 28th and 29th (last week). In this connection readers of these reports may recall that, in the April issue of this journal, published on March 20th (see page 118), the possibility of a relatively high disturbance factor was suggested for a few days in the vicinity of April 9th and 17th and, in addition, at the beginning and end of the month.

Sudden ionosphere disturbances of the Dellingt type occurred as follows, these and other times given in this report being G.M.T. on the 24-hour clock notation: (A) April 19th at 1019, (B) April 20th at 1040.

The effects of (A) and (B) were in each case confined mainly to easterly and southerly routes, and were in evidence for a period of about fifteen minutes; those on April 19th were, however, the more pronounced.

Particulars of the broadcast bands which, it is considered, should prove most reliable during June under normal conditions of propagation at the times stated for five selected routes are given below; these may serve as a guide when considering the possibilities of reception from places not too remote from those specified.

Attention is drawn to the fact that a number of factors, for example, (a) transmitting power, (b) efficiency of aerials at both the transmitting and receiving ends, and (c) ionosphere abnormalities, may often result in better reception being obtained on wavebands other than those quoted. Moreover, transmission on each of the stated wavebands may not necessarily be available.

Tokio: Midt, 19 or 25 m; 0400, 19 m; 0700, 16 or 19 m; 1000, 16 m; 1300 and 1500, 16 or 19 m; 1800, 19 or 25 m; 2000, 19, 25 or 31 m.

Montreal: Midt, 25 or 31 m; 0400, 31 m; 0600, 19 or 25 in; 1200, 1300 and 1900, 16 or 19 m; 2200, 19 or 25 m.

Under normal propagation conditions the most favourable period for reception should be between 1200 and midnight. The most difficult period is likely to be for a few hours in the vicinity of 0700.

Salisbury, Rhodesia: Midt, 25 or 31 m; 0300, 31 or 41 m; 0600, 19 or 19 m; 1000 and 1400, 16 m; 1700, 16 or 19 m; 2000, 19 or 25 m.

Conditions should be favourable for reception throughout most of the 24 hours; signals may, however, be subject to echo effects around 0400 and to weakness for a short period around 1100.

In temperate latitudes in the Northern Hemisphere, the highest values of critical frequency (F layer) usually occur during winter day and the lowest during winter night; the values for summer, both day and night, are normally between these two extremes.

As a result of the smaller range of critical frequencies encountered in summer, the usefulness of a frequency band employed for inter-communication within the Northern Hemisphere at this season may extend over several hours; in fact, under favourable conditions satisfactory long-distance communication (for example, with the Far East) may often be carried out for over 24 consecutive hours without the necessity of a change of frequency.

The E layer, in contrast to the F layer, has its maximum critical frequency in summer at about local noon; in consequence, under certain conditions of layer height it may frequently become the controlling factor in "skip-distance" calculations, particularly during late afternoon and early evening.

At the time of writing this report it would seem that conditions during June, and particularly during the latter part thereof, are likely to be more stable than of late.

Maintaining a Service

ALTHOUGH some journals, especially those from the Western Hemisphere, at times fail to reach this country owing to enemy action, every effort is made to obtain duplicate copies or, if this is not possible, photostat reproductions of the journals, in order that the Abstracts and References section of The Wireless Engineer may be a complete bibliography of articles on wireless and allied subjects published in the world's journals.

In this section of our sister journal the space devoted to abstracts from journals published in enemy countries is considerable. This fact has greatly enhanced the value of the section.

In addition to some 280 abstracts and references, the May issue contains articles on the rhombic transmitting aerial and receiver aerial coupling circuits.

Published on the first of the month, The Wireless Engineer is obtainable to order through newsagents, or direct from our publishers at Dorset House, Stamford Street, London, S.E.1., at 2s. 6d., including postage.
Makeshifts — Wartime Measures to Meet a Shortage of Servicing Components

By W. H. CAZALY

It must be made quite clear at the outset that the advice that follows on alterations to the circuits and components of probably very well-designed receivers is necessarily of a generalised nature, and that the results that may follow on such alterations cannot be forecast with certainty.

There is far more than meets the eye in even an apparently simple design of commercial broadcast receiver, and improvement seldom accrues from incautious and unintelligent "monkeying" with the products of experienced circuit engineers. On the other hand, we are faced nowadays with exceptional conditions, and if a receiver is put out of commission through a lack of some component that is un procurable, it is worth while making some alteration.

If a spare valve of a different make is available with characteristics similar to those of the original, probably no alteration at all will be necessary. If, however, the replacement valve is not of the variable mu type—it may be an old tetrode—it will be better to use it in the IF stage, and to place it adjusted to suit the aerial used. A certain all-round reduction of goodness of performance may be noticed; the signal/noise ratio may be higher than previously, especially on short waves, and AVC may not operate quite so efficiently. Local station reception will be hardly affected.

If the IF valve break down, the choice of a replacement—if one is available—should be governed by the considerations outlined for the case of an RF valve. If no RF valve of any kind is available, the IF amplifier must be dispensed with and the output of the frequency-changer fed direct to the diode rectifier. Local station reception at least will still be possible, but considerable loss of volume and selectivity may make the set almost useless for anything more. The arrangement is shown in Fig. 2.

A little experimenting with, and when stable reaction—not oscillation, or quality will suffer badly) and fixed working potentials as shown.

Valve Types

A shortage of replacement valves is likely to cause the greatest difficulties. Receivers may have to be adapted to work either with valves of characteristics different from the originals or without certain valves. As used in the stages of a typical superheterodyne receiver, valves fall into functional categories that will be dealt with in turn.

If a signal-frequency RF valve breaks down, reception is still possible without further alteration if the aerial is connected directly to the grid of the frequency-changer, via a very small pre-set condenser, which should be ad-

Fig. 1.—A frequency-changer valve may often be used as an IF amplifier if the oscillator grid and anode are given fixed working potentials as shown.
Wireless World

JUNE, 1941.

some earthy point—depending on whether the frequency-changer does or does not require a steady initial bias. It may be worth while, in this connection, to take this AVC line to a potentiometer across some source of considerable bias and use it as a RF manual volume control.

The above outline partly covers, evidently, the procedure possible to adopt if the double-diode-triode breaks down and cannot be replaced. Since the signal strength in a superhet is normally considerable by the time it reaches the rectifier circuit, it may be well to try anode-bend rectification, since this deals with signals of considerable strength without the distortion—within limits—that might easily arise with leaky grid detection. AVC must be dispensed with. "Power grid detection" may also be utilised, but this is likely to put an excessive load on the HT battery in a battery receiver, since the current taken with the high anode voltage required and no bias may be several mA. This high anode current will preclude the use of resistance-capacity coupling to the output stage and a transformer will have to be used—not more than 1:1.5 step-up—so that it may be inconvenient.

Replacing Battery Valves

The output stage of a battery receiver presents straightforward problems. A pentode and a triode output valve may be exchanged, if due attention is paid to matters of bias. The comparative inefficiency of the triode may to a certain extent be offset by turning up the volume control. If bias is obtained "automatically" by the potential developed across a resistance in the HT negative lead, this resistance may have to be changed for another value calculated from the formula

$$\text{Bias voltage required} = \frac{E}{R}$$

where $E$ is rated bias voltage and $R$ total anode current in mA. The added "bleeder" resistance $R_1$ will be

$$R_1 = \frac{E \times 1000}{I_1}$$

where $E$ is rated bias voltage and $I_1$ total anode current in mA. The added "bleeder" resistance $R_1$ will be

$$R_1 = \frac{E \times 1000}{I_1}$$

ohms, where $I_1$ is total anode current of original valve and $I_2$ is that of substitute valve, both in mA.

Wireless World

JUNE, 1941.
The best thing to do is to fit a non-reversible plug and socket, so that, in the course of domestic upheavals consequent upon dusting and such-like non-technical interference, the lay person cannot reconnect the set wrongly. Moreover, in case the receiver should be taken to a district supplied from AC mains, connection to which of the altered circuit will have disastrous results, a note about the alterations should be stuck to the back of the set in a conspicuous place.

Mention must be made of the possibility of using valves with different heater voltages and currents. Thus, 4-volt AC valves might be replaced by the 6.3-volt variety or vice versa. The safest and best way of doing this is to provide a separate filament or heater transformer for the new valves, or, the design of which can be readily worked out from the Wireless World Data Charts, based, perhaps, on laminations from a good-sized unwanted choke or AF transformer. In such a case the load provided on the heater windings of the existing mains transformer by the valves that have been replaced must be simulated by a resistance, in order to prevent undue rise of heater voltage which would damage the original valves still remaining. Thus, if two 4-volt AC valves each were taken off the 4-volt heater circuit, their heaters would have to be replaced by a resistance of 2 ohms capable of passing 2 A. Or, if one 0.3-volt valve were taken out, the load its heater represents (at 0.3 A) would have to be replaced by 333 ohms. A small heater transformer is not very difficult to make, and care only has to be taken over insulation and layer-winding of the primary. The connections are shown in Fig. 5.

**Extra L.T. Winding**

Another possibility is that of making a small low-voltage auto-transformer fed from the original heater circuit. Yet another way, if room can be found for it on the original transformer, is to put on an extra winding; the extra load will probably not make much difference to the heating of the transformer. It involves finding the number of turns used in the original heater winding, by counting them or by calculating from the ratio of input primary volts to the output volts of this heater winding (ascertained preferably by an AC meter), the turns on the primary and so the turns ratio needed for the new secondary. Results should always be checked up by an AC meter, as incorrect heater current will seriously shorten the life of a valve.

The volume control is another component that may be difficult to replace.

If only one of a lesser resistance value is obtainable, it may be possible to use it in series with a resistance that will make up the total to the value of the original. Control will only be partial and, if the slider of the new component is insulated from chassis, the series resistance may be put either at the 'live' end—if loud volume is seldom wanted—or at the earthy end, if the set is normally used at average or considerable volume. If the new component is of higher value, it can be put in parallel with a fixed resistance, so that the combination will make up the original load on the diode, as can be calculated from the formula \( R_1 = \frac{R \times R_2}{R_2 - R} \), where \( R \) is the value of the original volume control. \( R_1 \) is that of the fixed resistance, and \( R_2 \) that of the new volume control.

If no replacement volume control at all is procurable, it is possible to use a step control, with a stud switch and a string of resistances. Even a 3-way switch will provide a useful measure of control, by providing high, medium and low levels, the medium being fixed at the most favoured level. Another way of controlling sound output if the earlier stages of a receiver are already taken care of by AVC is to provide attenuation in the speech coil circuit, as shown in Fig. 6.
Larger condensers, of the electrolytic type up to many μF, may be scarce. In the smoothing circuits of the power supply, their lack is serious and not too easy to remedy. In Fig. 5 is shown a typical power supply unit; C1 is essential, and in the majority of domestic radio receivers, 3 μF is the least value it should be. It can be made up from smaller condensers connected in parallel, each being rated at 500 volts peak, or from larger condensers in series of lower peak rating—but in the latter case a 100-mA fuse should be included as shown, because if one of the series condensers short-circuits, the other will soon follow suit, and such a short-circuit, unless the receiver were switched off at once, might damage both the rectifier and the transformer. In any case, short-circuiting one of the condensers would double the value of this reservoir condenser, raising the anode voltage and causing a heavy current to pass through the rectifier that might soon damage it. The main smoothing condenser C2 can only be of less capacity if additional inductance is provided in series with the existing choke or field winding, otherwise intolerable hum is likely to result. The extra choke L (if needed for any reason) should be of low DC resistance—not more than 200 ohms—and about 10 or 15 henrys inductance when passing the total anode current; C2 might then be of 4 instead of 8 μF capacity. Smoothing is also possible by using a choke-capacity tuned filter which is tuned to the fundamental 100 c/s of the rectified supply voltage. If nothing can be found to make up even half their value, the drastic step may have to be taken of replacing automatic by battery bias even in mains receivers, which may be done as shown in Fig. 7. The bias batteries should be positioned as far away as possible from any parts of the receiver that get warm, should be of the best quality obtainable, and should be checked (preferably under an artificial load) every month or so, or at the least sign of distortion in quality; if they fail for any reason, the valves will pass very heavy anode current that may damage both themselves and the power supply unit. In battery receivers, decoupling and voltage dropping through resistances feeding screening grids can be obviated by taking extra leads from these screening grids to suitable voltage taps on the HT battery. A small amount of decoupling, with small condensers and resistances, may in some cases still be necessary.

The foregoing covers many of the things that can be done without any profound knowledge of receiver design. It is very far, of course, from being a complete and exhaustive treatise on the subject; its purpose is merely to enable the man with a little knowledge and a lot of common sense to preserve, if not unimpaired, at least in working order, a domestic service that has now become a national necessity.

**Wireless Servicing Manual**

New Edition Now Available

In publishing a new edition of this well-known book on wireless servicing, opportunity has been taken to carry out a certain amount of revision including extensive alterations in the section devoted to valve base connections which has been brought completely up to date. An entirely new chapter has been added dealing with automatic frequency control, a feature which is to be found in several modern receivers.

For those who are entirely unfamiliar with the book it may be said that, as its name implies, it consists of a very complete treatise on the servicing of wireless receivers. In the first place it deals very thoroughly with all types of testing apparatus, including cathode-ray gear, and advice is given on the most suitable type of equipment to obtain, both commercial and home-constructed instruments being dealt with, constructional details being given in the latter case. More important still are the chapters that deal with the most efficient method of using the equipment.

Later in the book, actual fault tracing is described in detail, obscure troubles as well as the better-known ones being dealt with. Short-wave receivers are considered in a separate chapter. Apart from actual fault tracing special interest attaches to the chapters which deal with aerial and earth installations and with the fitting of extension loudspeakers.

In the appendices will be found a collection of tabulated data, including the ever-useful copper wire tables and colour codes as well as valve base connections. Details for constructing a capacity and resistance bridge and a valve testing bridge will also be found in this section of the book.

This book is published from the offices of The Wireless World by our publishers, Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1, at a cost of 6s., or by post 6s. 6d.
Noise in FM Receivers

Further Light on the Behaviour of Discriminator and Limiter Circuits

The problems of noise in frequency-modulated systems have been carried a stage further towards solution by a very methodical series of investigations with the cathode ray oscillograph on the life history of a noise pulse in its passage through the receiver.1

It has been shown that when a noise pulse of very short duration is applied to the input of a receiver, the output is in the form of a train of waves having a frequency the same as that at the centre of the IF passband, and a duration equal to the reciprocal of the cut-off frequency. With the usual FM band width of 200 kc/s the cut-off frequency would be 100 kc/s and the duration of the pulse 10 microseconds. Thus, with an intermediate frequency of 5 Mc/s, there would be 50 cycles in the wave-train.

The shape of the envelope of this wave-train is determined by the shape of the selectivity curve and a double-peaked curve results in the formation of a marked secondary lobe as shown in Fig. 1A. The secondary lobe is still discernible when the response is flat topped, but disappears when the curve is rounded. Lack of symmetry tends to fill in the valley between the two lobes as in Fig. 1D.

The discriminator output resulting from noise wave-trains of different types is a useful indication of errors of alignment in the RF circuits. If the low-frequency peak in a double-bumped selectivity curve is higher than the other, the discriminator output has the form shown in Fig. 1E. If the high frequency peak is greater, the output falls below the zero line as shown in Fig. 1F. Similar curves to these are obtained by mistuning the secondary of the discriminator one way or the other.

The usual discriminator output consists of two separate diode circuits connected in series, and these should be balanced from the point of view of frequency response. The output circuit is earthed on one side and not at the centre, so that it often happens that there is more capacity across one side than the other. The effect of an out-of-balance capacity of 10 μF across 100,000 ohms is shown at I in Fig. 1.

At an early stage in the investigations it was discovered that the shape of the wave-train was considerably modified by the signal strength, and this was found to be due to the effect of grid current in altering the tuning of one or more of the RF circuits. The limiter grid circuit was, of course, the worst offender, and some idea of the magnitude of the detuning effect which may be met with is given by the curves in Fig. 2.

The trouble may be minimised in several ways. A larger tuning capacity giving a lower L/C ratio may be used, or the circuit response may be broadened by damping. Another useful expedient is to ensure that both primary and secondary of the RF transformers have circuits' of equal Q, and that less than critical coupling is employed.

The oscillograms shown so far were taken with noise only and they are not valid for signal-to-noise ratios of more than 1/10. For higher signal/noise ratios, the noise output is a function of the interaction between the signal carrier and the noise wave-train after passage through the RF circuits. The result may be amplitude or frequency modulation, or a combination of both, depending on the phase of the noise and carrier waves.

1 "Impulse Noise in FM Reception," by V. D. Landon, Electronics, Feb., 1941.
Noise in FM Receivers

To investigate the matter more closely, special equipment was built to ensure constant phase relationship between the signal carrier and noise impulse generators. A 10,000 c/s oscillator was used as the master driver, and its output was divided, one section being multiplied to a frequency of 5 Mc/s, and the other passed to a circuit designed to produce narrow uni-directional pulses at 10,000 per second. Finally the output from both branches was brought together and applied to the input of an IF amplifier with 200 kc/s band width and a mean frequency of 5 Mc/s. The phase between the signal and noise impulse was varied by altering the tuning of one circuit in the frequency multiplier.

The results of combining two elements in different phases are shown by the oscillograms of Fig. 3. At 0 deg. and 180 deg., amplitude modulation is at maximum and frequency modulation, as shown by a small discriminator output, is at minimum, while at 90 deg. and 270 deg. the conditions are reversed. At intermediate phases both modulations are present. The effectiveness of amplitude limiting stages as noise suppressors is called into question when it is revealed by these oscillographic records that frequency as well as amplitude modulation may result from noise impulse, and the action of the limiter stage was accordingly further investigated.

In Fig. 4 the wave-trains resulting from the injection of a noise impulse are shown for various signal-noise ratios, and phase relationships. The amplifier gains have been adjusted to show the action both above and below the threshold of the limiter stage. In the plate voltage limiter a low anode voltage is used, and the RF swing at the anode is limited to something less than the DC anode volts. The grid leak limiter depends for its action on the self-biasing action of the valve caused by the flow of grid current in the leak as the signal is increased. Values of 100,000 ohms and 20 μF were used in the limiter grid circuit to give a short time constant as possible.

It will be seen that from the point of view of amplitude modulation the grid leak limiter is not as good as the plate voltage limiter. The grid condenser does not charge up quickly enough to follow the rising front of the impulse. Also, when the response starts there is a tendency for the valve to over-bias, and the carrier is attenuated for a short time after the pulse has ceased, until the mean grid voltage is restored.

By themselves the oscillograms of Fig. 4 do not tell the whole story. The curves of Fig. 3 show that amplitude modulation does not come through the discriminator when the noise pulse and the carrier are synchronised, and Fig. 2 proved that grid current in the

**Wireless World**

**Fig. 3.** Oscillograms, in the presence of a signal, of noise wave-trains and discriminator output for different phase angles between the noise impulse and signal carrier. In the right hand set of records the signal-to-noise ratio is less than unit and although the wave-train is considerably modified, the discriminator output preserves the same character. This is probably due to limitation of high frequencies in the audio circuits.

**Fig. 4.** Waveforms of impulse noise and carrier for different types of limiter.

*JUNE, 1941.*
Noise in FM Receivers—

The limiter can be effective in reducing noise when the signal carrier is tuned at the edge of the pass band, as shown by the oscillograms of Fig. 6. That the limiter can be effective in reducing noise when the signal carrier is tuned at the edge of the pass band, is shown by the oscillograms of Fig. 6.

Noise in FM Receivers—
limiter may actually increase the noise by its detuning effect on the preceding RF circuit. Fortunately it is in

Wireless World

that of simple amplitude limitation. If the curves of Fig. 6 with and without limiter are compared it will be observed that one effect of the limiter is to equalise the area enclosed by the impulse curve above and below zero line; without the limiter the impulse curve is definitely asymmetrical. Analysis of the frequency distribution and total energy constant of the spectra produced by various types of impulse shows that less noise is likely to result from the symmetrical type of curve. Fig. 3 indicated that a reasonably symmetrical discriminator output was obtained without a limiter stage, when the carrier was accurately tuned to the centre of the pass band, so that the chief function of the limiter is the reduction of noise arriving when the instantaneous frequency of the carrier is off centre, e.g., when peak modulation causes mistuning. The grid leak limiter, in spite of its failure to remove amplitude modulation, provokes the least detuning due to grid current, and in practice is probably the best type to use.

The limiter stage is justified by considerations other than that of noise reduction, and its usefulness in limiting distortion due to lack of flatness in the top of the IF amplifier response just such circumstances that the limiter action is most effective, i.e., when the carrier is not exactly in the centre of the pass band of the amplifier.

If the carrier is tuned to the edge of the pass band, beats are generated between the noise wave-train and the carrier. The frequency of the beat is fc, or the cut-off frequency, i.e., half the band-width, and the beat note goes through one cycle in $\frac{2}{fc}$ seconds. As was seen earlier in the article, this is the duration of the noise wave-train.

In the first oscillogram in Fig. 5 the noise train starts 180 deg. out of phase with the carrier and causes a small valley hardly deep enough to show in the reproduced photograph. As it grows it changes its phase until at the peak it is in phase with the carrier, after which it reaches a phase difference of 180 deg. at the moment of returning to zero amplitude. The phase relations on the left of the figure refer to the peak conditions. As the relative phase changes the valley of the beat note travels progressively across the noise pulse. The corresponding discriminator outputs show that for the off-tune condition greatest noise occurs with 180 deg. phase difference between noise and carrier. Yet in these circumstances there is least evidence of amplitude modulation in the original wave-trains.

(Above) Fig. 5. Noise wave-train and discriminator output with carrier tuned to edge of pass band.

(Right) Fig. 6. Illustrating noise reduction by plate and grid leak limiters with carrier off tune. Carrier tuned to edge of pass band; signal-noise ratio, 2.

The discriminator output is shown for both plate and grid leak limiters, and it will be noticed that the performance of the grid leak limiter is at least as good as that of the plate limiter in spite of the disturbed wave-train which the former type of limiter produces (Fig. 4).

It would seem, therefore, that the effectiveness of the limiter is dependent on some factor other than curve would alone suffice to ensure its retention in FM receiver circuits.

JUNE, 1941.
Reducing Loading on Short Waves

When valves are used at high frequencies the input impedance decreases as the operating frequency increases. This loss in the input circuit of the valve is the result of the increase of the input conductance due largely to the cathode lead inductance, because this cathode lead inductance is common to the anode and control grid return circuits.

It is now generally recognised that the inductance of the cathode lead of an amplifier or converter valve, which is common to both anode and control grid circuits, represents a degenerative coupling between these circuits. This degeneration exhibits itself in ordinary commercial valves.

The cathode transconductance of a typical amplifier stage, shown in Fig. 1, is equal to the sum of the valve transconductance and the product of the input loading in ordinary circuits.

It is now generally recognised that the inductance of the cathode lead of an amplifier or converter valve, which is common to both anode and control grid circuits, represents a degenerative coupling between these circuits. This degeneration exhibits itself in ordinary commercial valves.

The cathode transconductance of a typical amplifier stage, shown in Fig. 1, is equal to the sum of the valve transconductance and the product of the input loading in ordinary circuits.

The common cathode lead inductance is represented by an inductance $L$ and may be either due to the length of the internal cathode tube lead, or to the length of connecting wire, or to both.

Split Cathode Connection

The degenerative effect due to $L$ may be overcome by means of the circuit arrangement and valve shown in Fig. 2. Here the cathode is provided with two separate leads, the inductances of which are represented by $L_1$ and $L_2$. In this arrangement two leads are provided, one for the anode and screen-grid return, and the other for the control grid return. If the mutual inductance between these two leads is negligible, the common cathode impedance is substantially reduced, and the input loading due to this cause will be practically nonexistent. However, if valves provided with two cathode leads are used in practical amplifier or converter stages, the input loading would not necessarily be greatly reduced. The reason is that if the impedance of the path through the HT supply is small as compared with the impedance of the path through $L_2$, as it may be in an actual circuit, most of the AC anode and screen grid return current will flow through the supply path, and hence through the grid return lead. If it does so, then the object of having two leads is not fully realised, for the first cathode lead again constitutes a common inductance. However, this difficulty is removed by the insertion of choke coils or resistances as indicated at $Z_1$, $Z_2$, $Z_3$ and $Z_4$. In this way AC anode currents are prevented from flowing through the HT supply path to the cathode lead $L_1$ and are forced to flow through the separate return lead $L_2$. The impedances $Z_3$ and $Z_4$ can be used alone or the impedances $Z_1$ and $Z_2$ used alone. These additional circuit elements present a high impedance to currents of the operating radio frequencies and preferably, though not necessarily, a low impedance to the DC return currents.

The operation of the valve can be still further improved by mounting the by-passing condenser $C$ (Fig. 2) inside the valve and connecting it directly to the cathode.

Circuit Values

In one successful example, in which the screen grid lead was by-passed to the control grid-cathode return lead, the impedance $Z_3$ was a 60,000 ohm resistance and impedance $Z_4$ a 5,000 ohm resistance; the by-pass condensers were all of 0.0002 mfd. With this arrangement an input conductance of about 130 micromhos at 60 Mc/s was

JUNE, 1941.
Reducing loading on short waves—
measured as compared to 500 micromhos in a conventional valve for the same value of anode current. The improvement was, therefore, in the ratio of 4 to 1.

Carrying the above further, the cathode may be provided with as many leads as there are electrodes in addition to the cathode. These leads can then be each separately connected by means of by-pass condensers to one of the other electrodes using suitable chokes or resistances to keep the radio frequency currents out of common paths due to common leads.

Special Construction

A valve incorporating this improvement is shown in Fig. 3, provided with two cathode leads and a by-pass condenser. This by-pass condenser, by obviating the effect of the screen grid impedance, eliminates the degenerative effect of the screen grid current and ensures better shielding at high frequencies. The condensers can be of two types; namely, commercial condensers mounted on the tube structure, or built-up condensers which make use of mica spacers at each end of the mount.

The degenerative effect of the AC screen grid current can be still further reduced by using valves designed to have a low screen grid current. It is now generally known that such valves also have the virtues of reduced fluctuation noise and increased efficiency.

This development is reported from the Laboratories of the Radio Corporation of America.

Frequency Measurement

THE G.P.O. CHECKING STATION

It is the responsibility of the General Post Office, as the Department entrusted with the control of all wireless communications in this country, to see that transmitters operating under its licence adhere as closely as the existing state of technical development permits to their allotted frequencies. The matter first became of great importance when the value of short waves for world-wide communication became evident in about 1924. Soon after that date the G.P.O. set up a frequency standard, with the necessary associated apparatus, for the accurate measurement of the frequency of signals received from stations under its control. This apparatus was installed at the Post Office Research Station, Dollis Hill, on the outskirts of London.

Dollis Hill proved to be an inconvenient site for routine measurements and still more for the important subsidiary work of investigating interference, and so the frequency measuring station was transferred to Colney Heath, near St. Albans. The accuracy attained at the new site ultimately rose to within 12 parts in a million, but this was not considered good enough when crystal-controlled transmitters became almost universal, and it was decided to equip a new station, transferring operations to a new site in clear open country, where reception conditions are good, particularly from the point of view of freedom from all kinds of interference.

The latest checking station is described by C. F. Booth and G. Gregory in the October, 1939, issue of The Post Office Electrical Engineers' Journal. It is pointed out that, in addition to its primary function of measuring the frequency of transmitters under G.P.O. control within the range of 15-30,000 kc/s, a station like this must be laid out for the investigation of jamming, the measurement of incoming signals from overseas, observation on the choice of frequencies for new services, and at the same time to keep a watch on the activities of British amateur transmitters. In addition, it must perform special interception work where required. The station must also be prepared to measure, on request, the frequencies of stations under the control of other administrations.

The specification for the equipment of the new station was a stringent one. The stability over a period of weeks of the frequency standard was to be within $\pm 1$ part in a million, with a short-period stability of $\pm 1$ part in 10 million. These requirements were satisfied by a Marconi-Ekco type 482-C cry-
Frequency Measurement—

stal frequency standard, which, in addition to generating the fundamental frequency, provides a number of harmonics and includes two interpolating oscillators, a crystal-controlled clock, and facilities for listening. The complete measuring equipment was built up around this unit, and the arrangement of apparatus for collecting and "presenting" the signals for frequency measurement is shown in the key of the accompanying photograph. The receivers used are a Marconi-Ekco RG37 and an American HRO "communication" set.

Means are available for checking the station's sub-standard frequency unit from the Rugby time signals, and regular checks are also made against the primary standard frequency generator at Dollis Hill.

Three main methods of measuring the frequency of received signals are in use. The first, that of normal interpolation, operates over the range 14.5 to 30,000 kc/s and is used when the highest accuracy is not essential.

The second method, used between 1,000 and 30,000 kc/s, depends on inter-modulation, a harmonic from the 1,000-kc/s multivibrator being modulated by the output of the interpolating oscillator in such a way that the sum or difference frequency produced coincides with the frequency of the signal under observation. The accuracy over the greater part of the range is of a very high order; errors are greatest towards the long-wave end of the range, so this method is mainly used for routine short-wave measurements.

Graphical Records

To increase the accuracy of measurement on long and medium waves a third method, that of audio-frequency interpolation, is used. In addition, the principle of allowing the signal to beat directly with a harmonic of one of the multivibrators and recording the beats against time as shown by the crystal clock, may also be employed, with the limitation that the signal must be of a frequency within about ±30 c/s of a multivibrator harmonic. One pen of the recorder is actuated by the resultant slow beats and the other pen marks an impulse each second from the clock.

One of the many checks made on the accuracy of the station's apparatus consists of carrying out simultaneous comparisons between the sub-standard frequency generator at that station and the standard at Dollis Hill. Simultaneous measurements of the same transmitter are made at the two stations and very good agreement is reached. In the case of observations of the N.P.L. standard frequency transmissions, it is stated that the frequencies as determined at the two stations seldom differ by more than a few parts in 10 million.
As readers of a previous article may remember, it can be taken as a fairly well-established fact that there are two stages in learning Morse, just as in learning to skate or to ride a bicycle, to quote two parallels only. The first stage is the conscious assimilation of the alphabet, so that when dash-dot is heard, N is thought of; the second is the driving of this into the subconscious mind, so that when dash-dot is heard it is impossible not to think of N.

Again, it can be accepted that teaching methods should differ from one stage to the other: slowly sent letters with slow dashes and dots during the short first stage; quickly sent ones with long pauses between letter and letter, these slowly decreasing as the learner gains speed, during the second stage. (Incidentally, it may be worth mentioning that my own experience indicates that if anyone feels like learning non-wireless systems of Morse signalling, and if these systems work at low speeds, a lamp, for example, it is best for this study to be done either during the first stage or else left until the end of the second stage is nearing: i.e., when the learner is at about six words a minute or at about 20, respectively.

If he tries to learn lamp with a friend as a relaxation when they are doing about twelve words on buzzer, it will merely tend to delay the progress of the second stage.)

Now during this second stage: a "pause" almost invariably occurs, a horrid period that may last for days or even weeks, during which the learner makes no progress, curses the shade of Samuel Morse, bites pieces off the end of his pencil, swears that it should all be his, and if one of such favoured persons wants to learn how really to manage it, he will never manage it—even chucks up the whole thing in despair.

Another, ridiculously simple and often effective when the transmission is being taken: "I did it yesterday—I told you I could do it," and the conscious will nearly asserted itself that very little was needed. One such dodge, mentioned with all due reserve, is to get slightly drunk. Another, more generally applicable, is to recite mentally (or better audibly) some passage of poetry or the Bible or the multiplication table—anything else favoured while a transmission is being taken: in this case, for obvious reasons, it should be a test in code, not in plain English. Another, ridiculously simple and often ridiculous, is to do with the left hand something demanding a certain degree of attention while the right hand writes down the text—for example, to balance a pencil across the forehead or to keep a pencil standing upright on end by checking it as it falls with the circle formed by forefinger and thumb. Such devices have the advantage that the transmission can be in plain language or code as desired, but may distract the eye too much and make writing too difficult. Others which may be tried, and which need no visual attention, are buttoning and unbuttoning one's coat, turning a coin over and over in the left hand, and such like: the trouble is that, as a rule, these do not demand sufficient attention to keep the conscious mind from interfering. What is "sufficient" here, however, obviously varies from one person to another and even for the same person from day to day: sometimes the subconscious has already so nearly asserted itself that very little is needed for it to take full charge, and here very simple devices will suffice. It is a matter for the learner himself to try; and it is amusing to note that the fact that he is thus observing himself may in itself supply the needed extra attention.

Another possibility, often recommended by teachers although as a rule with no idea why desirable, is that of forcing oneself to copy one letter behind in code, or several letters behind in plain language, so that no letter is written down until after it has been sent. Here the conscious mind is kept busy remembering the letter or letters: it is particularly effective when the transmission is taken on a typewriter (a thing that all beginners should learn to do), and above all if the learner is only a fair class and the machine-gun expert. Yet another is to form the letters with excessive attention, almost drawing them rather than writing; or to make them extremely small and yet legible—I have as a souvenir of the last war a full-length Army test message taken down, quite legibly, on a scrap of paper the size of a Coronation stamp by a learner whom (he said) this dodge saved from "drunk and despondency." It is a matter for personal experiment. In any case, let it yet again be emphasised that if only the pause-speed can be once passed it is extremely rare for any further trouble to recur at this speed, so that a little experimentation may save the learner "weeks of 'orrid doubt" and "faith and 'ope and cursing and despair" (to quote Kipling from memory).

R. R.-H.

The Psychological Pause

As in the Learning of Morse

A Phase in the Learning of Morse

162

JUNE, 1941.
THE WORLD OF WIRELESS

CENSUS OF SERVICE ENGINEERS

Forces Will Take 87 per Cent.

The publication of the Revised Schedule of Occupations and Protected Work, in which it will be remembered service-men continue to be reserved from 35 years of age, was thought an opportune moment to reveal the result of the second Service Questionnaire issued by our contemporary, The Wireless & Electrical Trader.

When the first census was undertaken by The Trader soon after the war began, it was estimated that with the reservation age at 30, as it then was, 6.5 per cent. of the pre-war service engineers were liable for military service. The latest census, which is in print, shows that there are a number of changes in the wavelengths to be used for the transmissions of news and services and the wavelengths used are as follows:

- Fully-trained engineers (reserved) ... 13
- Owners and managers (reserved) ... 20.5
- Improvers (reserved) ... 18

It is stressed, however, that this does not mean that the personnel available is equivalent to 70.5 per cent. of the original staffs, for it must be remembered that the majority are not up to the technical standard of the pre-war engineers.

FREE EUROPEAN AMATEURS

Hospitality from the R.S.G.B.

In extending greetings and good wishes to the large number of European amateur wireless men at present in this country, the Radio Society of Great Britain, through The T. & R. Bulletin, offers to publish notes from any representative group. Poles and Czechs, Free French and Belgians, Norwegians, Danes and Dutch are among those present in these islands. They no longer have a journal of their own, and the offer of space in the Society’s journal will doubtless be much appreciated. It will serve not only as a connecting link between exiled amateurs of the same nationality, but will also give an opportunity for them to get in personal touch with British amateurs with whom they worked in peacetime.

BONDS OF FRIENDSHIP

At the present time, when the ties between Great Britain and America are binding the two countries closer together, the following telegram from Mr. Sarnoff, president of the R.C.A., to Mr. Donisthorpe, at the Tenth Annual General Meeting of the Radio Industries Club, is of special interest.

"Each year, since Marconi’s first wireless message from England to America forty years ago, radio has strengthened bonds of friendship between our countries, and today it carries cordial and affectionate greetings to British Radio Industries Club and best wishes for success of Annual General Meeting this year, next year and many years to come.—David Sarnoff."
U.S. TELEVISION

According to our American contemporary, Broadcasting, it is expected that television stations in the States will very soon be granted facilities by the Federal Communications Commission for "full-time commercial operation." It will be remembered that the F.C.C.'s authorisation of "limited commercial operation" was rescinded in March, 1940, following a dispute between the Commission and the parties concerned.

The standard of transmission favoured is 525 lines, 30 frames interlaced, as recommended by the National Television System Committee. The proposed 30 hours per week operation is likely to be reduced to 15 hours.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>America</td>
<td>WXII (Round Brook)</td>
<td>17,750</td>
<td>16.83</td>
<td>4.0, 6.0</td>
</tr>
<tr>
<td></td>
<td>WBOB (Milwaukee)</td>
<td>9,570</td>
<td>11.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WCB (Philadelphia)</td>
<td>15,270</td>
<td>10.65</td>
<td>12.30 a.m., 7.45.</td>
</tr>
<tr>
<td></td>
<td>WCUX (Wayne)</td>
<td>9,650</td>
<td>31.69</td>
<td>9.57, 11.45±</td>
</tr>
<tr>
<td></td>
<td>WCRX</td>
<td>11,830</td>
<td>25.56</td>
<td>7.30.</td>
</tr>
<tr>
<td></td>
<td>WCRX</td>
<td>17,830</td>
<td>16.83</td>
<td>2.0±, 3.0±, 4.0±, 4.15±, 5.0±, 5.30.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>HCC2 (Tokyo)</td>
<td>9,500</td>
<td>31.57</td>
<td>11.20.</td>
</tr>
<tr>
<td></td>
<td>JZJ</td>
<td>9,635</td>
<td>31.46</td>
<td>7.0.</td>
</tr>
<tr>
<td></td>
<td>JZJ</td>
<td>11,800</td>
<td>25.42</td>
<td>7.0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manchuria</td>
<td>MTCY (Sioning)</td>
<td>11,775</td>
<td>24.48</td>
<td>9.0 a.m., 11.5.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>SBO (Motala)</td>
<td>6,005</td>
<td>49.46</td>
<td>11.20.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>HSIO (Bangkok)</td>
<td>11,715</td>
<td>25.61</td>
<td>1.45.</td>
</tr>
<tr>
<td></td>
<td>HSIOJ</td>
<td>10,920</td>
<td>15.77</td>
<td>1.45.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>TAP (Ankara)</td>
<td>9,405</td>
<td>31.70</td>
<td>8.15.</td>
</tr>
<tr>
<td></td>
<td>TAQ</td>
<td>13,150</td>
<td>19.74</td>
<td>1.15.</td>
</tr>
</tbody>
</table>

U.S.S.R. (Moscow)

<table>
<thead>
<tr>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>49-metre band</td>
<td>-</td>
<td>- 2.0 a.m., 8.30, 10.0.</td>
</tr>
<tr>
<td>41</td>
<td>-</td>
<td>12.0 m.t.</td>
</tr>
<tr>
<td>31</td>
<td>-</td>
<td>8.0, 9.30, 10.0.</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td>1.0, 6.0, 8.30.</td>
</tr>
<tr>
<td>19</td>
<td>-</td>
<td>1.0 m.t.</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>8.33 a.m., 1.0.</td>
</tr>
</tbody>
</table>

Vatican City

| HVJ   | 6,190 | 48.47 | 8.15. |

LONG- AND MEDIUM-WAVE TRANSMISSIONS

<table>
<thead>
<tr>
<th>Country</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cairo</td>
<td>1,348</td>
<td>222.6</td>
<td>7.50, 11.10.</td>
</tr>
</tbody>
</table>


U.S.S.R.

| Moscow | 172 | 1,744 | 12.0 m.t. |

It should be noted that the times are two hours ahead of GMT, and are p.m., unless otherwise stated. The times of the transmission of news in English in the B.R.C. Short-wave Service are given on the preceding page.

* Saturdays only, § Saturdays excepted, † Sundays only, ‡ Sundays excepted.
Wireless

World

Dr. G. W. C Kaye

It is with regret that we record the death of Dr. G. W. C. Kaye, D.Sc., F.R.S., the present incumbent of the position of director of the National Physical Laboratory. Dr. Kaye, who had received many professional honours, died on April 10th, a few days after his 64th birthday.

R.C.A. Laboratories

It was recently announced by the president of the Radio Corporation of America that a branch of the parent company was to be established for research work, It will be known as R.C.A. Laboratories and will be housed in new premises to be built at Princeton, New Jersey. Mr. Otto S. Schairer will be vice-president in charge of R.C.A. Laboratories, with Dr. C. B. Jolliffe as chief engineer, Dr. V. K. Zworykin and Mr. B. J. Thompson as associate directors.

U.S.-Norway Direct Radiotelegraph Circuit

The reopening of the direct radiotelegraph circuit between the United States and Norway, which had been closed since Germany took over control of the country in April, 1940, was recently announced by R.C.A. Communications. The Norwegian terminal is the Oslo station of the Administration of Postal Telegraph and Telephone, which has been reconditioned. During the past year, all radiotelegraph traffic from the U.S.A. for Norway has been handled over the Berlin circuit, except for the first few weeks when it was transmitted via Stockholm, Sweden.

Australia's Transmitters

Australia now has a total of 129 broadcasting stations. Of this number 26 medium-wave and 3 short-wave transmitters are operated by the National Broadcasting Service. The remainder are commercial stations. According to figures issued by the U.I.R., the average power of the transmitters is very low, being approximately 1.6 kW.

The Wireless Industry

A range of new power type loudspeaker units is described in a leaflet (No. 25) recently issued by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. The types listed include omni-directional diffusion units for halls and factories, weatherproof moving coil driving units for horn loading, including a folded type designed for mounting on car-bumpers, etc.

Mr. G. H. Walton has been appointed works manager of British Insulated Cables, Ltd., on the retirement of Mr. E. A. Bayles, who continues his association with the company in a consultative capacity.

R. A. Rothermel, Ltd., announce that from May 1st the price of the Rothermel New Junior Pick-up has been increased from 23s. 6d. to 26s.

The "Fluxite Quins" at work

Cried Ol, from the gutter, "Hold tight! Till I've soldered this aerial right.

Why it's broken again.

Pass me down, lads, the tin of FLUXITE!"

See that FLUXITE is always by you—in the house—garage—workshop—wherever speedy soldering is needed. Used for 30 years in Government works and by leading engineers and manufacturers. Of ironmongers—in tins, 4d., 6d., 1/4 and 2/8.

Ask to see the FLUXITE SMALL-SPACE SOLDERING S.T.—compact but substantial—complete with full instructions, 7/6.

Write for Free Book on the art of "soft" soldering and ask for Leaflet on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE

TO CYCLISTS! Your wheels will NOT keep round and true unless the spokes are tied with fine wire at the crossings AND SOLDERED. This makes a much stronger wheel. It's simple—with FLUXITE—be IMPORTANT.

THE FLUXITE GUN is always ready to put Fluxite on the soldering job instantly. A little pressure places the right quantity on the right spot and one charging lasts for ages. Price 1/6, or filled 2/6.

FLUXITE LTD.
Dept. N.W., BERNONDEY STREET, S.E.1

ALL MECHANICS WILL HAVE FLUXITE

IT SIMPLIFIES ALL SOLDERING
LETTERS to the EDITOR

The Editor Does Not Necessarily Endorse the Opinions of His Correspondents

Post-war Amateur Transmission

In discussing the outlook for amateur transmitters after the war, all your contributors and correspondents take the gloomy view that the G.P.O. will refuse to restore the privileges (or should it be "rights"?) enjoyed previously by the amateur.

Why should the G.P.O. do any such thing? The frequency bands occupied by amateurs are allotted by international agreement, and presumably can only be diverted to other uses by similar agreement. So long as these bands are occupied by amateurs in other countries, the G.P.O. could not usefully employ them for its own purposes, and so the motive of self-interest would not arise—except, perhaps, with regard to the ultra-short waves.

C. T. C.

WHY be almost apologetic for saying that a transmitting amateur without a knowledge of morse "seems all wrong." There is a great deal more than "mere conservatism" (I again quote from your April Editorial) behind that point of view. A "phone only" transmitter would get very poor value from the few watts allowed by his licence and would be quite unable to observe the common courtesies of non-interference with morse transmitters.

RADIOPHARE.

It seems that the majority of British amateurs believe that a more difficult code test would be beneficial to the amateur movement. I do not know how the R.S.G.B. feel about this, but it is interesting to note that the Society's American counterpart, the American Radio Relay League, is reported (by Radio News, February, 1941, issue) to have approached the Federal Communications Commission with a view to "the lowering of standards of admission to the ranks of the licensed amateur."

Radio News continues: "It is said the A.R.R.L. believes there should be more amateurs and accordingly has asked the F.C.C. to make the entrance examinations leading to a licence a little easier. Code restrictions will be lowered instead of raised, and it may become a possibility that amateurs will be licensed with considerably less than 13 w.p.m. code speed requirements and lighter technical requirements. The exact code speed prerequisite . . . is supposed to be in the neighbourhood of 4 to 5 w.p.m."

E. A. S. JONES, (ex 2FOA).

Gibraltar.

[The two cases seem hardly comparable. The U.S.A., in process of re-arming, naturally wishes to have a large body of amateurs from which to draw recruits for the wireless branches of its fighting services. In this country, so far as the present discussion is concerned, we are thinking solely of the post-war position.—Ed.]

"Mystery" Record Players:

G.P.O. Ruling

It is considered that the publication of the article on "Mystery" Record Players in the April Wireless World might encourage some of your readers to construct similar apparatus, and you will appreciate that if such a device were connected to an efficient aerial it would radiate appreciably. Its possession and use would then be regarded by the G.P.O. as infringements of the Defence Regulations (S.R.O., 1939, Nos. 1687 and/or 1688). The P.M.G. has no objection to the use of this class of apparatus provided signals are of such a strength that no radiation can be detected outside the premises in which the device is housed.

E. F. H. GOULD,

For Engineer-in-Chief, G.P.O. (Radio Branch).

The Cathode Follower

I SHOULD like to suggest that the formula given for the impedance of a cathode follower in the article "Photographing Transients," by Dr. T. H. Turney, in your issue for April, 1941, page 99, is inaccurate.

The fundamental formula for the output impedance of a cathode follower (diagram (a)) is

\[
Z_o = \frac{1}{1 + \frac{R_1}{R_a}}
\]

BOOKS ON WIRELESS

issued in conjunction with "The Wireless World"

<table>
<thead>
<tr>
<th>Title</th>
<th>Net Price</th>
<th>By Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;RADIO LABORATORY HANDBOOK,&quot; by W. G. Scroggie, B.Sc., A.M.I.E.E. (Second edition ready shortly)</td>
<td>10/- 11/1</td>
<td></td>
</tr>
<tr>
<td>&quot;TELEVISION RECEIVING EQUIPMENT,&quot; by W. T. Cocking, A.M.I.E.E.</td>
<td>8/- 8/6</td>
<td></td>
</tr>
<tr>
<td>&quot;RADIO INTERFERENCE SUPPRESSION,&quot; by Gordon W. Ingram, B.Sc.</td>
<td>5/- 5/4</td>
<td></td>
</tr>
<tr>
<td>&quot;LEARNING MORSE,&quot; Sixth Edition</td>
<td>6d. 7d.</td>
<td></td>
</tr>
<tr>
<td>&quot;RADIO DESIGNER'S HANDBOOK,&quot; Edited by F. Langford Smith, B.Sc., B.E. (Reprint in preparation)</td>
<td>8/- 9/1</td>
<td></td>
</tr>
<tr>
<td>&quot;THE WIRELESS WORLD&quot; GREAT CIRCLE PROJECTION MAP</td>
<td>2/- Post free</td>
<td></td>
</tr>
</tbody>
</table>

Obtainable from Leading Booksellers and Railway Bookstalls or by post (remittance with order) from

ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1

JUNE, 1941.
i.e. $Z_c$ is equal to the resistance of $R_a$ and $\frac{1}{g}$ in parallel.

Thus in the circuit given (b), the output impedance

$$Z_o = \frac{1}{R_z + R_f + Z_c}$$

which, in the case under consideration, cannot be less than

$$\frac{1}{R_z + R_f}$$

or 93.66 ohms.

Actually $Z_c$ will be about 100 ohms, so $Z_o$ will be about 105 ohms, a value considerably different from the 20 ohms given in the article mentioned.

Cardigan. E. F. GOOD.

**Club for South Manchester**

Will any young reader who is interested in the formation of a radio and television club in the South Manchester area please communicate with me? J. ROBERTS.

30, Milton Grove, Whalley Range, Manchester.

---

**Vibrator Power Packs**

**A New Development in Smoothing for Use with Sensitive Receivers**

The standard type of vibrator pack as designed for use with broadcast receivers has proved itself to be not only efficient and reliable but also remarkably silent in operation. When it is used in conjunction with communication receivers of advanced design, the extreme sensitivity and also the extension of the wavelength coverage is apt to disclose traces of contact noise which would pass unnoticed under the conditions of use for which the unit was originally designed.

Low-frequency Ripple

Masteradio, Ltd., have recently investigated the matter, and have evolved a modified form of smoothing which enables communication sets of the most sensitive type to operate at full gain while drawing their HT supply from a vibratory rectifier. We have recently had an opportunity of trying out the new system, which is termed the "Silent Surge" circuit, and there can be no doubt that it marks a considerable step forward.

The residual ripple from a standard vibrator pack arises chiefly from contact pulses in the LT battery leads, and is radiated over a wide band of frequencies. Low frequencies are particularly troublesome, and may affect the 50-ke/s band which is included in certain communication sets.

Balanced Smoothing

In the normal vibrator system the battery circuit, although of low impedance, is not symmetrical to earth, and the small intermittent field which is established is sufficient to cause trouble when the degree of sensitivity is high. The method of overcoming this difficulty which Masteradio have adopted is first to prevent the greater part of the contact pulse reaching the battery leads by connecting a large reservoir condenser of the order of 1,000 mfd's across the LT supply inside the vibrator screening, and, secondly, to use a balanced smoothing circuit in the external battery leads. With this method the battery may be earthed on either side or left unearthed altogether without evoking any interference. A modified form of this smoothing circuit has been developed in which a part of the unwanted ripple can be used for the balancing out of residual hum in the filament circuits of sets using directly heated valves, and also for reducing the ripple in the rectified HT supply leads, thus enabling less expensive smoothing to be used.

Another improvement has been effected in units of the self-rectifying type by shunting the contacts with a resistance-capacity circuit, the time constant of which bears a definite relationship to the duration of the spark. In this way the transients occurring at the corners of the square waveform are removed and there are fewer high-frequency components to filter in other parts of the circuit. The current rating of the vibrator can be exceeded by a considerable margin without deterioration of the contacts when this circuit is employed.

We were given the opportunity of handling a National H.R.O. receiver deriving its HT supply through the new circuit, and were unable to find any part of the wavelength spectrum where vibrator noise was more than a whisper. Tests with an oscilloscope also demonstrated convincingly the smoothing out of unwanted ripple components.

---

**Wireless World**

---

**Vortexion Ltd., 257, The Broadway, Wimbledon, S.W.19. **Phone: LIBerty 2514

**VORTEXION 50w. AMPLIFIER CHASSIS**

A NEW DEVELOPMENT in amplifier packs is here. 10 per cent. increase in plate efficiency is the result of the use of 100 watt 5000 ohm in the output stage, and the separate HT supplies to the valve and screen have better than 4 per cent. regulation, while a separate transformer is provided for each stage. The d.c. output is supplied by a diode transformer incorporating fast-track. This amplifier is supplied with a filament transformer of 5,000 ohms; 40,000-50,000 ohms; 5,000-10,000 ohms; 40,000-50,000 ohms. Three output lines can be switched using all available valves and will deliver the full power rating of 40,000,000 ohms to the loudspeakers with extreme low over- current protection.

CHASSIS with valves and picks £17 10 0

Goodman P.A. Speakers £6 6 0

Moving Coil Microphones £5 5 0

Chromium Microphone Stands from 15 0

---

**Many hundreds already in use for A.R.P. & GOVERNMENT purposes**

**15w. AC & 12-VOLT DC AMPLIFIER**

This small Portable Amplifier operating either from AC mains or 12-volt battery, was tested by "THE WIRELESS WORLD." October 1st, 1937, and has proved so popular that a Consultants' demand it remains unaltered except that the output has been increased to 17.2 watts and the battery provision is lowered 0.6 amperes. Read what "The Wireless World" said ---

"During tests an output of 14.7 watts was obtained without any sign of distortion so that the rating of 10 watts is easily justified. The measured response shows an upper limit of 18,000 c/s and a lower of 20 c/s. Its performance is exceptionally good. Another outstanding feature is its exceptionally low hum level when AC operated even without any earth connection. In order to obtain the maximum undistorted output, an input to the microphone jack of 0.007 volt was required. The two independent volume controls enables one to adjust the gain of the amplifier for the same power output from both sources, as well as superposition on the other, or fade out one and bring the other up to full volume. The secondary of the output transformer is tapped for loud speakers or line impedances of 4, 7.3, and 15 ohms." Prices:

AC and 12-volt CHASSIS with valves, etc. £12 12 0

AC only CHASSIS with valves, etc. £8 18 6

Gauze Case for either chassis, 12/6 extra.

Plus 5% War Increase.

Delivery: Prompt. Delivery on "Priority 1A" orders.

---

JUNE, 1941.
Tell-tale Lamps

**How** many of us have run down accumulators and shortened the lives of H.T.B.'s by leaving battery wireless sets switched on when we imagined that they were off? It's so easy to do with two designs of receiver. The first is the one whose volume control does not actuate the battery switch when turned counterclockwise as far as it will go. I have one of that kind: the volume control is just a plain rheostat and the wave-change switch has four positions: SHORT, MEDIUM, LONG and OFF. The set, however, becomes silent when the V.C. is at its minimum position, though both H.T. and L.T. current are still flowing merrily. The other design that may catch you out is the one whose wave-change switch has a GRAM position. You turn the knob absent-mindedly when you've finished listening, and don't notice that its indicator registers GRAM. Again the loudspeaker's voice is stilled; again the load on the batteries continues unchecked and unsuspected. With battery sets of either of these kinds the only safe way is to fit a tell-tale in the shape of a small 0.06 amp. filament lamp placed in a conspicuous position so that it is bound to catch your eye. The lamp is, of course, wired in parallel with the valve filaments. The tiny extra load makes little difference to the life per charge of the L.T.B. and the lamp genuinely earns its keep by acting as a safeguard.

**The Americans, MW and SW**

How have the medium-wave Americans been coming in during the winter months? I'd like to know, if any readers care to write, for I haven't been able to try for them much myself. For various reasons I can't rig up a domestic kind in its stead, you realise what a tricky piece of apparatus the latter is to work. To the man used to what is commonly called a broadcast receiver the C-R, with its many knobs, dials and switches, looks rather frightening: he probably feels when he tries one for the first time that it will take him a long while to become familiar with its working. Actually, for all its complicated appearance, the bigger set is by far the easier to use. There is, of course, an art in handling a C-R so as to get the very best results out of it. When, for example, selectivity, RF (or IF) amplification and AF amplification are all variable, the C-R artist can work wonders by giving each control exactly its right setting. But apart from such skilled achievements, the C-R is less difficult to use than the "simple set" for short-wave reception just because of its better tuning arrangements. Bandspreading combined with smooth, backlash-free slow-motion gears and large dials with clear graduations, make it so easy to find exact resonance, or to alter the tuning by the few kilocycles that separate one station from its next door neighbours on either side. But when, say, the entire 19-metre band with its score of stations occupies only a fraction of an inch on the dial and the coarse and rather jerky gears move a pointer half as thick as a poker, I, at any rate, find the tuning-in of all but the noisier short-wave stations a difficult and fiddling business. With a C-R you can always return quickly to a station if you leave it for a while to search elsewhere; with the other kind it is often a very different business.

**The Debate Continues**

**What** is the highest frequency in use on the other side of the Atlantic that is picked up in this country with any kind of regularity? The question arose just before I sat down with this note, when a fellow enthusiast and I were discussing a problem. Neither of us could remember just what had happened "below ten" in 1938 and 1939. I seemed to recollect reports of reception of U.S.A. police and other transmissions on frequencies as high as 60 megacycles: he maintained stoutly that nothing with a carrier above 40 megacycles had been heard. Neither of us can get hold of his text books or his pre-war records, so there the matter has to rest, unless some reader will kindly help. And here's a further question awaiting an answer: What is the smallest skip-distance recorded for 50-megacycle transmissions? In other words, what is the shortest range outside its normal quasi-visual area at which such an U.S.W. signal has reappeared by means of its sky wave? I maintained that in certain circumstances a 50-megacycle transmission, though unreceivable at 100 miles, might be picked up at seven or eight hundred. My adversary contended that the skip distance would always be far greater; he maintained, in fact, that the signal would in all probability never reappear, that it wouldn't be receivable anywhere outside the limits of its direct-wave area. I seem to remember reading much the same thing about far lower frequencies in the now discredited text books of years ago!

**S.B.S.T.**

For the radio long-distance enthusiast this time business is getting a bit too complicated. Even before the war countries adopting some kind of summer time didn't all start it or end it on the same date. And countries near the equator didn't as a rule have special summer time at all. When on the night scheduled for its opening here you had wrestled with the problem whether putting the clocks forward an hour or back an hour was the correct thing to do and had acted accordingly, you looked ruefully at that neat world time-chart that had been so useful during the darker months and perhaps tried to work out what hour it then was in Nebraska or Japan. Another time-chart might eventually be compiled as you were able to ferret out information whether this country or that did or did not adopt a summer time and, if it did, when the change was made. In the course of a few days 6 p.m. in London might be noon in New York, then 1 p.m., then noon again. And now comes S.B.S.T. to present the D-Xer with maddening perplexities. To the best of my belief London's 6 p.m. is, at the moment of writing,
Random Radiations

New York's noon. But what it is now, or will be when this appears in print, in Moscow or Vladivostock, are mysteries too deep for my poor harassed brain to fathom.

Unfinished Argument

The other day I ran across an officer who in times of peace is one of our keenest amateur transmitters. We hadn't met before, but when he told me his call sign I realised that he wasn't exactly a stranger, for I recalled many occasions in the days before the war when I'd listened to him working this station or that. Curiously enough, I'd a clear recollection of a Sunday morning argument between him and another enthusiast, to which I had listened with the greatest interest. When I reminded him, he also remembered it. The two, who lived many miles apart, had arranged to meet and thrash out the subject at close quarters instead of through the ether. Unfortunately, the outbreak of the war knocked that idea on the head and the argument on which I had eavesdropped so long ago still awaits its continuation.

Things to Come

Like myself, this erstwhile keen amateur has had very little opportunity for more than a year and a half of indulging in our own particular kind of wireless. As we discussed past adventures on the short waves I could see that his fingers were as eager to get back to the controls of his transmitter as mine are to rest again on the knobs and switches of my big communication receiver. Even when on leave I have not been able to put it into action. All my radio gear had to be stowed away when the war came and brought an influx of evacuees. One of them now sleeps in what was once my wireless den. May it not be long before that room returns to its rightful uses? But I shall have a rare job in unpacking and sorting out the wireless gadgets that now repose in packing cases in a dry cellar. I've forgotten now which case contains what, and though everything was carefully stowed I'm sure that I shall be looking here, there and everywhere for various bits and pieces. And, of course, the thing that one wants most urgently is dead certain to be at the very bottom of the last case in which one rummages. But that unpacking will be a time of such joy that little bothers of that kind won't matter very much.
**RECENT INVENTIONS**

**RADIO NAVIGATION SYSTEMS**

The pilot of an aeroplane navigates his craft over an area of country in which a number of beacon stations O, Fig. 1, are arranged to radiate a network of beams B. The plane is fitted with a receiver, the tuning of which is continuously and automatically varied over a wide band of frequencies. As a result it picks up, simultaneously, the signals from all the beacon stations within range, each being indicated in a manner that distinguishes it from the others.

The received signals, after rectification and amplification, are applied to a cathode-ray receiver, Fig. 2, where they appear as traces T of different amplitudes and positions on a calibrated fluorescent screen. The screen is associated with a chart of the locality, which is mounted on rollers R, R1 and is so arranged that by following the co-ordinate lines 1, 2 enclosing, say, the amplitude peak K1 corresponding to the North-South beam, and the co-ordinate lines 3, 4 enclosing the peak K2 corresponding to the East-West beam, the geographical position of the actual transmitter K can be identified. In the drawing a map of France is shown.

M. Wallace. Convention date (France) 21st February, 1938. No. 525393.

**CATHODE-RAY TUBES**

The object of the invention is to reduce the risk of high-voltage leakage from the anode of a cathode-ray tube to any of the other electrodes such as the grid or cathode, or even to the focusing or deflecting coils, via the glass surface of the bulb. For this purpose the anode is mounted independently at one end of a tubular glass support, the other end of the support being sealed to the glass bulb of the tube at a considerable distance away from any of the other electrodes.

Since the glass support must be sealed to the metal of the anode at one of its ends, and to the glass wall of the tube at its other end, it is most conveniently made for assembly in three sections. The two end sections are each made of the particular type of glass best suited to the kind of seal required, whilst the middle section is of glass capable of being welded to both end-sections.

A. F. Pearce. Application date, 18th April, 1939. No. 527980.

**SECOND-CHANNEL INTERFERENCE**

The drawing shows an aerial input coupling designed to minimise second-channel interference in a superhet set. The aerial primary coil L is coupled to a secondary coil L1 forming part of the first tuned input stage, both coils being in series with a fixed condenser C. The secondary L1 is also in series with a coil L2; the circuit as a whole is tuned by a variable condenser C1 and is connected across the input terminals T of the first amplifier valve.

If the signal range is 150 to 300 kilocycles, and the intermediate frequency is 450 kc/s, the local oscillator will operate over a range of from 600 to 750 kc/s and second-channel interference is liable to occur between 1050 and 1200 kc/s.

To eliminate such image frequencies, the coupling between the coils L and L1 is adjusted so that, within this range, frequencies will scarcely be affected and will pass through to the amplifier.

**RADIO RELAY STATIONS**

The object of the invention is to relay signals simultaneously in different directions, so that a signal, introduced, for instance, at any one point, can be reproduced throughout a whole chain of such stations. The system is primarily designed for working on a common carrier wave, the signal being preferably superposed as a frequency modulation. It can also be used, among other things, to stabilise the frequency of a network of short-wave radio stations.

A. F. Pearce. Application date, 18th April, 1939. No. 527980.

_The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each._

JUNE, 1941.
ELECTRADIX RADIOS

HEADPHONES
L.R. Double Headphones
Field Signallers, 120 ohm Phones. All leather headbands with side adjustment chin strap and 4ft. cord. Comforatable. 5/-
L.R. Single Phone & Cord - 2/-

MORSE INKERS
The ROLLS-ROYCE of BUZZERS is the CAMBRIDGE-TOWNSEND. Tiny and Shrill. 10/-.

DYNAMO BARGAINS
110-volt, 8 amp. D.C. ball bearing, semi-enclosed. 1,850 revs., 15 lb. tin. x 5in. Stuff only 15/6 Post free. 200 volts at 1/2 amps. 19/6 Post free 200 volts 1/4 amps. 27/6

MOTOR DRIVES
GEARS
Slew drive Gear Boxes for Cine. or Boat, 1/2 or 1/4 h.p., 10/- Ditto on C.I. Pedestal, with flywheel, 15/- Small 2 to 1 Gear Boxes, 1/4 h.p. 4/6.

DYNAMO. Double Current. Govt., cost £15, two commutators, D.C., 6/8 v., 15 mps. and H.T. 400/600 v., 10 mps., 250m., 25 long, 17 low, 4,000 revs., ball bearings, 25/-. We have some surplus sold at 30/6.


MICRO-MOTORS
A.C. split phase synchronous motors, squirrel cage rotor, 3 in. dia. Dog clutch drive to reduction gear from 2,000 revs. to 58 r.p.m.
Voltage 15 to 20 volt, 50 cycles, reversible, double shaft, enclosed, laminated, new. Suit model drive, remote control switching, tuning drive, etc., 6/-. Post free.

ALTERNATORS

VERTICAL MOTOR - ALTERNATORS. 170 cycle, Marconi type, 4 kW. and 4 kW. Motor off 150 volts D.C. £10. 2/1 kW. NEWTON Vertical, 590 cycles 300 volts 20 amps. 1,500 revs. Motors, 220 volts D.C. £20.

3-PHASE ALTERNATORS. G.E.C. 333 cycles, 3 ph. 120 volt A.C., enclosed, rigid steel case. Self exciting horizontal, 6/6/10.

A.C. HAND ALTERNATOR. Permanent steel magnets, wound armature driven by gearing and handle. Output of 80 volts 20 ma. A.C. For Medical Treatment, A.C. experiments, etc. Sale, 7/6. Cargile, 1/-.

VIBRATOR H.T. KITS
Home-made L.T. Battery-operated
Supersede H.T. Batteries. The Vibrator converts D.C. to A.C. by vibrating uniformly. Any voltage to 100 watts obtained by transformers and rectified for radio H.T.

WE OFFER
American Vibrator totally enclosed, slightly dented covers. 4-pin non-sync. at the low price of 10/-

SWITCHES, METERS, ETC.
A Special Design in Auto-Switches with time-lag tripping on 2 to 3 amps. Safety thermo switch with quick-break auto overload trip, for back of panel with front indicating knob, compact, 4in. x 2in. x 3in. deep. Any voltage up to 1,000 volts. Worth a guinea. ONLY 5/6

Magnetically tripped Switches that operate instantaneously
Circuit Breakers of first-class make, in place of fuses. Operate instantly on an overload. Fireproof construction and bakelite or metal cover. Made in single, double, and triple pole. Prices are very low, and type marked with a star have thermal trip delay.

SINGLE POLE, HEAVY IRON CASE
200/600 volt A.C. mains Only 15/-

HOT WIRE METERS
For Radio or Low-Frequency 4 amp., 21/2 in. dial, front panel. 100 ma. to 1 amp., 15/- 300 ma. to 1 amp., 6/- 500 ma. to 2 amps., 7/6. To 21 amps., 15/- High voltage model in square case, 15/6, 100 v., 15/6. Special Sullivan Meters with cut-out switch, 15/6. High-grade magnets damped H.W. Meters. 150 to 500 ma., 36/-, dial, Marconi type, 250-1,000 ma. to 14 amps., £1 & P., brass case, 7/6. A. C. Meters to 10 amps., 20 amps. and 50 amperes, 40/-

PM METERS
Genuine Weston Model 35/. Central zero 1 to 15 amperes, pol. mag. dead beat. Flush panel, 21/2 in. dial, nickel or black. Sale price, 7/6. Wide range of large Switchboard Meters, 5/6 to 21/2.

LAB. GALVANOMETERS

HORIZONTAL BRASS-CASED GALVOS., 7/6.

CELL TESTERS, Pfeuger 3-6-3 mov. v cell, aluminium case, 25/-

If you have Resisances to measure you will find this Standard RESISTANCE BOX guaranteed to standard in 1,000 ohms, 4,000 ohms, 8,000 ohms, 12,000 ohms. Post free.

MEGGERs AND OHMMETERS

Add postage for all mail orders.

Advertisements II

ELECTRADIX RADIOS

218, UPPER THAMES STREET, LONDON, E.C.4
Telephone Central 4611
WIRELESS WORLD

JUNE, 1941

ADVERTISERS may have letters, other than circulars, addressed to numbers at this office. The words Box 660, or "WIRELESS WORLD," must be paid for and a further 1/- added for registration and forwarding replies.


Classified Advertisements

22 Advertisements

classified advertisements. The charge is 4/- for each paragraph of 2 lines or less, and 3/- for every additional line or part thereof, average 7 words to a line. Each paragraph is charged separately.

Advertisements for the July issue are accepted up to Firs, Post on Tuesday, June 15th, at the Head Office, Dorset House, Stamford Street, London, S.E.1, or one day at provincial offices.

Transformers & Chokes


If your work is for the Government and you are experiencing difficulty in obtaining transformers from your usual source, please get in touch with us.

We can still give prompt deliveries providing your order quotes the number of the Government contract for which the goods are required. The latter is essential.

Books

Books - The Superheterodyne Receiver by Alfred T. Witts. A reliable and comprehensive guide to the superheterodyne receiver, incorporating all recent developments. It provides the essential working knowledge required by every keen amateur, radio student and service engineer. Recognised everywhere as the standard work. "Gives all the information necessary for a complete understanding of the Superheterodyne Receiver," says PRACTICAL WIRELESS.

Classified Advertisements

PITMAN

Parker Street, Kingsway, W.C.2

Classified Advertisements intended for the July issue can be accepted up to Tuesday, June 10th.

NEW RECEIVERS AND AMPLIFIERS


MENBURD Silver 15/17 Olympic Antennograph, new, or pre-war list, 12 guineas. Elco G611 Console, picture, 17 tubes, 17 guineas. Ortofon 72, 2 tubes, 99 guineas. A.C.S. Radio, 44, Widmore Rd., Bromley. 6/-.

£15/10 Only, usual price £22. - Wireless World Receiver, with pull-push quality amplifier, chassis, 10 valves, including tone control stage, 8 watts triode output, ideal for quality reproduction from radio and gramophone; limited number.


RECEIVERS & AMPLIFIERS - SECOND-HAND, etc.

PARTRIDGE 10-va. or 25-va. complete radios, separate valves, supply for first stage, diode damping inaudible from 10. hrs. use. £16.-. Adventurer, 117, Clayton Rd., Newcastle.

SCOOT 15, with Capehart Changer, Operatic Amplifier, 4 valves, Marconi 545, 78/117/-; Philips, 98/-; A. C. S., 94, Widmore Rd., Bromley.

FOR SALE, Guthman-Silver Comm. set, single span. 20 pounds including single dynamo. Return a speeded-up instrument. ARCHIPELAGO, coupled 2 PX26s p.p. £1.10s. nil. little used.

- Box 2585, c/o The Wireless World.

SKYREDER Defiant, also Magnavox 66: full particulars.-CHI1, 213C, Leeds, 5. £6/6.

NATIONAL, Standard BHO, complete, coils, speaker, or SX17, £2.5s. Details, price, 2, Church St., Evesham.

WANTED, several M.R. receivers, in good condition, also Hallcrafters. - Write Box 2758, c/o The Wireless World.

COMMUNICATION Receiver, A.C. mains; excellent price paid for good make in first class condition. Details, Chancery Prec. Inst. Service, Middle Claydon, Hitchin.

HIGH Class Chassis or auto change radios wanted for £5. High price paid. M.W., Scott, H.M.V., R.G.D., etc., 27, Worcester St., Wolverhampton.

PUBLIC ADDRESS


NEW MAINS EQUIPMENT

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not?


SHORT-WAVE EQUIPMENT


NEW LOUDSPEAKERS

BAKERS Brand New Super-Exciting P.A. Bargains

EVERY Music Lover Interested in Realistic Reproduction should write for free descriptive leaflet now.

£5/10/-usual price £10.-Brand new, permanent magnet infinite battle speaker, complete with beautifully finished polished in walnut cabinet. £2/10/-usual price £5.-Brand new super quality triplo cone speaker, permanent magnet motor; exceptional Bargain; limited number. £15/-£20/-One of these Exceptional Bargains.

BAKERS Triple Cote Conversions Will Immensely Improve Your Radio Set. Inspect Excellent Present Speakers. (For a few shillings you have converted a speaker exchanged for the worthless black powder. W. B. Darby, Grad.I.E.E.) Write for details.

BAKERS SELHURST Radio, 75, Sussex Rd., South Croydon.

SECOND-HAND LOUDSPEAKERS

MAGNOVO Supplies, £4.-Adventurer, 117, Clayton Rd., Newcastle, Staffs.

CABINETS

CABINET for Every Radio Purpose.

SURPLUS Cabinets (Undrilled) from Noted Make.

WE Have Hundreds in Stock (no Catalogues); send measurements of chassis, etc., and say what kind of cabinet you want; stamp for reply.

INSPECTION invited.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2 Tel.: Fad. 5811.

WE MANUFACTURE: ROTARY CONVERTERS, BATTERY CHARGERS, Radio Receivers, etc., DC/DC ROTARY TRANSFORMERS, SMALL ALTERNATORS, SMALL DC MOTORS, H.T. GENERATORS, MAINS TRANSFORMERS up to 10 kva. PETROL ELECTRIC generator sets up to 50 kva.

BATTERY CHARGERS for private and industrial use.

We can also handle general small engineering work.

Full details of any of the above upon request.

CHAS. F. WARD

46, FARRINGTON ST., LONDON, E.C.4 Telephone: Holborn 3702.

Works:

37, White Post Lane, Hockney Wick, E.3.

RELIABLE AMPLIFICATION

buying sound equipment?

If you are buying Sound Equipment and P.A. Gear you will find an investigation of the R.S. Amplifiers range interesting and well worth your while. We do not claim to build "the best in the world"—perfection, we hope, is unattainable else we should not strive. But we do sincerely believe that what we make is as good as it can be made and perhaps better than most. Below are listed briefly a few items from our standard catalogue which will gladly be sent on request. If you have any special needs tell us and we'll be happy to co-operate.

AMPLIFIERS


-Porta Thirty.—30 watts output. Two speakers (this equipment can accommodate up to fifteen speakers!). AC 200-250 volts. Complete with "mike," C.P. stand and cables. The same perfection in portable amplifiers.

CHASSIS

Five types of chassis are available: 50 watts, 100 watts, 15 watt, 12 watt and a 12-watt Battery Unit.
- Crystal Microphone
- Speaker Units (Exponential Horns)
- 11 watts and 13 watts
- "Mike" stands.

Dynamus, Motors, Etc.

All Types of Rotary Converters, electric motors, battery chargers, power amplifiers, etc., in stock, new and second-hand.

Grampophones

Specialists in Automatic Phonographs, taking 45 or 78 rpm, and turn them over, latest, as new, £25; Columbia portable Record Player, new, £2.10.-A.C.S. Ltd., 41, Wimborne Rd., Bromley.

WANTED

new or second-hand Radiograms, P.A. or Universal—Particulaires, etc., to Dudley Bros., 587, Bearwood Rd., Smethwick.

RECORD Changers and Gram Unit. 500 wanted for cash. In M.Y. etc., record players any condition.—27, Wester St., Wolverhampton.

Valves

PURCHASED; serving 100 dealers' stocks; new and old types. Details, Chancer Pre, Inst. Service, Middle Claydon, Bletchley.


Test Equipment

Urgently: signal generators, analyser valves, etc. Details, Chancer Pre, Inst. Service, Middle Claydon, Bletchley.


Businesses for Sale or Wanted

Three Wireless Cables. 2000, 1000, 500 wanted, in any part of the equipment of every Wireless Trader, its pages reflect the very latest turn of trade for wireless and electrical traders for January 1941. We hope, in new and old types. By subscription, to the trade only, 17th per line, per week, for each advertisement desired or wanted. By subscription, to the trade only, 17th per line, per week, for each advertisement desired or wanted.

Repair and Service

L.F.P., Repair All Types of Wireless, Motor, Chokes, Prompt delivery.


Mains Transformers, output transformer rewound. Details, Chancer Pre, Inst. Service, Middle Claydon, Bletchley.

All Types of Receivers and Amplifiers, Service and Testing. Details, Chancer Pre, Inst. Service, Middle Claydon, Bletchley.

New Components

ERIAL. Equipment.—Insulators, Short-wave filter capacitors, by-the-lot. Glass, G.P, 3½d.; Glass, J. 5½d., down. Small porcelain shell, 1½ per dozen; 12/- per dozen, 3½d. per 100, 1½d. per 1000. All carriage paid. Cash with order or c.d.—John Marks Ltd., Birmingham.

Radioactive Materials, second-hand, in perfect order.

Radioisotope, a new type, best quality, guaranteed. 50 cycles AC., output 12 volts 10 amps. D.C. Price 85/10/-, post free.

Component, a new type, best quality, guaranteed. 50 cycles AC., output 12 volts 10 amps. D.C. Price 85/10/-, post free.

A Large stock of High Voltage Condensers. Price 5/6, post free.

Iron Filters, A.E.R.I.A.C. for rewinding, complete. Price 1/6, post free.


GALPINS ELECTRICAL STORES

Owing to War Conditions this business is now transferred to: —
21, William St., Slough, Bucks.
Phone: Slough 2007

Terms: Cash with Order

Electric Light Check Meters, small, rate type, well-known makers, in good condition, electrically guaranteed for 200/250 volts 50 or 60 cycle, 1 phase A.C. mains. 5 amp. type 8/6; 10 amp. 7/8, 10/9, each. Post 1/-on all types.

Dielectric Light Check Meters, 90/105 volts 5 and 10 amps. 6/6 each, post 1/- (in new condition).

Phillips High Voltage Condensers. Insulated, at 4,000 volts working, 5,5 each, carriage 1/-.

R.A.F. Glass Accumulator Tanks, 3 x 5 x 8in., 1/- each, carriage 2/6d.

R.A.F. Switch Panel, with case (new), fitted 8 small scale switches, leads, cords and clamps, complete in wood case, 2/6 each, post 6d.

High Voltage Transformer, useful for all test work. 12 volts output, 5,000 volts, 7,000 volts, post 1/2.

Voltage Changing Transformers (Auto Wound), for use with 240/280 volts a.c., 1,000 watts, 6/2, 2,000 watts, 110/115.

Dug-out Lamps. These are normally constructed, glass dome, complete with 12-volt bulb (any bulb can be fitted), wall fitting, 3/- each, post 6d.; Dito, wing type, as above, 4/- each, post 9d.

Dug-out Lamps, Ex R.A.F., portable type, or can be brazed into glass lamp bases, complete with 12-volt bulb, red or green, solid brass construction, 6in. dia., complete with bulb; any site bulb can be fitted. Price 6/-, post 6d.

Phillips Transformer, 220 v. input, output 2,000-0-2,000 volts, 200 m/a and 2 L.T.S., 60/- carriage forward.


Sunmetal Pulleys, 5in. diameter, to take 1in. dia. rope, complete with rope guard and hook, 7/6 each, post free.

Philips Transformers, 220 v. input, output 2000-0-2000 volts, 200 m/a and 2 L.T.S., 60/- carriage forward.

110 V D.O. Motor, in good working order, 2/- carriage forward.

Sliding Resistor, 5,000 ohms at 500 m/a, worm and wheel, complete, 2/-, post free.

Footlights, 12in. dia., multi mirror type with 5in. dia. centre, complete circuit, any bulb can be fitted, 15/-, carriage paid.

Aero Dymans, output 11v-15 amps, new, 15/- each.

Press-Suction Units, 8 ways, 7 x 6 x 1 in., insulated, fully adjustable, £1 carriage free.

1 Kw Auto Transformer Core for rewinding, complete with clamps and bolts. Price 8/-, carriage paid.

Crompton Dynamo, output 220 volts, 10 amps, 4 pole, shunt wound. Price 4/-10/-, carriage forward.

Rotary Converter, D.C. to A.C., input 230 volts D.C., output 85 volts 2 kw, 50 cycle, 3 or 1 phase Price 5/- carriage paid.

Rotary Converter, D.C. to D.C. 25 volts D.C. input, output 450 volts at 50 m/a. D.C. Price 20/- carriage paid.

Large Transformer, input 220 volts 50 cycles, output 300-0-300 volts at 6 amps. Price 4/-10/- carriage forward.

Large Transformer, input 220 volts 50 cycles, output 300-0-300 volts at 10 amps. Price 5/- carriage forward.

Rotary Converter for charging. Input 220 volts 50 cycles A.C., output 12 volts 10 amps D.C. Price £3/-10/- carriage paid.

Bell Pushes, ex-G.P.O., solid eccobus, two silver contacts, as new, 1/6, post free.

Mill cms. G. C. T. 1000, 0.30-25t., £0.15-25t.-ditto, 0.15-25t., or 25/-, £0.15-25t., post free.

Tungsten Contacts, new, one fitted screw and one fitted bolt. 25/- carriage paid.

H.T. Rectifiers, second-hand. in perfect order. 7/6 post free.

### Amplifiers Limited

**Phone: Walton-on-Thames 1019**

**Three & Four Highfield Road, Shepperton - Middlesex**

**Advertisements**

13
Radio Engineering, Television and Wireless Telecommunication.

For the Radio Service Man, Dealer and Owner

The man who enrolls for an L.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will know radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday radio service work. We train them to be successful!

International Correspondence Schools


Please explain fully about your instruction in the subject marked X.

Complete Radio Engineering Radio Service Engineers

Elementary Radio Television

If you wish to pass a Radio examination, indicate it below. Inst. of Wireless Technology P.M.G. Certificate for Wireless Operators Provisional Certificate in Radio Telegraphy and Telephony for Aircraft City and Guilds Telecommunications

Name

Address

(Use pencil only on unsealed envelope)

Radio Cables Ltd.

Lissone 2r. Battery Pentoloes, 6-pin. side terminals.

LOWLTA Ceramic Valve Holders, Lissone Hi-Q. tubeboard and chassis, 7-pin. each.

LOWLTA single-wire ceramic insulation brass valves, Lissone Hi-Q. minimum capacity 6 microfarads. List 1/6 each; 2 pairs 2/6 each.

PBUI-PLU. Switch, Lissone 2-point, 4d. each; 5 point, 6d. each.

YAXLEY Type Switches, 4-pole, 3-ray, 9d. each.

YAXLEY Type Switches, 4-bank, 2-pole, 4-way, 2/6 each.

YAXLEY Type Switches, 5-bank, 37. each.

YAXLEY Type Switches, 5-bank, 3/6 each.

OLA P.M. Speakers, 8-ohm, 10 watts, with power and period insensitive. Boxed, 17/6 each.

SHARPIT Line 3-wave-band Dial, 1/11 each.

Mains Transformer. 300-350v., 100.m.a.

Yaxley Type Switches, 6-amp. each.

PBUI-PLU Switch, Lissone 2-point, 4d. each; 5 point, 6d. each.

C.M.A. Mounting Valve Holders, American Circuit type.

C.M.A. Mounting Valve Holders, English Circuit type, 4-5-7-pin, £3 each.

Centralab Voltage Controls. Midrate, 5,000, 5,000, 100,000 ohms. Lead switch, 2/9 each; 1,000, 25,000, with switch, 5/6 each.

Solon Resin-Cored Adaptors. 1 lb. reel, 13d. each.

5 press buttons and caps, 4/1 each.

PBUI-PLU Switch, Lissone 2-point, 4d. each.

15 hours soldering.

You just plug in with Solon Electric Soldering

When the Solon you can work wherever there's a lamp holder—and do better work! Solon Electric Soldering is easy, neat, strong and clean. No stopping to heat up—constant heat maintained at point. 15 hours soldering uses only 1 lb. of Solon Resin-Cored Solder.

Handyman model supplied complete with Resin-Cored Solder, Flex and Lamp Adaptors 9/4 Solon Resin-Cored Solder per 1/4 lb.

For the radio service man, dealer and owner

The man who enrolls for an L.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will know radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday radio service work. We train them to be successful!
Joining the R.A.F.? 2

ARMY—NAVY—MERCANTILE MARINE OR TAKING UP WORK OF NATIONAL IMPORTANCE IN WHICH A THOROUGH KNOWLEDGE OF THE MORSE CODE IS ESSENTIAL FOR BECOMING A SKILLED W/T OPERATOR? THEN INVESTIGATE THE NEW, SCIENTIFICALLY DEVELOPED METHOD OF MORSE CODE TRAINING

There are courses for beginners and operators,
A CANDIDATE TRAINED OPERATOR NOW SERVING IN THE R.A.F. SAYS: "I should like to thank both yourself and the company for the great start which I obtained through taking your Junior Course. The experience which I gained from that, has kept me "in front of others" who relied on obsolete methods of learning code."

Fill in the Coupon and learn more about this highly efficient CANDIDATE's Method of Training in your own home.

JUNIOR SCIENTIFIC CODE COURSE FOR BEGINNERS. It teaches all the necessary code fundamentals scientifically.

ADVANCED and HIGH-SPEED TELEGRAPHIC CODES for operators who want to increase their w.p.m. speed and improve their technique.

TELEGRAPH TOUCH-TYPING COURSE FOR W/T OPERATORS who want to become expert in using a typewriter for recording messages.

Courses supplied on Cash or Monthly Payment terms.

**COUPON**

Please send me a Free Copy of Calendar "Book of Facts." 2

NAME__________________________

ADDRESS__________________________

Postage paid by the Method Co. to London Manager.

CANDIDATE SYSTEM CO. (S.S.W.)

CANDIDATE System Co., Asheville, North Carolina, U.S.A.

641

---

WIRELESS WORLD

WIRELESS Technical Instructors Required in Army Aircraft Units.

EOMOLMENTS.—Pay 9/8 per day (7 days a week). Electricians, radio mechanics and operators. If this cannot be arranged in the Army, every effort will be made to fit married and otherwise eligible, family allowance payable in respect of wife and children, subject to allotment from pay.

CANDIDATE Should Preferably be under 35 and over 24,

(A) Hold one of the following qualifications:—

Graduate of the Institution of Electrical Engineers, Final (Grade III) Certificate of City and Guilds of London Institute in Radio Communication.

(B) Be able to pass an examination on the following syllabus:

Simple equations; simple trigonometrical ratios; and identities; vectors; properties of electrical currents; heating of conductors; ohm’s law; resistance in series and parallel; potential difference; magnetic effect of current fields due to parallel wires; field due to a solenoid; simple theory of electron tubes; meters; induction; effect of rotating a coil in a magnetic field; mutual and self-induction; and inductances; effect of inductance on growth and delay of current. Capacitance, charging and discharging of condensers; through resistance and inductance. Alternating currents and voltages, diagram of resistance variation; effect of L and C in a.c. circuit; special properties of pure resistance, in series circuit; parallel circuit of L and C; Q factor. Elements of basic theory of vacuum tubes, amplifiers, oscillators and detectors; general principles of radio practice.

SUITABLE Candidates will be interviewed at Local Centres, and, if successful, will be enrolled as Apprentices. Applications are now being accepted for enrolment. Those who are on the Schedule of Reserved Occupations, special application will be made to enable them to be enrolled. In the event of any applicant found to be resident under Schedule of Reserved Occupations special application will be made for relaxation of the Schedule. No guarantee can be given that this application will be successful.

APPLICATION Forms may be obtained by Postcard to the Undersecretary of State, The War Office, A.M.ICE, Whitehall, S.W.1. (For CANDIDATES Required by Firm in S.W.1.)

C. R. TUBES, TUBES, ETC.

For Bin, Cathode Ray Tube. Well-made cadmium-plated chassis, size 17 x 13 x 1 x 1 in., containing approximately thirteen fixed resistors ranging from 15,000 ohms to 1 mohm, five variable resistors, 2,000 to 20,000 ohms ranges, 14 various tubular and electrolytic condensers, also sundry elements; good condition; £6. (Complete circuit and service manual available, price £6.)

VISING UNITS

To fit on above Time Base. Consists of 3 Mullard T.S.E.4 and 1 Mazda DI Valve. Approximately 25 volts, 15,000 ohms, and about 30 condensers of various values, together with Receiver, Grid and various Band Pass coils, also approximately 10 chokes of various descriptions and W.6 Wastercots. All completely checked and carefully screened in metal box. (Complete circuit and service manual available, price £6.)

TUBE SUPPLY UNITS

For high voltage 16/18in. Tubes. Approx. 6,000 volts, 2,000 ohms. Includes 8in., 10in. and 12in. tubes, 4 different model, filling the same functions but made of different materials. (Complete circuit available, price 25/-.)

MAINS TRANSFORMERS

These are all used in making Vising or Vising Description available. Table type, Consoles, and large pedestal lift-up lid. All in first-class condition. Beautiful example of the cabinet-maker’s art. Made to house costly Television receivers. Let us know your requirements and we will quote by return. The usual prices but must be collected by purchaser.

CABINETS

Cabinets of every description available. Table type, Consoles, and large pedestal lift-up lid. All in first-class condition. Beautiful example of the cabinet-maker’s art. Made to house costly Television receivers. Let us know your requirements and we will quote by return. The usual prices but must be collected by purchaser.

---

RADIO RECEPTOR SERVICING AND MAINTENANCE

By E. J. G. Lewis. Everything connected with wireless servicing, maintaining, and repairing of equipment is described and set out so for immediate reference. 80s. net.

"For lack in facts, as well as arrangements that the reader will gain the necessary knowledge to work in a logical manner."

MODERN RADIO COMMUNICATION

By J. E. Beatty, B.Sc. (Eng.), A.C.I.E. A comprehensive guide to modern radio theory and practice. A particularly valuable section for prospective recruits for Nicholas branches of the Services. Sufficiently wide in scope and giving fundamental principles in the clear, concise style of proceeding. There is no more popular or successful book. 2 vols. 26s. net each.

"A thoroughly good book" (F. J. Elting). Among the most important textbooks on "Wireless World."

SHORT-WAVE RADIO

By E. R. Brayne. A comprehensive practical survey of modern developments in radio in the field of short and medium wave propagation. Practical work is so arranged that on completion of the course the student will be able to teach short wave radio. 20s. net.

"Out of the finest short-wave treaties available" (Journal of the Institute of Engineers. Students Quarterly Journal.

THERMIONIC VALVES IN MODERN RADIO RECEIVERS

By A. T. Wills. This up-to-date handbook is a pocket-sized guide to the whole field of modern theory and practice in the application of thermionic valves to radio receivers. For radio mechanics. 9s. 6d. net.

ELECTRICAL AND WIRELESS FOR BEGINNERS—A TYPICALLY-PRINTED AIRCRAFT

Including Tubes, Transformers and Thermostats of Magnetics

By D. G. Webber. The primary object of this book is to indicate to ground engineers, in broad outline, the basic principles of design, construction, maintenance and repair. A volume in the Aeronautical Engineering Series—General Engineering. Fourth Edition. 10s. 6d. net.

67/6

TIME BASE ChASSIS

For Bin, Cathode Ray Tube. Well-made cadmium-plated chassis, size 17 x 13 x 1 x 1 in., containing approximately thirteen fixed resistors ranging from 15,000 ohms to 1 mohm, five variable resistors, 2,000 to 20,000 ohms ranges, 14 various tubular and electrolytic condensers, also sundry elements; good condition; £6. (Complete circuit and service manual available, price £6.)

30/-

7/5

TUBE SUPPLY UNITS

For high voltage 16/18in. Tubes. Approx. 6,000 volts, 2,000 ohms. Includes 8in., 10in. and 12in. tubes, 4 different model, filling the same functions but made of different materials. (Complete circuit available, price 25/-.)

40/-

25/-

MAINS TRANSFORMERS

These are all used in making Vising or Vising Description available. Table type, Consoles, and large pedestal lift-up lid. All in first-class condition. Beautiful example of the cabinet-maker’s art. Made to house costly Television receivers. Let us know your requirements and we will quote by return. The usual prices but must be collected by purchaser.

CABINETS

Cabinets of every description available. Table type, Consoles, and large pedestal lift-up lid. All in first-class condition. Beautiful example of the cabinet-maker’s art. Made to house costly Television receivers. Let us know your requirements and we will quote by return. The usual prices but must be collected by purchaser.
QUICK COURSE IN MORSE

by R.A.F. Signallers

on COLUMBIA Records

A complete new course of instruction in Morse Code made with the co-operation of R.A.F. Signallers. From the Alphabet to Fast Transmission with varying degrees of typical jamming. Invaluable to those about to join the Fighting Forces, A.T.C., or Merchant Service. What an advantage to enter, already proficient in this important part of the training! Start now — ask your local dealer about these records — today!

4 Records DB 1956/16 1/2d. (+ 2/6d. Tax)

Booklet of Instruction included

WANTED, Ghindhi Radio Physics Course — 6, Denmar Rd., Southport.


EVERY Radio Dealer Who is Not a Regular Reader of "The Wireless and Electrical Trader" should send his trade card at once for a specimen copy and full details of the "Trader" Services. "The Wireless and Electrical Trader" has the widest influence, and is read by all the leading manufacturers and traders. Trade only, 17/6 per annum, post free. Published at Dorset House, Stamford St., London, S.E.1. (0615)

LEARNING Morse (Sixth Edition). An easy method of mastering the International signal code, gives method of practising with the key, and also details of an easily constructed Morse practice set. Price 6d. net, by post 7/6d., from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.


VIBRATORS

are always dependable

(BRITISH PATENTS)

A long every front Mallory has pioneered in vibrator design to ensure safety, dependability and long service.

Mallory offers synchronous and non-synchronous vibrators for 6, 12 and 32 volt input also a new range of accepted "STRATOSPHERE" vibrators for high altitude aircraft service.

Mallory engineers are at your disposal.

P. R. MALLORY & CO. INC.
INDIANAPOLIS, INDIANA, U.S.A.
Represented exclusively in Great Britain by FRANK HEAVER LTD., Kingsley Rd., Bideford, N. Devon, Eng.

INVENTORS

We continually seek new inventions and products in all branches of industry for development and production by the manufacturing Companies of the Simmonds Group throughout the world.

SIMMONDS DEVELOPMENT CORPORATION LTD.
BUSH HOUSE, W.C.2.

WHY LEAVE YOUR SPEAKER AT HOME?

Our Compact 2ft. mouth HORN, for use in limited space. Ideal for ideal speech. Unbolts for packing into a small space, 6ins. W.

Price £3 16 3 (ex works)
UNIT WITH TWIN DIAPHRAGM £3 15 0 (locks 40 watts required for full rendition)

WIRELESS SERVICING MANUAL

Sixth Edition, Revised and Enlarged


It deals fully with Testing Apparatus and explains the methods of locating and curing faults in receiving equipment. Includes an additional chapter on automatic frequency control. Gatling, Automatic Volume Control, Instability, Distortion, Malfunction, Whistles, Local Interference and aerials are all separately treated.

PRICE 6/- net By post 6/6
Issued in conjunction with "THE WIRELESS WORLD" and published by the Proprietors:

ILIFFE & SONS LTD., DORSET HOUSE, STAMPFORD STREET, LONDON, S.E.1.
LOUD SPEAKERS
THE WORLD'S FINEST REPRODUCERS

TRANSFORMER LAMINATIONS
Core Width \( \frac{3}{8} \) to \( \frac{1}{4} \)\( (E's & I's) \)

EIGHT STOCK SIZES
A Comprehensive Bulletin together with details of Associated Covers and Chumps with design data will be sent to manufacturers on request.

BRITISH ROLA LIMITED
MINERVA RD., PARK ROYAL, N.W.10. WILlieden 4322

Cheerfulness
When cheerfulness is in danger of disturbance, light a 'Player,' and with a few 'puffs' put trouble in its proper place. The friendly Sailor, as always, stands for cheery contentment and a guarantee that quality and purity remain unchanged.

KEEP THAT HAPPY EXPRESSION
Player's Please

FREE
TO ENGINEERS AND RESEARCH LABORATORIES

Two publications have been issued by Multicore Solders Ltd., which give much useful information about soldering in general, in addition to facts about the advantages of Ersin Multicore Solder, with its three cores of non-corrosive Ersin Flux. Executives are invited to send for copies of these publications and a free sample of this A.I.D. and G.P.O. approved solder.

MULTICORE SOLDERS LTD.
BUSH HOUSE, LONDON, W.C.2.
Tel : TEMple Bar 5563/4

Ern Sin
Multicore
THREE CORE
SOLDER

Send 3d. to Dept. W.W. for a copy of "The All-Metal Way." for strong and reliable RECTIFIERS

ERSIN MULTICORE SOLDER

MULTICORE SOLDERS LTD.
BUSH HOUSE, LONDON, W.C.2.
Tel : TEMple Bar 5563/4
T.C.C

PRE-EMINENT IN PEACE
INDISPENSABLE IN WAR

Advertisement
of
THE TELEGRAPH CONDENMER CO., LTD.