BUILDING AN ALL-WAVE THREE

Practical Wireless

9D. EVERY MONTH

Vol 22. No. 484. || Editor: F. J. CAMM || OCTOBER, 1946

A TWO-VALVE ALL-DRY PORTABLE

PRINCIPAL CONTENTS

'AVO' *Precision* ELECTRICAL TESTING INSTRUMENTS

Registered Trade Mark

The UNIVERSAL AVOMINOR

Electrical Measuring Instrument

A small but highly accurate instrument for measuring A.C. and D.C. voltage, D.C. current, and also resistance. It provides 22 ranges of readings on a 3-inch scale, the required range being selected by plugging the leads supplied into appropriately marked sockets. An accurate moving-coil movement is employed, and the total resistance of the meter is 200,000 ohms.

The instrument is self-contained for resistance measurements up to 20,000 ohms, and, by using an external source of voltage, the resistance ranges can be extended up to 10 megohms. The ohms compensator for incorrect voltage works on all ranges. The instrument is suitable for use as an output meter when the A.C. voltage ranges are being used.

Supplied complete with leads, testing prods, crocodile clips and instruction booklet.

Size : 4¾" × 3¾" × 1¾". *Nett weight : 18 ozs.*

D.C. Voltage	A.C. Voltage
0—75 millivolts	0—5 volts
0—5 volts	0—25 ,,
0—25 ,,	0—100 ,,
0—100 ,,	0—250 ,,
0—250 ,,	0—500 ,,
0—500 ,,	

D.C. Current	Resistance
0—2.5 milliamps	0—20,000 ohms
0—5 ,,	0—100,000 ,,
0—25 ,,	0—500,000 ,,
0—100 ,,	0—2 megohms
0—500 ,,	0—5 ,,
	0—10 ,,

Sole Proprietors and Manufacturers :—

AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
Winder House, Douglas Street, London, S.W.1 *'Phone : VICtoria 3404-8*

? ARE YOU A ONE ROOM RADIO LISTENER

Now that Stentorian Extension Speakers are coming back to the shops the pleasure of listening again becomes complete. Just plug in one of these superb permanent magnet speakers to your set and you can enjoy its clean, pure tone anywhere in the house ; sitting-room, kitchen, bedroom, wherever you happen to be. Supplies are still short, but a Stentorian is worth looking for. Ask your local dealer about them.

PRICES

Minor Type MX (for Low Impedance Extension) - -	**29/6**
Minor Type MC (with Universal Transformer) - - - -	**35/6**
Baby Type BX (for Low Impedance Extension) - -	**43/6**
Baby Type BC (with Universal Transformer) - - - -	**49/6**

Stentorian

THE PERFECT EXTRA SPEAKER FOR ANY SET

WHITELEY ELECTRICAL RADIO CO. LTD., Mansfield, Notts.

Practical Wireless
and PRACTICAL TELEVISION
14th YEAR OF ISSUE
EVERY MONTH
VOL. XXII. No. 484, OCTOBER, 1946.
Editor F. J. CAMM

COMMENTS OF THE MONTH. BY THE EDITOR

The Passing of the R.M.A.

THE Radio Manufacturers' Association, which has served the industry well for so many years, was finally dissolved on July 26th, 1946, at a meeting whose purpose was to pass the resolutions necessary to give final effect to the reorganisation of the Radio Industry Manufacturing Association under the name of the Radio Industry Council, and to make legal transference of the functions, assets and liabilities of the R.M.A. to the new Council.

This course was decided upon at the Annual General Meeting of the R.M.A. on June 2nd, 1944, and the action now taken is the final step required to hand over to the Radio Industry Council the work previously performed by the R.M.A. Everyone hopes that the new Council will function as satisfactorily as the old association.

The first Secretary and Treasurer of the R.M.A. was Mr. D. G. Strachen, who resigned some time ago.

The R.M.A. was, of course, responsible for staging the succession of wireless shows known to the public as Radiolympia. It had been known for a long time that the R.M.A. had outgrown its period of usefulness, since it was still functioning on lines laid down in the early days of radio. It had, as a fact, become slightly out of step with the times. Whilst we have not always agreed with the attitude of the R.M.A., which in some cases bordered on dictatorship, we readily admit that it laid the foundations of the industry, evolved conditions of fair training, and did its best to purge the industry of the quacks, the charlatans, the bearded "scientists," and the schoolboy technicians who obtained posts in firms as designers merely on the strength of having once built a crystal set. No wonder that some of the early commercial receivers built by firms who were led by the nose by these schoolboy designers were so unsatisfactory. Little wonder, too, that those firms are now no longer in existence.

When the first issue of this journal went to press on September 24th, 1932, the R.M.A. did not welcome our entry into the field of radio journalism exactly with open arms, notwithstanding the clean editorial policy on which the paper was founded, and which has been the guiding principle in the conduct of the journal ever since. We did not design this journal around a group of advertisers whose goods were specified in articles describing receiver construction. We designed the receivers to give satisfaction to our readers, and we specified only those parts which we had actually used in the original design. There were no alternatives. Moreover, we guaranteed our receivers under a free service guarantee to fulfil the claims we made for them. It would be thought by reasonable people that this policy would have been supported by an industry which had been complaining for years about alternative specifications, and whose goods were not specified unless they were supported by advertisements. It took some time, however, for the industry to make up its mind that this journal intended to stand on its policy and that it was not just an advertising sheet. It has stuck to that policy ever since, and the rightness of it is demonstrated by the fact that, except for one esteemed contemporary, all of the other journals catering for the experimenter and the amateur have ceased publication.

It has been our duty since 1932 frequently to criticise the R.M.A., and we like to feel that we have played our part in showing the way which has led to its reformation under an entirely new ægis.

We wish the new Council success and long life.

Editorial and Advertisement Offices : "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone : Temple Bar 4363. Telegrams : Newnes, Rand, London. Registered at the G.P.O. for transmission by Canadian Magazine Post.

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed : The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

First Post-War Radiolympia

ONE of the first decisions reached by the new Radio Industry Council was to hold the first post-war Radiolympia in late September or early October, 1947. Negotiations are now being made for a tenancy of Olympia in the autumn of 1947 for this purpose.

The radio industry has thus not got off the mark so quickly as other industries which have either held exhibitions already or intend to do so before the autumn of 1947.

Needless to say, our readers will have an opportunity of visiting us at the 1947 Radiolympia, where our stand will display a full range of our technical books and blueprints as well as copies of this journal.

ROUND THE WORLD OF WIRELESS

Television Possibilities

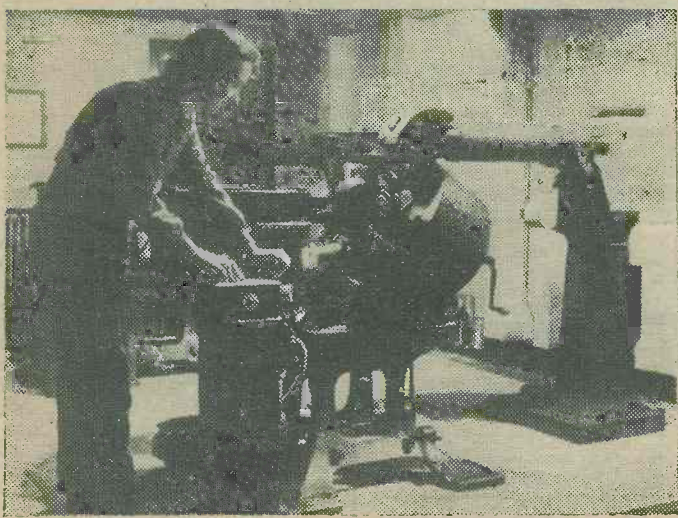
BRIG. GEN. DAVID SARNOFF, president of the R.C.A. and chairman of the National Broadcasting Company, during his recent visit to this country, said that internal television installations giving shoppers the opportunity of viewing various departments of a store, and factory managers being able to tour their works by television without moving from their office were now possible. He stated that the number of television receivers in the U.S.A. was about 15,000, two-thirds of these being in New York City. He added, "Colour television will mean a change in the entire system as we know it at present, and it will probably come in the next phase of development, in about five years."

M.B.E. for Philips Scientist

DR. K. E. LATIMER M.I.E.E., of the Philips Group, has been awarded the M.B.E. He served in *H.M.S. Vernon* for nine months, 1940-41, and later served in Iceland for a time.

Dr. Latimer joined the Philips Group later in 1941, where he worked mostly on H.M. Anti-submarine Experimental Establishment Contracts. He is now in charge of the newly formed Line Development Laboratory.

The award of the M.B.E. was made to Dr. Latimer in respect of his services to the country during the war. These include the period during which he was in the Navy and for the work he did at the Philips Laboratories.



In this equipment the standard cine film is projected direct into the television camera. The film is used as a fill-in in broadcast plays, etc. Trainee Mrs. Dorothy Jones is operating the apparatus.

Radio in Every Room

IN addition to the Grosvenor Hotel installation mentioned last month, a Bournemouth hotel was recently supplied with 71 loudspeakers, each fitted with a switch for the Home or Light programme, the receiver and amplifiers operating from a room in the basement of the hotel and controlled by a time switch. The installation was carried out by Signals Radio and Electronics of Bournemouth, who are now installing 150 speakers in another hotel.

Two Appointments to the Board of Radio and Television Trust

AIR VICE MARSHAL ROBERT STANLEY AITKEN, C.B., C.B.E., M.C., A.F.C., and U.S. Legion of Merit, Vice-president of the British Institute of Radio Engineers, has been appointed to the Board of Radio and Television Trust, Ltd., as a full-time director.

In his new post, Air Vice Marshal Aitken will be occupied with general administrative matters for the RadioTel Group. The group of companies consists of Philco Radio and Television Corporation of Gt. Britain, Ltd.; Airmec Ltd.; Airmec International Sales, Ltd.; P.R.T. Laboratories, Ltd.; Brittanic Electric Cable and Construction Co., Ltd.; British Mechanical Productions Ltd.; General Accessories Co., Ltd.; and Hopkinson Motors and Electric Co., Ltd.

Air Vice Marshal Aitken retired from the R.A.F. on July 19th at the age of 50. He has had a long and distinguished career with the Royal Air Force, joining the Royal Flying Corps as a pilot from the Royal Garrison Artillery in 1916. Throughout the greater part of the last war he was a fighter pilot, but after the Somme in 1916, because of his earlier training as a Garrison Artillery officer, he became an artillery co-operation pilot. Since 1921 he has specialised in signals, and subsequently Radar, for the R.A.F.

Appointed British Air Attaché to China in 1938, he returned to Gt. Britain in 1940. He then became Chief Signals Officer, Fighter Command, which post he held until 1941. From then until 1943, he held the post of Air Officer Commanding 60 Signals Radar Group. From that date on he served in the North African and Mediterranean area as Air Signals Officer of the Mediterranean Allied Air Force. Throughout the whole of his Service experience he remained an active pilot.

Following VE-Day, he went to Cairo to become Chief Signals Officer, Mediterranean and Middle East Command of the R.A.F., until his recent retirement.

Radio and Television Trust Ltd. also announce the appointment to the Board of Mr. B. Hallows Garside, M.I.E.E. and member of the Association of American Electrical Engineers. Mr. Garside is the managing director of Hopkinson Motors and Electric Co. Ltd. and the Britannic Electric Cable and Construction Co., Ltd., both of which are subsidiaries of the RadioTel Group.

Rola Speaker Servicing

THE repair, reconditioning and overhaul of Rola Speakers is now being undertaken by Speaker Services, Ltd., of Cheam. This company has been newly formed especially to carry out this Rola service, and has as its managing director, Mr. W. T. Maynard, who for 15 years was works director of British Rola, Ltd.

Communication Convention

THE I.E.E. is holding a Radio-Communication Convention from March 25th to 29th, 1947. Papers to be read will refer particularly to wartime developments and their peacetime applications.

Servicing Examinations

THERE were 68 entrants for the Radio Servicing Certificate Examination of the Radio Trade's Examination Board held in May, and of these 44 passed the entire examination, six passed the written section and nine passed the practical tests.

Broadcast Receiving Licences

STATEMENT showing the approximate numbers issued during the year ended June 30th, 1946:

Region	Number
London Postal	2,026,000
Home Counties	1,351,000
Midland	1,541,000
North Eastern	1,643,000
North Western	1,418,000
South Western	893,000
Welsh and Border	617,000
Total England and Wales	9,489,000
Scotland	1,027,000
Northern Ireland	155,000
Grand Total	10,671,000

Airmec Board

MR. LAURENCE D. BENNETT, chairman of Radio and Television Trust, Ltd., is giving up the joint managing directorship of Airmec, Ltd., hitherto shared with Mr. E. M. Benjamin, but continues as group chairman and chief executive of the RadioTel Group.

On October 1st, Mr. J. Vivian Holman, A.F.R.Ae.S., M.I.Ae.S. became joint managing director of Airmec, Ltd., with Mr. Benjamin.

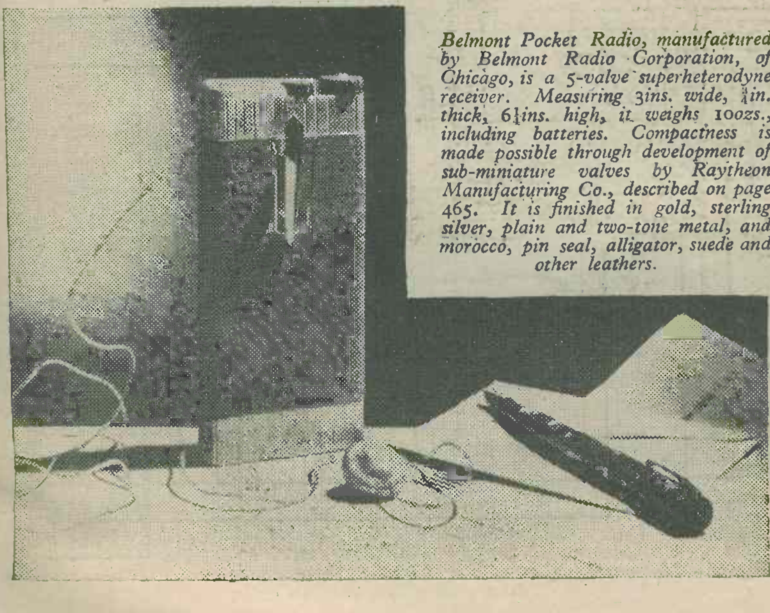
Mr. Holman, who recently resigned as manager of the Aeronautical Section of the Sperry Gyroscope Co., Ltd., is also joining the boards of Airmec International Sales, Ltd., Philco Radio and Television Corporation of Gt. Britain, Ltd., and P.R.T. Laboratories, Ltd.

Having spent a working lifetime in aviation, Mr. J. Vivian Holman is well known to the aeronautical industries here, and of the Continent, Europe and the U.S.A. He served in the R.F.C. and the R.A.F. in the first world war, and ceased active service in 1928. He then joined the De Havilland School of Flying as instructor, and later Cirrus Aero Engines, Ltd., as assistant sales manager, and later held the position of sales manager and test pilot up to 1932.

Mr. J. Vivian Holman then rejoined the De Havilland Aircraft Co. and was closely concerned with the introduction of the controllable pitch airscrew. He later resigned to join the Lockheed Hydraulic Brake Co. as manager of the Aeronautical Products Section. In 1938 he joined the Sperry Gyroscope Co., Ltd., and was in charge of all aeronautical sales. He became general manager of the Sperry Gyroscope Co.'s Western Division Factory, Glos., in 1940, relinquishing that position in 1942 and returned to the London office as manager of the aeronautical division.

He made an extensive tour of American aircraft industry, 1942-3. He has had 3,000 hours Service instruction and test flying. He is the holder of the Polish Air Force Honorary Pilot's Badge for services to the Polish Air Force during the war and is a member of The Guild of Air Pilots and Air Navigators of the British Empire, and a member of the executive committee of the Air League of the British Empire.

Miss Gillian Webb, new twenty-year-old television announcer, is here seen being photographed in the B.B.C. studios.



Belmont Pocket Radio, manufactured by Belmont Radio Corporation, of Chicago, is a 5-valve superheterodyne receiver. Measuring 3ins. wide, ¾in. thick, 6¼ins. high, it weighs 10ozs., including batteries. Compactness is made possible through development of sub-miniature valves by Raytheon Manufacturing Co., described on page 465. It is finished in gold, sterling silver, plain and two-tone metal, and morocco, pin seal, alligator, suede and other leathers.

Ekco Experts Back

JUST back from Germany are two Ekco Technical Experts—Mr. E. B. Greenwood of the Radio Division, and Mr. J. Hanaway of Lighting Division. Their reports to the British Intelligence Objectives Sub-committee have been submitted and will be published later, with those from other members of the Industrial Team.

An All-wave Three

Constructional Details of a Simple Battery-operated Set for All Wavelengths from 10 Metres Upwards

As the circuit in Fig. 1 shows, this is a detector-L.F.-pentode arrangement with band-pass tuning on long and medium waves, but only a single tuned circuit on the short-wave ranges. As a result, the selectivity is as high on long and medium waves as with a H.F.-detector-pentode circuit, while on short waves there is considerably more volume than with the latter arrangement. In consequence the receiver performs very well on all wavelengths. So that the short-wave frequencies tunable are not limited, plug-in coils are used on this range, and the receiver will function well down to 10 metres.

In the L.F. part of the circuit a volume control and top-cut control are added, the latter being useful to remove or lessen high-pitched interference as well as for its usual purpose. A switch to change from speaker to 'phones is also used (this is not shown in the circuit, but in the wiring diagram) for listening to very weak stations.

Ample decoupling assures stability. To avoid any trouble due to resonant peaks over the frequencies tuned a resistor is included in series with the high-frequency choke.

Panel and Baseboard

The panel layout will be seen in Fig. 5; 12in. by 8in. is a suitable size, although this may be adjusted to fit a cabinet available. The baseboard is of similar size; 5-ply is used for the latter and it is fixed 1½ins. above the lower edge of the panel to leave room for the switches and tone and volume controls. The rear of the panel should be covered with screening foil before any of the parts are secured to it; the foil is taken across the baseboard also, leaving the section of the panel below unscreened. This permits the 'phone-speaker switch, included in the H.T. circuit, volume control, etc., to be mounted upon the bare wood.

The components shown in Fig. 2 are now screwed in position as depicted, paying particular attention to the short leads which will be necessary in the detector circuit for best results.

The gang condenser is mounted back from the panel to leave room for a good-quality reduction drive and dial. To shorten wiring the wave-change switch is similarly positioned, either by mounting on a plate bolted to the condenser or to a component bracket. A coupling and length of ¼in. rod extends the spindle as necessary. To assist in tuning to high frequencies on the S.W. ranges the trimmer of the front section of the gang condenser is removed and subsequently connected across the long- and medium-wave detector coil.

The reaction condenser and controls below the baseboard are fixed directly to the panel in the position shown in Figs. 2 and 3.

The detector valve holder is raised about 2½ins. so that its connecting tags come above the wave-change switch to shorten wiring. The rear octal holder is for coils and is raised 1in. by means of bolts. When fixing, position the keyways as shown.

Baseboard holders are used in the L.F. section of the receiver, these being right to the edge of the base with the L.F. transformer between. Although a decoupling condenser with three 1 mfd. sections is used, three separate components could be used instead.

The Coils

The well-known plug-in coils are used for short waves and if any other make is employed instead, connections must be changed accordingly. Whatever coils are used, the manufacturer's instructions should be followed so that no error arises. If care is taken with the wiring and a tuning condenser with low minimum capacitance used the smaller coil will enable the 10 metre band to be tuned, when many amateurs will be heard.

Any type of coil may be used for long and medium waves, those shown being Wearite. One coil is fixed

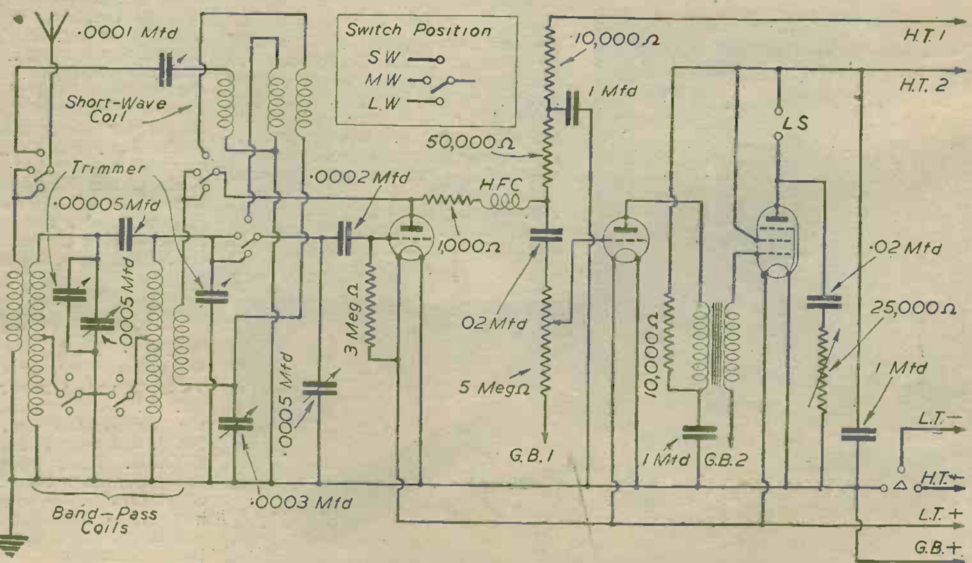


Fig. 1.—Theoretical circuit of the All-wave Three.

to the panel, as shown in the illustration. The particular connections for the coils used must be followed, any unnecessary primary or reaction windings being ignored. Unscreened coils are suitable although screened, iron cored coils naturally provide slightly better results.

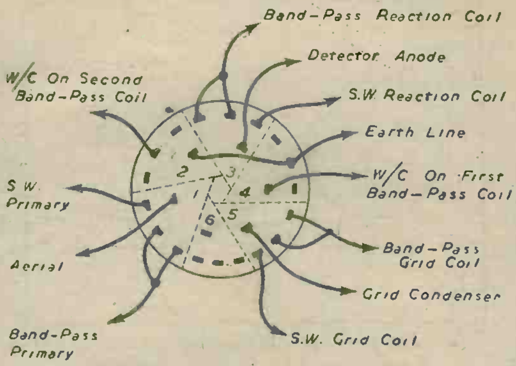


Fig. 4.—Details of the switch wiring.

If the baseboard is not covered with foil the can of the rear coil must be earthed by a convenient lead.

Wiring the Switch

This should present no difficulty if Fig. 4 is examined. A small soldering iron will be necessary and the detector valve holder may be temporarily removed to facilitate connections. Commencing with section 1 on the switch, the first contact is taken to the S.W. primary and the second and third to the band-pass coil primary. Section 2 is wired so that when the switch is in the central position the long-wave winding of the band-pass coil is shorted for medium-wave reception. Section 3 connects the detector anode to the short-wave coil in its first position; in both second and third positions the anode is switched to the reaction winding on the second band-pass coil. Section 4 shorts the other band-pass coil in its central position for medium-wave reception. Section 5 connects the grid condenser to the short-wave coil in its first position; both second and third positions connect to the band-pass grid coil.

Section 6 is left blank because only a 5-pole 3-way switch is required. If the other sections are wired one at a time as in Fig. 4 no error should arise.

Other Wiring

Fairly stout tinned-copper wire is used for all connections in the receiver, insulation being added where wires may touch each other or the foil. Leads in the tuned circuits should be short, and this is best attained by running the wires as shown in Fig. 2.

The .0001 mfd. pre-set connected to the short-wave coil is suspended in the wiring. The band-pass coupling capacity is obtained by twisting together two insulated wires for about 1in. of their length.

Battery leads are made from flex and taken down through the baseboard. Other leads which pass through the baseboard are connected as in Fig. 3. Here, the left-hand switch is the on-off switch and the right-hand one 'phone-speaker switch, the headphones and speaker being connected to the four terminals on the strip to the left of the base. The right-hand variable resistor controls the tone and the potentiometer to the left the volume. Figs. 2 and 3 make these connections clear.

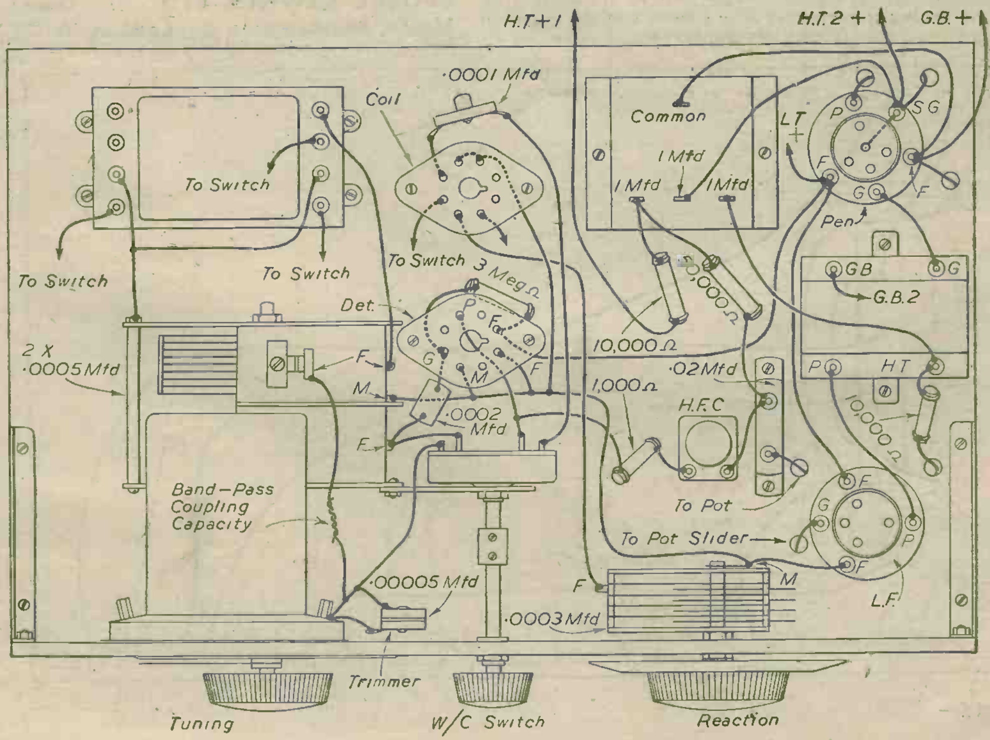


Fig. 2.—Above chassis wiring of the All-wave Three.

Above the baseboard the aerial connection is taken to a terminal fixed upon an insulated strip near the detector. If an earth is used it is taken to grid bias positive.

Adjusting

Upon setting the switch to the medium-wave (central) position and switching on, stations should be received when the tuning and reaction controls are adjusted. The band-pass coils should then be trimmed in the usual way by having one trimmer fully opened and the other screwed down until further increase of capacity decreases volume. The band-pass coupling capacity may then be adjusted to reach the desired compromise between selectivity and volume on both medium and long waves. The circuits should be trimmed on a weak station with the reaction control near the oscillation point.

LIST OF COMPONENTS

FIXED CONDENSERS: Three 1 mfd., two .02 mfd., one .0002 mfd., one .00005 mfd. for band-pass coupling (see text).

VARIABLE CONDENSERS: Two-gang .0005 mfd., one .0003 mfd. PRE-SETS: Two .00005 mfd. trimmers, one .0001 mfd.

RESISTORS: One 3 megohm, one .5 megohm potentiometer, one 50,000 ohm, one 25,000 ohm variable, two 10,000 ohm, one 1,000 ohm.

Premier short-wave coils and holder.

Band-pass or similar coils for long and medium waves, with reaction.

One 4-pin and one 5-pin low-loss octal baseboard holders.

High-frequency choke.

Low-frequency transformer for direct coupling.

On-off switch.

5-pole, 3-way switch.

Single-pole, double-throw switch.

High-grade reduction drive; knobs, etc.

Valves: Mazda HL23, Osram HL2, Cossor 220HPT (or similar types).

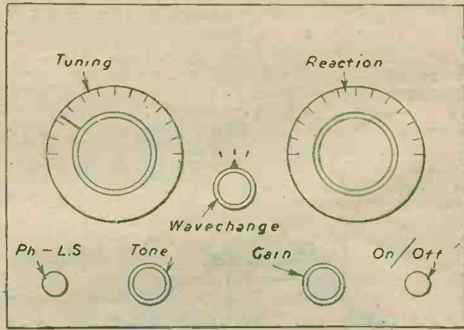


Fig. 5.—Layout of the panel controls.

On short waves there is no trimming, but the .0001 mfd. condenser should be adjusted to remove any dead-spots caused by a long aerial. For all-wave reception a high wire, clear of all walls, etc., about 30ft. long is most suitable. Other short-wave coils may be inserted in the rear holder as desired.

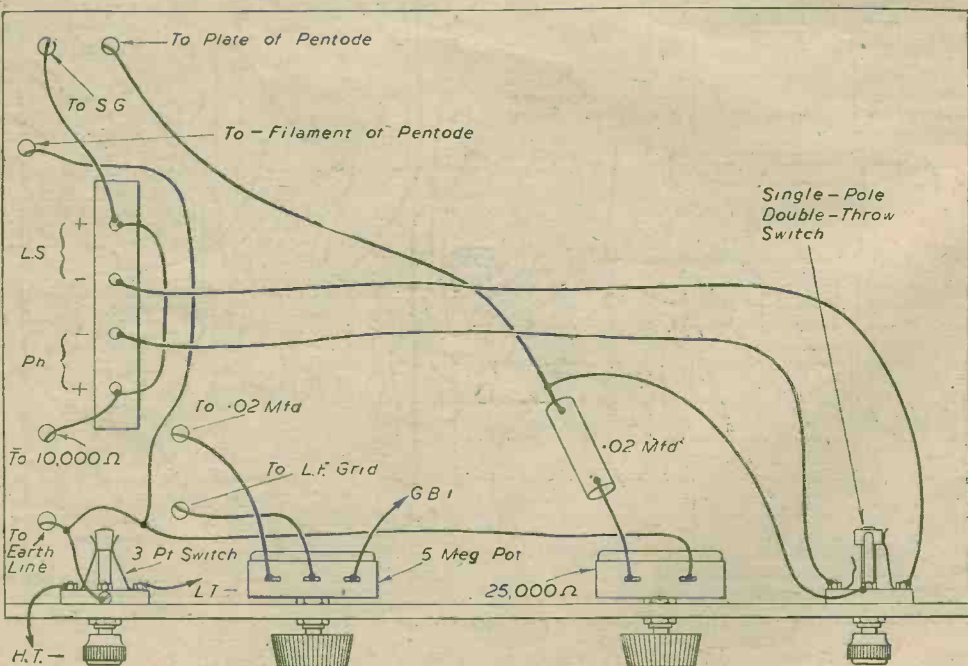


Fig. 3.—Under-chassis wiring of the receiver described above.

Crystal Filters

Features in the Design and Operation of I.F. Circuits in Communications Type Receivers

MANY amateurs are aware of the high standard of efficiency set up by the type of superhet receivers commonly known as Communications Types. These receivers are merely well-designed superhets, with a few features not found in standard broadcast equipment. These features generally include a Beat Frequency Oscillator, a switchable A.V.C. circuit, some form of bandspread tuning on the wavebands used by amateur transmitters, and in most of the better class models by a Phasing control or Crystal Filter. The name varies with different makes of receiver, but the principle is the same, namely, a form of Intermediate-Frequency amplifying stage in which a special crystal is included, with means for varying the degree of selectivity. This particular type of filter can, of course, be included in any home-made receiver or even in some forms of commercial equipment, and for the benefit of those readers who are anxious to know more about the filter the following notes will prove of value. These details were given recently by G. L. Grisdale, Ph.D. and R. B. Armstrong, B.Sc., in a paper read before the I.E.E.

Two Types of Circuit

The types of I.F. selectivity curves attained with a modern high-grade communication receiver are shown in Fig. 1. It will be seen that discreet values of pass-band are provided, covering requirements varying between reproduction of music at one extreme and the practical limits of adjacent channel selectivity for telegraph working at the other.

Some of the variation in band-width shown is provided by altering the coupling between circuits, and narrower band-widths are achieved by switching in crystal resonator circuits.

Where additional L.F. selectivity is incorporated, it is convenient from an operational point of view to introduce this feature by the same switch control as that involved in I.F. pass-band variations.

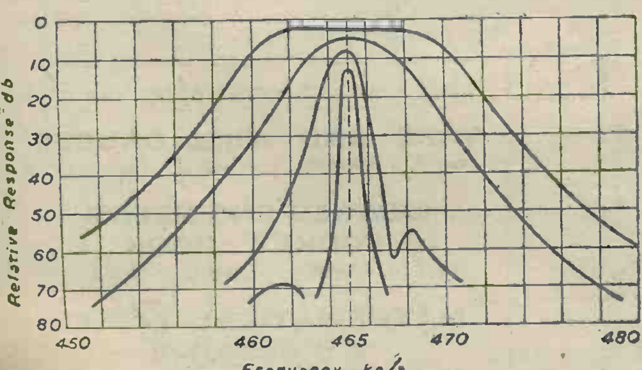


Fig. 1.—Typical I.F. selectivity curves of a modern high-grade receiver.

The behaviour of quartz crystals as circuit elements has been extensively investigated by Mason and others in connection with work on lattice and bridged T-filters for use mainly at frequencies of the order of 100 kc/s. The circuits used at intermediate frequencies in communication receivers are simpler than these filter circuits, and the band-pass characteristic is less ambitious.

Two types of circuits are in general use. The first is the neutralised single-crystal circuit shown in Fig. 2. With the omission of condenser C_4, this was the first type of crystal circuit to be used in communication receivers. By making condenser C_3 the front-of-panel control and adjusting it to neutralise the crystal capacitance, a symmetrical curve, as shown in Fig. 3, is obtained. As C_3 is adjusted to under- or over-neutralise the crystal capacitance, a rejection dip appears above or below the optimum response of the circuit. This arrangement is popular among skilled operators because, with considerable care, a high degree of rejection can be obtained to a single unwanted interference frequency. It is now considered inferior to an arrangement in which the crystal is left permanently neutralised and the effective pass-band of the circuit is altered in a series of finite and symmetrical values. Apart from being more satisfactory to unskilled operators, this arrangement does not call for readjustment as the frequency of the interfering signal changes.

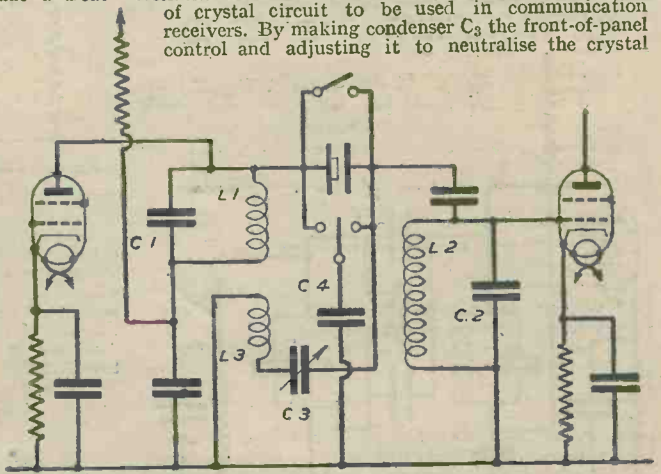


Fig. 2.—A simple single neutralised I.F. Crystal Stage circuit.

In order to provide two narrow band-widths with a single crystal as in Fig. 2, the capacitance C_4 is introduced and switched to effect the band-width change.

Finally, neglecting C_4, the circuit reduces to Fig. 4, giving a stage gain at mid-band frequency

$$G=\frac{g_m Z_1 Z_2}{Z_1+Z_2+R_c}$$

where Z_1 and Z_2 are the impedances of the side circuits when adjusted to resonate at the crystal series-resonant frequency, and R_c is the series-resonant impedance of the crystal. C_p disappears in the neutralised position.

The band-width at 6 db below optimum response is approximately

$$\Delta f=\frac{1.73}{2\pi}\times\frac{Z_1+Z_2+R_c}{L_c}$$

Typical values in use are $Z_1=Z_2=75{,}000$ ohms; $R_c=5{,}000$ ohms; $L_c=25$ H; $f_0=465$ kc/s; $g_m=2\times10^{-3}$ A/V. Then band-width $=1{,}710$ c/s and gain $=37$ db.

The above condition gives the maximum band-width because the impedances of the side circuits are a maximum and the crystal resonator is subjected to maximum damping. If C_4 be made a part of the total tuning capacitance of one of the side circuits in the resonant condition, switching it over to the other tuned circuit detunes the side circuits above and below their resonant value by equal amounts, and it is shown that for $C_4=7.6$ $\mu\mu$F the original band-width of 1,710 c/s would be reduced to 500 c/s, although the gain changes only from 37 db to 36.5 db. Wider band-widths can be obtained by short-circuiting the crystal altogether and changing the mutual inductance between coupled pairs of circuits in subsequent I.F. amplifier stages, and narrower band-widths by the insertion of L.F. tuned circuits.

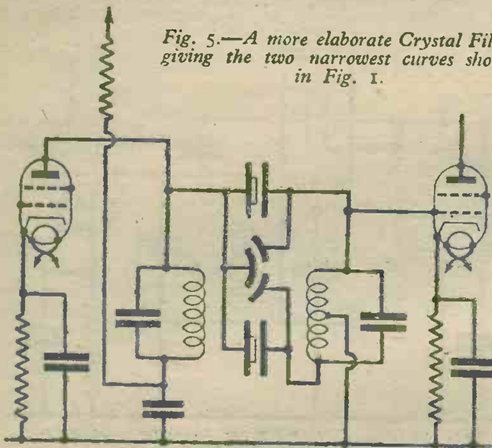


Fig. 5.—A more elaborate Crystal Filter giving the two narrowest curves shown in Fig. 1.

A similar result may be obtained by lowering the impedance of one or both of the side circuits by inserting series damping, but the crystal filter stage then has substantially lower gain.

Alternative Circuit

The second type of circuit in general use, with which the two narrowest band-pass curves in Fig. 1 are obtained, is shown in Fig. 5.

The crystal series-resonant frequencies are spaced above and below the mid-band frequency f_o, and the effective band-width is somewhat greater than the crystal-frequency spacing. The crystals have equal inductance.

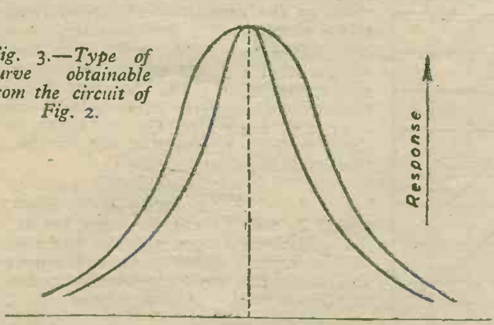


Fig. 3.—Type of curve obtainable from the circuit of Fig. 2.

The response curve shown in Fig. 6 is produced when the differential condenser, with the crystal capacitances, does not give a perfect capacitance balance. As balance is approached the two rejection dips f_{d1} and f_{d2} move outwards from the pass-band, and the trough between the two crystal frequencies f_{c1} and f_{c2} becomes deeper. After balance is passed, the dips move in towards the pass-band and the steepness of the sides of the curve increases; however, the response at the "return hump" frequencies f_{r1} and f_{r2} also increases, and the usual working condition is when the return humps are 20 db below mid-band response. The response at f_{r1} and f_{r2} is attenuated by the other selective circuits of the amplifier.

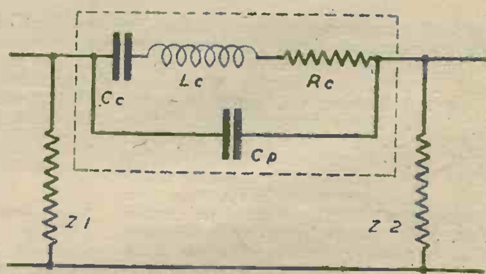


Fig. 4.—Theoretical representation of the circuit of Fig. 2.

Most of the crystals in use in communication receivers employ air-gap holders. The air-gap increases the inductance considerably, and requires close production tolerances. The plates used for oscillator control are unsuitable for resonator use because of their numerous spurious responses, which are not necessarily apparent when the crystals are used as oscillators. On the other hand, the temperature coefficient of frequency of the resonator is not usually so important as it operates with circuits whose temperature coefficient is of the order of 50 parts in 10^6 per deg. C.

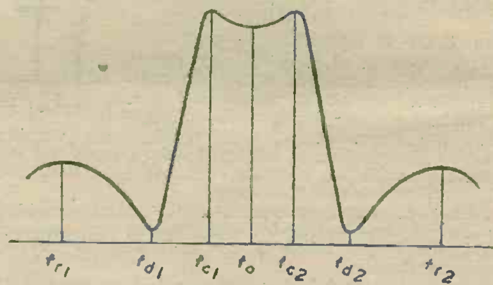


Fig. 6.—Curve obtained when a proper balance is not struck.

More About "Phase" in Amplifiers

Further Details on L.F. Design, with Simplified Vector Conventions

BY "DYNATRON"

IN a previous article I outlined some basic ideas on phase-shifts in amplifier circuits. The present article will enter into more detail, and show how to apply vector diagrams to various cases.

Mention of "vector diagrams" at once raises a vexed question. *Whose* vector diagrams? The subject has begun to look pretty abstruse, and it seems hopeless to try to get any general agreement.

Now this lack of agreement does not necessarily prove anything essentially "wrong" about the many theories and conventions. Different points of view are possible. Thus, where one writer shows Eg and Ia *in phase*, another may look at things from an angle which puts these two quantities 180 deg. out of phase.

It should be observed, too, that matters of disagreement generally have to do with the vector interpretation of valve equivalent circuits. That particular aspect will not be considered in any detail in this article.

While it is true that different conventions are possible, it is equally true that if a simpler set will yield the same results, they will be largely justified for practical purposes. Moreover, we must distinguish between a mere "convention" and a well established *fact*, or *principle*.

Let us first consider a few fundamental facts which are not open to dispute.

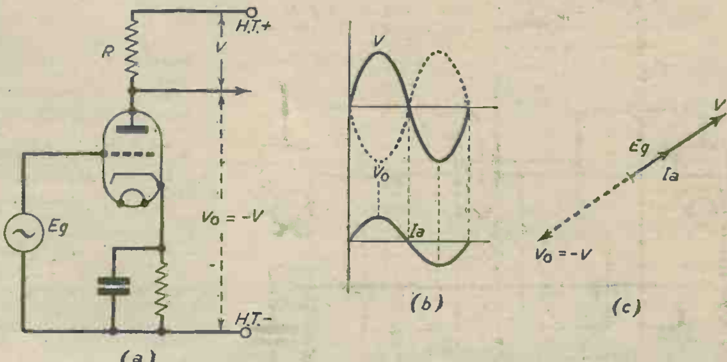


Fig. 1.—Phase relations in a simple stage with resistance load R: Eg and Ia are in phase. Ia develops a "supply-voltage" V across R, but the output voltage Vo is at 180 deg. to V, i.e., phase-reversed to the load voltage, and to Eg.

Some Fundamental A.C. Ideas

In my previous article, certain *essential* phase relationships were mentioned, which do not depend upon any conventions. They *must* be true, irrespective of what are defined as "positive" or "negative" directions, etc. For example: in any inductance an alternating current develops a *back E.M.F.* which, by definition, is phase opposed (or at 180 deg.) to the supply voltage. No amount of juggling with signs and conventions can alter this statement.

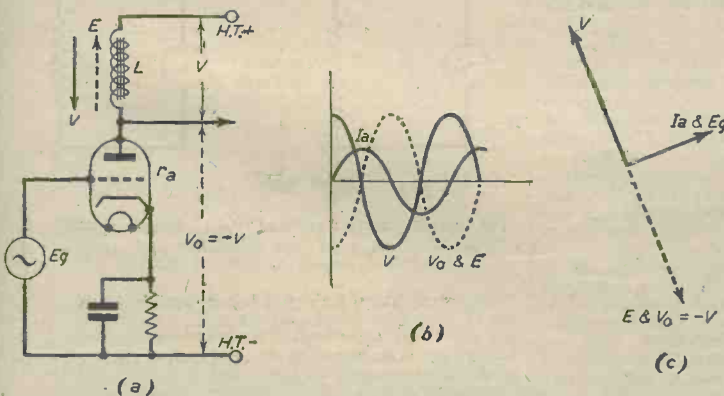


Fig. 2.—With a pure inductance L in the anode circuit, there is a back E.M.F., E, which requires a "supply" component V equal and opposite to it. The anode-to-cathode valve voltage, Vo, has the same phase as E, i.e., both have a negative sign, relative to V.

If, in any circuit, conventions lead to the conclusion that these E.M.F.s are "one and the same thing," there is something radically wrong with the conventions!

In the previous article, reference was made to rather involved arguments to show that the secondary E.M.F. of a transformer must be at 180 deg. to the primary supply voltage, i.e., using + and − signs, etc. But the phase of the *induced* E.M.F.s must be the same in both windings. They are both at 180 deg. to the primary supply voltage, since they are caused by the same inducing magnetic flux.

In a pure inductance, too, an alternating current lags 90 deg. on the applied voltage—or leads 90 deg. on the back E.M.F. A convention might be used, quite consistently, which reverses these phase relations, e.g., clockwise instead of anti-clockwise vector rotation.

But only confusion could result from such a non-standard convention. Moreover, the back E.M.F. and supply voltage would still be at 180 deg. The statement "*action and reaction are equal and opposite*" cannot be altered by drawing the parallelogram of forces upside down!

Here is the difference between a convention and a *fact*. Again, in a pure resistance the current and supply voltage are *in phase*. How, therefore, can the supply voltage component across a load resistance in the anode circuit of a valve be said to be *phase-reversed* relative to Eg and Ia? We shall consider this in a moment.

Meanwhile, we may note there are those who say that the phase-reversed output voltage is also the *load voltage*—implying that it represents the phase of the *supply* component derived from the H.T.

It is considered that this is the main source of confusion in applying vectors to valve circuits, since, to get a consistent account, it becomes necessary to give Ia, also, a reversed phase, i.e., put the alternating anode current at 180 deg. to its cause, Eg.

"Output" and "Supply" Voltages

In Fig. 1 (a) we have an output voltage Vo, phase-reversed in respect to the grid signal E.M.F., Eg, *because an oppositely-phased component of the H.T. is dropped across the load resistance R.*

If we set out to represent things graphically, our curves would be as in Fig. 1 (b). When Vo is on its negative half-cycle, say, we must denote the *increase* in potential-drop across R by a half-cycle of a voltage, V *at 180 deg. to Vo.*

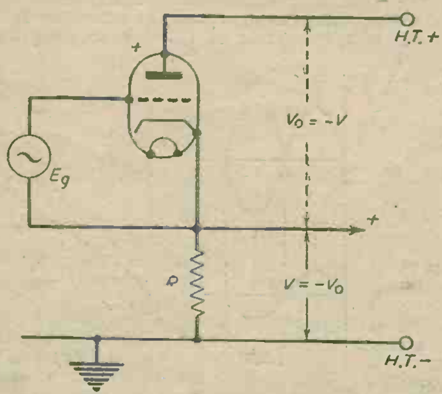


Fig. 3.—If the load resistance R were put on the cathode side, the output voltage would be V=—Vo. There is no phase-reversal such as exists across the valve.

While Vo=V=IaR as regards *magnitude*, the phase relationship is quite clearly, Vo= —V, or V= —Vo. There is no way of showing the two voltages by sine curves or vectors other than by drawing them 180 deg. out of phase.

It follows that we must consider a *supply* (or *applied*) voltage component in the anode circuit, itself at 180 deg. to the output voltage Vo, and it can only result in hopeless confusion to say V and Vo are one and the same as regards phase.

Practical Demonstration

But while all this seems pretty obvious, the valve circuit is a somewhat peculiar one.

The only point in Fig. 1 (a) where we can find any alternating potential is the *anode end* of R. The opposite end is tied to the fixed potential of H.T.+—or from an A.C. point of view, it is at "earth" (cathode) potential.

So, the phase-reversed component Vo is the only alternating voltage which can be found anywhere in the circuit! If a "supply" component V exists, how can it be demonstrated?

At ordinary A.C. frequencies no demonstration is possible. But if we used a very low frequency which the pointer of a centre-zero voltmeter could follow, opposite deflection would be observed across R, and the valve, respectively, during an A.C. cycle. Even with an ordinary voltmeter, the steady drop across R would move the pointer to some steady scale reading, and an A.C. change would be indicated by a movement above and below this steady reading.

Come to think of it, no ordinary A.C. measuring instrument will tell us much about "phase," but this experiment with a low frequency at least demonstrates V and Vo varying in opposite "sense"—which could only be denoted graphically by two sine-waves of opposite phase.

What is true at a very low frequency must be equally true at any other, in this case (neglecting the effects of reactances, etc.), even at radio-frequencies.

Oscilloscope Experiments

Will a cathode-ray oscilloscope show a voltage V across R, of opposite phase to the output voltage Vo?

If the experiment were tried (using suitable blocking condensers to D.C.), it would again be found the CRO. tells us nothing about any "supply voltage." The oscilloscope will show only the voltage VO, whether connected across the valve or directly across R from anode to HT+!

This looks like a flat contradiction of our low-frequency meter experiment! The CRO suggests that V and Vo are one and the same, and that both are at 180 deg. to Eg?

But wait a moment! *Why* cannot the CRO tell us anything about V? Surely, because, unless one deflector plate is given the D.C. potential of +HT, conditions are identical as under ordinary working conditions, i.e., at usual frequencies, the oscilloscope will always virtually be connected across anode and earth—or anode/cathode.

We will now look at a case where theoretical considerations demand E.M.F.s of phase of V and Vo.

A Theoretical Demonstration

Let us substitute for R a pure inductance, L, Fig. 2 (a).

Here, at any rate, we cannot get away from the facts. By the fundamental principles of A.C., an alternating E.M.F. of self-induction (or a *back E.M.F.*), E, is developed in the inductance, lagging 90 deg. on the alternating current Ia, Fig. 2 (b) and (c).

Now, E cannot possibly be the only E.M.F. in the circuit. There must be an equal and opposite applied voltage V, which is a component of the H.T. acting in the opposite sense to the back E.M.F.

Thus, during the first part of a positive half-cycle of Eg the current Ia will be increasing in magnitude. The magnetic field around L will be increasing—lines of force will be coming into existence—and will induce a counter E.M.F. opposing the current-change. This will obviously be a back E.M.F. in the direction of the dotted arrow in Fig. 2 (a)—in direct opposition to +HT.

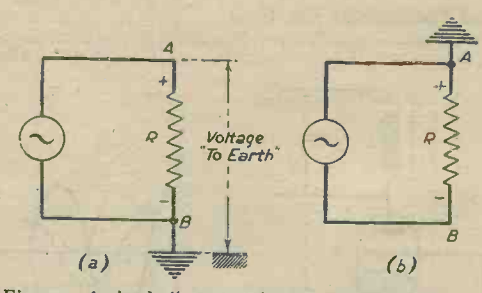


Fig. 4.—A simple "earthed" A.C. circuit to illustrate "phase-reversal"—of the insulated end relative to earth. Compare with Fig. 1 and Fig. 3.

Simultaneously, an equal but opposite component of the H.T. will be developed across L, acting therefore in the direction (or "sense") of the full-line arrow in Fig. 2 (a). The two E.M.F.s are denoted throughout by E (dotted lines and vectors), and V (full lines).

Clearly, then, we have two voltages, equal in magnitude, but in mutual phase-opposition. V is what we call the "*supply voltage*."

The curves and vector diagram are given in Fig. 2 (b) and (c). Ia develops the back E.M.F. E, lagging 90 deg. Directly opposing E is the supply voltage V, at 180 deg. to E, and therefore leading Ia by 90 deg.—or, the current in a pure inductance lags 90 deg. on the *applied* voltage.

What is the Phase of Vo?

What is the phase of the *output voltage* Vo in this inductive case? Has it the same phase as E, or V?

The question is important, because the answer will settle once and for all whether it is necessary to make any distinction between V and Vo. True, we are not dealing with a simple resistance at the moment, but a principle that is true of an inductive load must be equally true of any other load—in so far as a "supply voltage" is always necessary.

Look again at the dotted arrow in Fig. 2 (a). This is the back E.M.F. in the coil (over the part of a cycle considered), and it is acting *away from the anode*—or in direct opposition to +HT. The direction is such as to make the anode more negative, or "less positive." The cathode side is tied to HT−, hence the potential-difference across the valve *falls*.

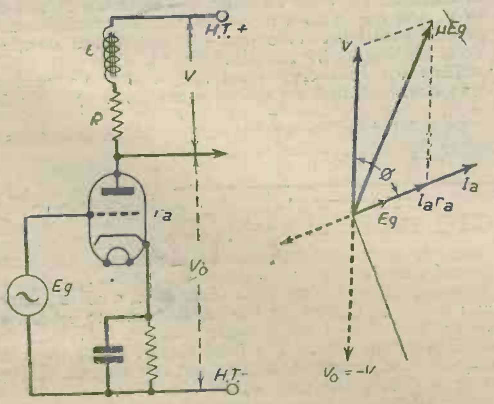
But this potential-difference across the valve is represented by Vo. A CRO will show it *lagging* 90 *deg.* on Ia, exactly the same as E. This statement, of course, depends to some extent what conventions are made in defining the phase of Ia.

Here, we shall adopt the simple view that Ia and Eg are in-phase; that Ia develops a back E.M.F. in L, lagging Ia by 90 deg.; that the back E.M.F. is counter-balanced by an equal and opposite applied voltage V, which therefore leads Ia and Eg by 90 deg.; finally, from a consideration of the "negative" potential sign across the valve (during a part of a cycle when Eg and Ia are varying in a "positive" sense), the output voltage Vo has the same sign as the *back E.M.F.*, i.e., is at 180 deg. to the supply voltage V.

In our previous article we referred to certain ambiguities of "signs." For example, a + sign may refer to an applied E.M.F. acting upon a given circuit, say, in the direction A−B, or to an internally generated counter E.M.F. acting in the direction B−A.

However, in Fig. 2 (a), the arrows show both E.M.F.s in mutual opposition. The "valve voltage" Vo has the negative phase sign of E.

Observe, too, that although the phase-shift of Vo on Eg is 90 deg., *V and Vo are always at 180 deg., whatever the nature of the anode load.* The current vector (and Eg) will take up some other angle, depending upon the resistance and reactance of the load.



(a) (b)

Fig. 6.—Vector diagram for load having resistance and inductive reactance.

"Load Reaction"

"Ah!" it will be said, "your inductive case does not explain Fig. 1. If the load is a pure resistance, you have no back E.M.F."

It is at least certain that there must be some equivalent of a supply voltage. As before, this must be derived from the H.T. source. What is not so clear is how Vo can be said to have the same phase as a "back E.M.F."

While we cannot very well talk of a "back E.M.F." in a resistance—there is no self-induction, we will suppose—yet, there is something not so very different from a back E.M.F., and having the same negative sign in relation to an applied voltage.

This has been termed by Morecroft (Principles of Radio-communication) the *load reaction*, as in mechanics. Stated simply: *the volts lost in a resistance give rise to a potential-difference of opposite sign to the applied E.M.F.* Or: the alternating potential-difference across an anode load resistance is at 180 deg. to the applied volts, and the current.

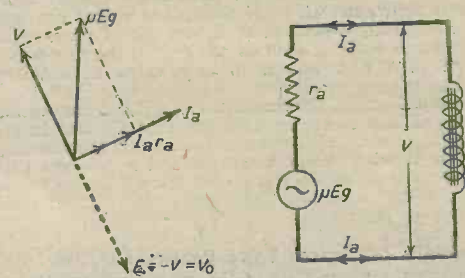


Fig. 5.—Equivalent valve circuit, when the internal resistance ra is taken into account (purely inductive load).

Generally, when we use the term "p.d." we mean the supply voltage. But we are now considering a case where one end of a load resistance is at a fixed potential. It is then a question of interpreting the "negative" alternating potential sign of Vo at the anode end.

The negative sign of Vo, in all cases, denotes the *load reaction*, owing to the peculiar circumstance that the +H.T. end of the load is virtually at "earth" A.C. potential.

If a load resistance were placed on the cathode side, Fig. 3, one end is now tied to the constant potential of H.T.—. The output voltage sign at the cathode end will be *positive*, thus denoting the phase of the *applied voltage* V, i.e., no phase-reversal occurs between input and output sides. However, the valve-voltage (anode-to-*cathode*) will still be of negative phase.

"Earthed" A.C. Circuits

Fig. 4 (a) and (b) will make some of these points clear.

A resistance R is connected to an alternator. In (a), the line B is earthed; in (b), line A is earthed.

Suppose we agree to the convention that an applied E.M.F. acting from A towards B represents a "positive half-cycle"—this matters little as far as phase relationships are concerned, and we might equally choose the direction B to A.

If we wanted to define potential signs relative "to earth," we would say that terminal A, in (a), is, say, of + sign. But if A were the earthed terminal, as in (b), then, over the same interval, a potential taken off terminal B would be of — sign with respect to earth.

We might talk of "phase-reversed" voltages if dealing with a valve circuit having opposite ends earthed, as in Fig. 1 and Fig. 3. The output voltage, Vo, in each case, takes the sign of potential at the "insulated" end of the circuit.

If so, one sign (say the +) denotes the phase of the supply voltage, whilst the negative sign must be interpreted to signify the phase of the back E.M.F., or the load reaction.

Phase of Eg and Ia

The question of the relative phase of V and Vo has been discussed at length, because failure to take account of V probably accounts for all the confusion attached to valve vectorising.

For example, if the supply voltage is considered as having a negative phase, it becomes necessary for consistent results to phase-reverse Ia relative to Eg.

Some writers do, in fact, adopt this convention. There is nothing fundamentally wrong about it, excep that matters are made extremely difficult for the student. Except at very high frequencies where electron transit-times have a bearing on the matter, the anode current of a valve appears to vary exactly in step with, or in time-phase with, the alternating E.M.F. Eg on the grid.

A consistent theory can be held, putting Eg and Ia at 180 deg. But why? Simply to get a consistent set of conventions which might have started from more obvious premises. In some books, the writer has seen vector diagrams where Ia is shown out of phase with Eg by some angle ϕ, such as 30 deg.—if the reader can picture such a condition in any valve at ordinary frequencies!

As stated earlier, the convention—if it is a convention—adopted here is the obvious one that Eg and Ia are always in-phase. If the reader makes this his starting-point in drawing vector diagrams, and remembers that *phase conditions in the grid circuit are not altered by the nature of the anode load* (neglecting Miller effects), he will not go far wrong.

Phase-shifts in Typical Valve Circuits

Finding the phase-shift of the output voltage Vo on Eg is a simple matter if we bear the foregoing considerations in mind. At least, the results may be readily checked by an oscilloscope.

The resistance load, Fig. 1, is the simplest. Starting with Eg and Ia in-phase, we have: the supply voltage V across R (=IaR), in phase with Ia and Eg; an output voltage, Vo=—V=—IaR, across the valve, at 180 deg. is Ia and Eg. Thus Vo is phase-shifted 180 deg. on Eg.

As shown in Fig. 2 (c), Vo is shifted 90 deg. on Eg where the load is a pure inductance, with Ia and Eg still in phase. This gives the true phase-shift, but we may elaborate a little on our vector analyses, taking into account the effect of the valve internal resistance ra.

This is in series with the external load, and a more complete vector diagram for the inductive case is given in Fig. 5. Starting again with Eg and Ia in phase, we have: V leading Ia by 90 deg., and Vo=—V, as before. Thus the phase-shift between Eg and Vo is 90 deg. (Vo lagging), *irrespective of ra*.

The effect of the internal resistance is to cause an internal voltage-drop, Iara, in phase with the current. As far as the output circuit is concerned, these volts are "lost," but if added vectorially to the *supply* voltage V, we get the total E.M.F., μEg, Fig. 5. This is the E.M.F. given by an "equivalent generator," i.e., Eg volts applied to the grid is equivalent to μEg volts acting upon the load and ra in series, Fig. 5 (b).

It follows that V is the vector-difference, or the result of vectorially subtracting the internal drop Iara from μEg. With a pure resistance load, Fig. 1, simple arithmetic addition or subtraction apply—or simple Ohm's law.

Load with Reactance and Resistance

To repeat; internal resistance has no effect upon the phase-shift between input and output voltages. But things are different if the *external load* has resistance and reactance.

In Fig. 6 is a load having inductive reactance and series resistance. The current Ia must lag on V by some angle ϕ‡, less than 90 deg. Fig. 6 (b). Then, as before, Vo will be at 180 deg., to V— having here the phase of the *total* load reaction, including the back E.M.F. in L.

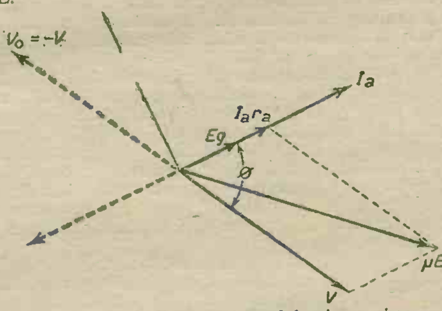


Fig. 7.—Vector diagram for load having resistance and capacitive reactance.

Suppose ϕ=60 deg. Then the simplest way of stating the phase-shift is to say that Vo is leading Eg by (180 deg.+60 deg.)=240 deg. Again, μEg is the vector resultant of V and Iara. The load has a *power factor* of 0.5 (=the *cosine* 60 deg.), and so the true power output is, VIa×*power factor*=0.5VIa.

If the load were a resistance and *capacitive* reactance, Ia will lead on V by an angle ϕ. With Vo at 180 deg. to V, and ϕ=60 deg., as before, the simplest statement of phase-shift is: (180 deg.−60 deg.)=120 deg., i.e., Vo is leading Eg by 120 deg. (Fig. 7).

Thus an inductive reactance makes Vo lead by (180 deg.+ϕ), and a capacitive reactance by (180 deg. −ϕ).

In a later article we shall apply these principles to other devices, such as oscillators.

Servicemen are Honest

THE following details of an American trade survey will, no doubt, be of interest to our readers. A similar test should be carried out in this country.

Fify-five per cent. of the radio shops canvassed by a non-technical shopper for a big metropolitan daily are to be recommended on a basis of servicing charges and operating policies. This will be welcome news to the serviceman, who has been used to surveys which show him up in an unfavourable light. The 45 per cent. "not recommended" were not necessarily classed as "gyps" but other factors such as high prices were taken into consideration.

The survey was made by the New York City newspaper PM, and was carried out by a person unfamiliar with the technical side of radio. A set which was actually defective was used, in sharp contrast to a famous survey made some years ago, in which defects were faked. This offered the shops a genuine repair job to estimate, and was no doubt responsible for the higher number of shops found to be competent to do an honest and reasonably priced job.

Before taking the set to the first shop, a radio engineer was called to determine the trouble and to estimate a reasonable charge for putting the set into first-class operating condition. The total cost of repair work was estimated at \$4.00 to \$5.00 without new valves. If these were replaced, the cost would rise to a maximum of \$7.00. Of the 10 shops canvassed with the radio, only *two erred* in their diagnosis. Prices, however, varied from \$4.75 to \$8.00. The highest price quoted by a "recommended" shop was \$7.10. Five of the shops were recommended on the basis of the charges and operating policies.

In contrast to the "survey" conducted by *Reader's Digest* several years ago, the findings of PM present a much more accurate picture of the radio servicing field. It should also be noted that as previously, stated, the mal-function of the receiver was real and not some wire that had been disconnected purely as a means of testing the serviceman.

ON YOUR WAVELENGTH

By THERMION

Radiolympia

THE expected 1946 Radio Show will not take place and we must wait until the autumn of 1947 before we shall have a chance of inspecting all those technical developments which manufacturers have promised us as a result of six years of war development. It seems a long time since 1939, when the threat of war put an untimely end to the last of the pre-war radio shows. It was easily the best of them, but war and the fear of war cast a cloud over it, and in spite of all the efforts which had been put in by the late Colonel Ozanne to make it a great success, the exhibition closed without having completed its prearranged run. Television at that time was on the move and many television receivers were on view. The war put an end to all that, and so here we are in 1946 putting out television programmes on the same system and on the same lines as when we left them in 1939. No blame attaches to the B.B.C. here, and the gap of six years represents a loss which cannot be retrieved.

However, we can now look forward to a definite show in 1947, when I hope once again to be able to renew my acquaintance with the many hundreds of readers who called upon me before the war and to make fresh acquaintances among the tens of thousands of new readers who have joined our ranks since the war began. I shall hope even to meet some of those few readers who do not like my views on crooning. I shall hope to convert them. For I do not think any of them are so far gone that they cannot be put back on to the path of rectitude from which they have in their technical juvenescence strayed! If I am to take some of those few critics seriously I shall have to arrive in my armour plate complete with visor. But then, perish the thought! Crooners and lovers of crooning must be meek and mild people to have their voices pitched in so soft a key.

Long before the next Radiolympia I shall have had an opportunity, and so will you, of inspecting the latest receivers and components at the "Britain-Can-Make-It" exhibition, which will have taken place before you read these notes. This exhibition may to some extent steal the thunder of Radiolympia, for it will undoubtedly attract orders normally placed at Radiolympia. I think it was an error of judgment not to have held the radio show this year. I can claim to have been to every radio show held before and since broadcasting commenced. I founded the first radio journal which appealed entirely to the home-constructor, and I have regularly contributed to every issue of this journal. Notwithstanding my long association, I look forward to the next show with greater enthusiasm than ever before. It will help to get the public mind off wars and effects of wars.

Lord Reith on Critics

LORD REITH in a letter to the "Times" attacks the critics of the B.B.C. engineers:

"Animadversions on them in recent debates in the Houses of Parliament so astonished me that I made inquiries of the Corporation; what they say is good enough for me, and I will underwrite it. Charges of neglect of ultra-short waves and of frequency modulation were adequately met by the Postmaster-General in the Lords and by the Lord President and the Assistant Postmaster-General in the Commons. But two other specific charges have had no reply. One speaker said:

"'The most powerful and the most efficient broadcasting station in this country during the war was not run by the B.B.C., but was run by the Government, and it was in no way under B.B.C. control. It is also worth bearing in mind that that station, which was put up by engineers and run by engineers who had no connection with the B.B.C. at all, was able to do things which the B.B.C. engineers had announced in advance were impossible. That station reached a pitch of efficiency and set an example of what could be done in wireless which the B.B.C. would never have set.'

"The reference was presumably to a special war purposes transmitter erected by the Government in the South of England. But this was not the most powerful broadcasting station in Great Britain, and it was probably neither more nor less efficient than others. The one at Ottringham, designed throughout by B.B.C. engineers, has a maximum power of 800 kW., which is 200-300 kW. higher; moreover, it can be used on both long and medium wavelengths instead of medium only. And what did B.B.C. engineers announce as impossible? There were abstruse discussions and disagreements about calculated coverage, the facts of which are still uncertain, but as to which the B.B.C. engineers are at least as likely to be right as wrong.

"The same speaker remarked:

"'Their reproduction of gramophone records is frankly paralytic compared with that of other nations. If you take a gramophone record programme of the B.B.C. and compare it with a gramophone record programme coming out of Germany, Holland, France, America, or anywhere you like, there is just no comparison at all.'

"Does this refer to the reproduction of commercial records, some of which probably are mediocre? But that is not the fault of the B.B.C.; they must use what they can find to suit particular types of programme.

"Or did the speaker refer to records which the B.B.C. itself makes? The number of discs cut weekly by the B.B.C. in August, 1939, was 350; in August, 1945, it was 4,300. This meant procuring apparatus from abroad, good in itself but subjected to strains for which it was not designed. Even so, I expect their home-made records were as good as those used anywhere; certainly no such violent stricture is justified. The B.B.C. will shortly have in service broadcast recording apparatus of their own design, probably the most highly developed of its kind in the world."

A Pæan of Victory

Suggested for the B.B.C. on the renewal of their present Charter for another five years.

TRALLALALAH, whoops, Trallalalay,
We've got another five years to stay,
To give the listeners what we like
From bores gathered round the mike,
Brains Trust gigglers, well dug in,
Have heard this news with a happy grin;
Croonettes with adenoids take fresh hope—
For another five years of their awful dope;
Dance-band leaders, who cannot play
A single instrument, blithe and gay;
Government spokesmen telling the tale—
With "Jam to-morrow" will not fail;
We'll broadcast "Orders" as they're spoken—
With penalties mentioned if they're broken.
Our bloated staffs we won't cut down,
No matter how the listeners frown;
Sponsored programmes they shall not hear,
We'll show them they cannot do that there here.
And in these couplets, crude but true,
The listener's fate you may construe,
And we've doubled the fee he used to pay,
Now we've got another five years to stay,
Whoops, trallalalah, and trallalalay!

"TORCH."

The Battery L.F. Amplifier

Hints on the Construction and Design of Various Types of Equipment for the Battery User

By F. G. RAYER

THE particular type of L.F. amplifier which is used in any receiver greatly affects the results obtained. It may be desired to obtain maximum amplification with low current consumption and average quality of reproduction, as in a short-wave receiver. Or rather better quality may be required, with current consumption of only secondary importance and a high amplification not necessary, as with apparatus intended primarily for local station reception. Maximum power output, current consumption, overall amplification and quality of reproduction are considerations upon which the design of the amplifier will depend. The circuits following—besides being suitable for inclusion in any battery receiver—should clear up any difficulties and enable a choice to be made when constructing a receiver.

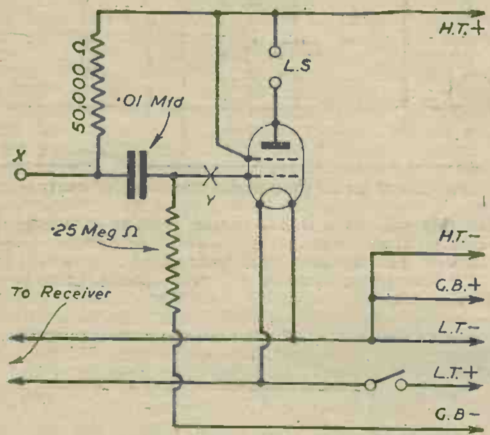


Fig. 1.—A simple amplifier stage using a tetrode valve.

Single-valve Amplifiers

Fig. 1 shows a very simple type of amplifier, but one which is very satisfactory for either a S.W. receiver for 'phone reception, or a long- and medium-wave receiver of moderate power. It will also give fair speaker reproduction of the more powerful S.W. stations.

In this, and the circuits to follow, the point marked X should be connected to the anode of the detector, not forgetting the H.F. choke used for reaction purposes, which should be wired near the detector. Similarly the leads which are to be taken to the receiver should be connected to the filament positive and filament negative sockets on the detector valve holder. H.T. and other battery supplies will then be applied to the detector in the required manner.

Because the 50,000 ohm resistor reduces the voltage reaching the detector anode 120 volts should, for preference, be used. If a S.G. or pentode detector is used this resistor may be increased to 100,000 to 250,000 ohms with advantage. If used with an U.S.W. set where a fairly high voltage is required on the detector anode the resistor may be reduced to 25,000 ohms, but a lower value should not be used. With a S.W. receiver a "grid stopper" of about .1 megohm may be included at the point marked Y.

An Improved Circuit

One or more of the modifications shown in Fig. 2 may be added. The .01 mfd. condenser and 25,000 ohm variable resistor provide a means of mellowing reproduction, minimum "top" being obtained when the resistor is at zero ohms. Alternatively a fixed condenser of from .001 to .01 mfd. may be used, connected either from anode to earth, or across the speaker. The higher the capacity, the more will high notes be reduced.

The use of automatic bias removes the need for a grid bias battery or connections. From the circuit it will be seen the valve grid will be negative by the extent of the voltage dropped across the resistor R. This governs the bias made available. From Ohm's Law the value of R may be obtained, but for a small battery set 500 or 750 ohms is generally suitable. If the anode current of the receiver is 10 mA. 500 ohms will drop 5 volts, so this will be the bias applied. With a reduction in H.T. voltage less bias voltage will automatically be obtained. The 25 mfd. condenser may be of 12 volts working, and the polarity should be observed, as shown.

Decoupling

Both detector anode and pentode screen are decoupled in Fig. 2. The latter is not usually necessary unless more than one stage of L.F. amplification is used. In addition a transformer provides an increase in gain, the coupling condenser being increased to .05 or .1 mfd. for

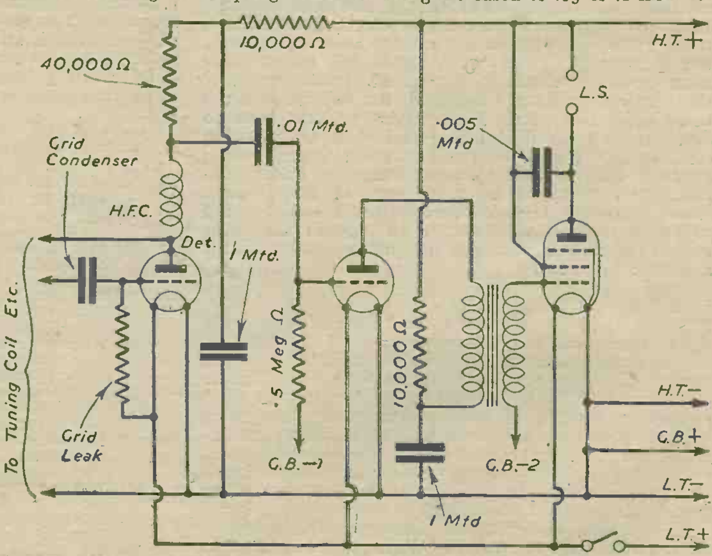


Fig. 3.—A three-stage amplifier with "mixed" couplings.

preference when this is done. If the transformer is of the type suitable for including directly in the anode circuit then the primary should be connected in place of the 40,000 ohm resistor shown. The 10,000 ohm decoupling resistor may then be taken to a H.T. tapping of about 80 volts.

Suitable valve types for these circuits are Cossor 220HPT, Osram PT2, Mullard PM22A, or a similar type, either of L.F. pentode or tetrode. These valves will give a very good degree of amplification with low consumption. A triode, such as Osram LP2, Mullard PM2A, or similar small power valve, may be used. Less amplification will be obtained. In all cases the bias should be adjusted for best results with the H.T. voltage used.

Two-valve Amplifiers

Where more gain is required (as with a S.W. set for speaker reproduction, or a portable), the circuit in Fig. 3 may be used. The detector is shown also, to make connections clear. In the first L.F. stage a detector valve may be used (such as the Osram HL2, Madza HL2, Mullard PM2HL, or PM1HL). The output valve may be any of the types mentioned for Figs. 1 and 2.

In this circuit a fixed degree of tone control is obtained by the .005 mfd. condenser connected across the speaker. If volume control is required the .5 megohm grid leak may be replaced by a potentiometer of similar value, the grid of the L.F. valve being transferred to the slider of this control.

The circuit in Fig. 3 is not suitable for a long- and medium-wave receiver unless some pre-detector type of volume control, or the L.F. volume control mentioned, is used. This is because although it provides considerable amplification it is easily overloaded on strong signals.

The L.F. transformer may be parallel fed, as in Fig. 2, but this will considerably reduce the anode voltage of the L.F. stage, with a consequent reduction in amplification. For the valves mentioned, and 120 volts H.T., G.B.1 may be taken to 1½ or 3 volts, and G.B.2 to 4½ or 6 volts.

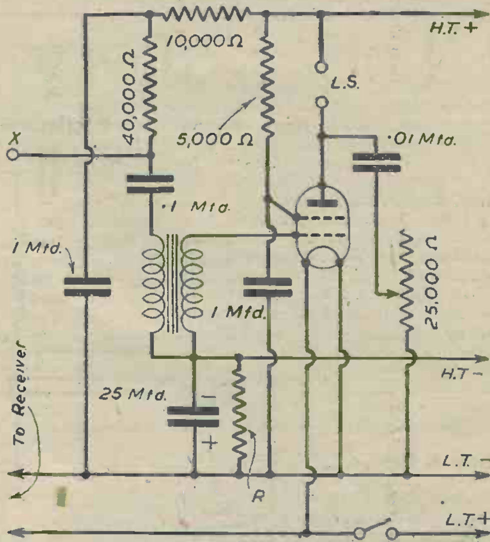


Fig. 2.—A parallel-fed transformer-coupled amplifier.

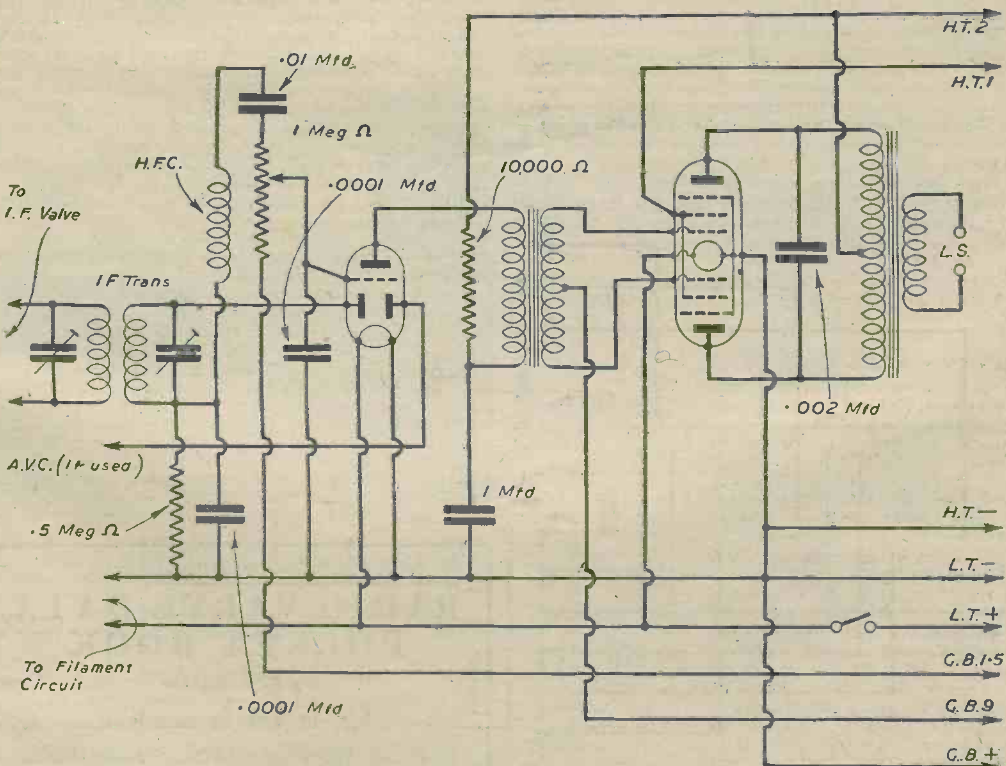


Fig. 6.—An elaborate two-stage amplifier, with Q.P.P., and a multiple valve for the first stage.

A Simple Triode Circuit

Although the circuit in Fig. 4 contains only the bare essentials, it will give a good degree of amplification. For the L.F. stage a L.F valve, such as Osram L21 is suitable, with a power or small power for the output stage. In a S.W. receiver, however, a detector type may be used instead for the L.F. stage with advantage.

The first transformer may have a ratio of about 1 : 3, and the second 1 : 5. With a good layout no instability should arise, but if it does the connections to the secondary of the first transformer may be reversed. If this does not afford a cure the H.T. battery is probably developing a high internal resistance and decoupling may be added. Normally, however, this circuit is stable with triodes.

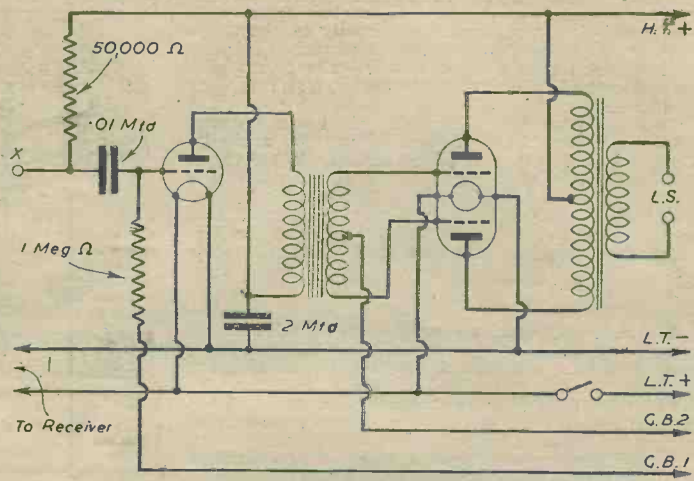


Fig. 5.—This two-stage amplifier uses a Class B valve.

Class B Circuits

For higher outputs with moderate current consumption, the single output valve is not very suitable. A circuit such as that in Fig. 5 may then be used. It should be realised that the Class B valve itself does not amplify more than would one valve of a type similar to one of its sections, but greater power may be handled. Furthermore, the current consumption is proportional to the signal so that during low volume and silent periods the drain on the battery is greatly reduced.

A suitable valve type is the Osram B21, Mullard PM2BA, or Madza PD220A, or similar double triode. A driver, such as the Osram L21, is required to provide a signal of sufficient volume for application to the output valve. If maximum volume is required a small power valve may be used for driver.

Tone control may be obtained by connecting a condenser from anode to anode (see Fig. 6), or from each anode to earth, with a resistor also in series if desired.

With 120 volts H.T. about 4½ volts grid bias will be required on each valve, although this may be increased if a small power valve is being used in the driver stage.

The output transformer shown will in most cases be in the speaker. If a speaker is connected at L.S, it must be of the low-impedance type, e.g., moving-coil speaker without transformer.

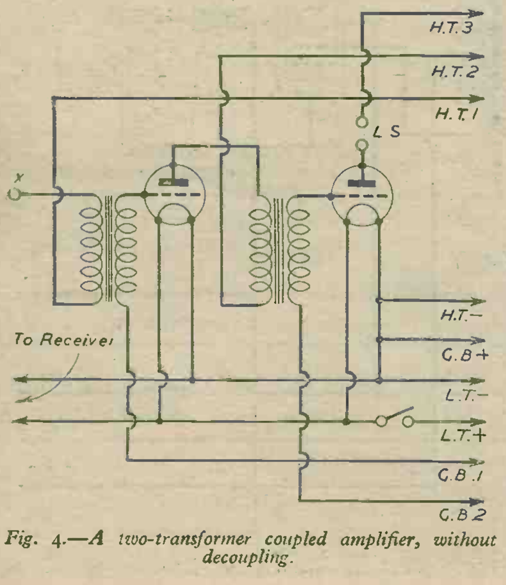


Fig. 4.—A two-transformer coupled amplifier, without decoupling.

Double Pentode

With a circuit such as Fig. 6, considerable power output may be obtained with comparatively low current consumption. Suitable types are the Mazda QP240 or Osram QP21. Alternatively separate valves (Cossor 220HPT, etc.,) may be used provided they are of the same " age " and characteristics.

A valve of this kind may be operated satisfactorily without the aid of a driver, so that it may follow the detector, especially in a superhet, where the detector output will be fairly powerful. If possible, 150 volts should be applied to H.T.2, with 120 volts to the screens (H.T.1). To smooth possible surges a fairly large capacity condenser may be connected across the H.T. battery. The circuit (in common with normal Class B circuits) is not suitable for operation from an eliminator, due to the considerable variation in anode current when reproducing at varying volumes.

Figure 6 also shows how a multiple valve may be used to provide L.F. amplification. With a valve such as the Mullard T.DD2 or Mazda HL.21DD detection, A.V.C., and L.F. amplification may be obtained It will be seen that one diode anode provides detection, the L.F. signal being applied to the grid of the triode section through a .01 mfd. coupling condenser, with a potentiometer for volume control. Sufficient volume will then be available to load the double pentode. Alternatively, of course, a separate valve of the detector or L.F. type may be used before the output stage, or additional L.F. amplification wholly omitted if the detector output is fairly high.

'What's it like in the Navy, Chum?'

It's a good life and a good job, too! I'm an Able Seaman and a Gunner — oerlikons, bofors, pom-poms. That's my line. You might go for wireless or radar. What's the gold stripe mean? That's a badge. It means extra pay for one thing. There are lots of extras in the Navy . . . chance to travel . . . plenty of sport, plenty of leave, plenty of friends — and a good chance to get on . . .

If you are between the ages of 15½ and 23 there are some vacancies for you in the Navy now. For more information call at any recruiting office or write today to the DIRECTOR of NAVAL RECRUITING, ADMIRALTY, LONDON, S.W.1.

Make the **ROYAL NAVY** *your career*

FOR THE RADIO SERVICE MAN, DEALER AND OWNER

The man who enrols for an I.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, every-day, radio service work. We train them to be *successful!*

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 94, International Buildings, Kingsway, London, W.C.2.

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

Complete Radio Engineering
Radio Service Engineers
Elementary Radio

If you wish to pass a Radio examination, indicate it below.

British Institute of Radio Engineers
P.M.G. Certificate for Wireless Operators
City and Guilds Telecommunications
Wireless Operator, R.A.F.
Wireless Mechanic, R.A.F.

Write to the I.C.S. Advisory Dept., stating your requirements. It places you under no obligation.

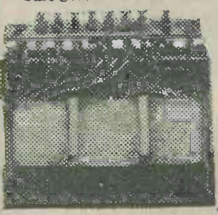
Name...Age ....
(USE BLOCK LETTERS)

Address ....
....
(Use penny stamp on unsealed envelope.)

ICS

CONCORDIA L.V. TRANSFORMERS

Designed by transformer specialists to suit given conditions of service. Types available for Radio, Bell, Lighting, Mines type, phase changing. Concordia also design and make transformers up to 50 kVA. to customers' requirements, air or oil cooled, and arrange for any enclosures (damp-proof, totally enclosed, etc.).



Sole Agents. **ELCORDIA LTD., 225, Westminster Bridge Road, London, S.E.1.**
Tel.: WATerloo 5502/3.
Grams: Elcordia Lamb London.

COVENTRY RADIO

COMPONENT SPECIALISTS SINCE 1925

NOW READY 21st BIRTHDAY LIST OF COMPONENTS

With full details of the "NAPP" AC/DC 5-VALVE SUPER HET., Circuit, Plans and Component List.

Price **3d.** post paid.

COVENTRY RADIO,
191, Dunstable Road, Luton, Beds.

BRITISH PHYSICAL LABORATORIES

17 RANGE UNIVERSAL TEST SET

1,000 ohms per volt on A.C. and D.C. ranges. Toughened glass. Size 5⅞" × 4⅛" × 2¾". Ranges 0/75m.V. D.C., A.C. and D.C. volts 0/10, 0/50, 0/100, 0/500, 0/1,000. D.C. Milliamps 0/1, 0/10, 0/100, 0/500. Resistance ranges 0/1,000 and 0/100,000 ohms; 0/1 megohm with external battery. Accuracy 2%. Rotary range selector.

PRICE £8 : 17 : 6

If unable to obtain this high-grade instrument from your dealer, apply to U.K. Trade Distributors:—

RADIO AGENCIES LTD.
157, WARDOUR ST., LONDON, W.1.
Phone: GERRARD 4456.

HENRY'S

RADIO COMPONENTS & VALVES,

5, Harrow Road, Edgware Road, W.2.

PAD. 2194.

9.30-6 o'clock, Mon.-Sat. Thurs. 1 o'clock.

2 Gang .0005 Con. Ceramic with feet. **10/6.**
T.C.C. and B.I .8 mfd. 500v. wkg. **3/-.**
8×8 mfd., 500v. wkg. **6/-.**
16×16 mfd., 350v. wkg. block. **6/-.**
16 mfd. 350v. wkg. block. **3/6.**
4 mfd. 1,000v. wkg. **7/6.**
1 mfd. 750v. wkg. **2/-.**
1 mfd. 1,000v. wkg. **2/6.**
Metal Rectifiers. 200/600 Input, Output 300 m/a. **30/-**

Analysis of the Television Receiver—3

D.C. Restoration and Vision Output Circuits are This Month's Subjects

THEORETICALLY, in order to reproduce frequencies down to and including zero, direct coupling must be used in the video-amplifier, the anode of one valve must be connected directly to the grid of the next without a coupling condenser. This can be done, and is used in D.C. amplifier circuits, but it is not a thing to be attempted by the home constructor. The usual, and by far the simplest, thing to do is to use coupling condensers in the ordinary way, ignoring the D.C. component of the signal until later on, when it can be reinserted by a very simple device.

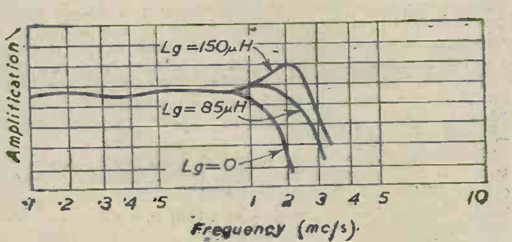


Fig. 14.—These curves show the amplification with various loads.

It is not usual to use more than one video-frequency stage in a receiver; V_7 of Fig. 1 is a typical stage, being fed directly from the anode of the detector. A valve of the power or R.F. pentode type may be used, and the writer has obtained good results with the Cossor 42 SPT and the American 807. Both these valves have a mutual conductance of 11 mA. per volt and were worked with 400 volts on their anodes. Where the H.T. supply is limited to 250 volts (point A in Fig. 1) the Mazda S.P.41 makes a useful video-amplifier, in which case suitable component values are (referring to Fig. 1): R_{10}=2,500Ω, R_{14}=40Ω, C_5=0.1 μF, C_6=0.05 μF and L_9=85 μH. The screen resistance may be 50 ohms.

The action of L_9 in such a typical circuit is no doubt familiar to most readers; an arrangement of this type properly designed will give a more uniform response at high frequencies than is possible with plain resistance coupling. At medium and low frequencies the reactance of L_9 is so small as to be negligible, so that the amplifier characteristics are then the same as for a corresponding resistance-coupled case. At high frequencies, however, the inductance resonates with the stray circuit capacities in such a way that the amplification characteristic is "lifted" beyond its normal range and the useful frequency coverage of the amplifier is considerably extended. In order to obtain a flat response up to some particular frequency, the coupling resistance should equal the reactance of the shunting capacities at this frequency, and the inductance should at this same frequency have a reactance equal to half the coupling resistance.

Taking the experimental case mentioned above, allowing 30 μμF for stray capacities, we have, in order to obtain a flat response up to 2.5 mc/s:

$$\text{Coupling resistance } (R_{10}) = \frac{1}{2\pi fC}$$

$$= \frac{1}{2\pi \times 2.5 \times 10^6 \times 30 \times 10^{-12}} = 2{,}200\Omega$$

And for the reactance of L_9 at this same frequency to equal half of this resistance—1,100Ω—we have:

$$X = 2\pi f L_9$$

$$\therefore L_9 = \frac{1{,}100}{2\pi \times 2.5 \times 10^6} = 72 \ \mu\text{H approx.}$$

In practice these theoretical values may be raised to 2,500Ω and 85 μH respectively for the coupling resistance and the series inductance. With these proportions the amplification is substantially constant up to the desired 2.5 mc/s as shown in Fig. 14. By using other values of coupling components, it is possible to obtain either a rising or a falling characteristic as the figure depicts.

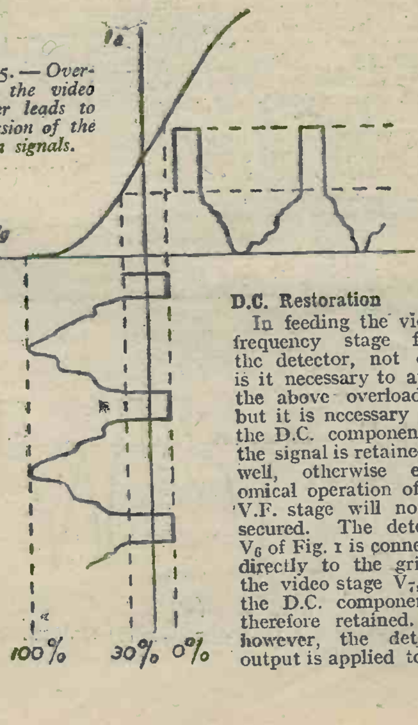
Overloading the Video-amplifier

Overloading the output stage of a sound receiver leads to serious aural distortion; similarly, overloading the video-stage of the vision receiver leads to a peculiar form of picture distortion.

Consider the characteristic $I_a.V_g$ curve of a typical video-amplifier valve as shown in Fig. 15. During the complete excursion of the grid signal swing, the curved foot of the characteristic is swept over by those voltages corresponding to 100 per cent. modulation, or white regions of the picture. As the curve is such that in the area of the bottom bend the I_a change for a given V_g change is less than on the linear portion of the characteristic, the result is a reduction, or "compression," of the signal peaks corresponding to white tones. As a result the image on the screen of the cathode-ray tube loses much of the detail contained in the bright portions.

It is apparent that if the valve curvature is excessive, or the signal input is so large that it sweeps beyond the extremity of the curve into the anode current cut-off region, all detail in the white parts of the picture will disappear.

Fig. 15.—Overloading the video amplifier leads to compression of the vision signals.



D.C. Restoration

In feeding the video-frequency stage from the detector, not only is it necessary to avoid the above overloading, but it is necessary that the D.C. component of the signal is retained as well, otherwise economical operation of the V.F. stage will not be secured. The detector V_6 of Fig. 1 is connected directly to the grid of the video stage V_7, and the D.C. component is therefore retained. If, however, the detector output is applied to the video-amplifier through any form of resistance-capacity coupling, such as is shown in Fig. 16a, the condenser C will remove the D.C. component of the signal and proper working of the video stage will not be obtained.

In order to understand this point consider Fig. 17a, where two typical line signals are shown. These signals correspond roughly to lines consisting of a black line with a bright centre and a bright line with a black centre. The signals are in negative phase, as they would be had they come from the diode detector of Fig. 16a, and the amplitude of signal handled by the video stage

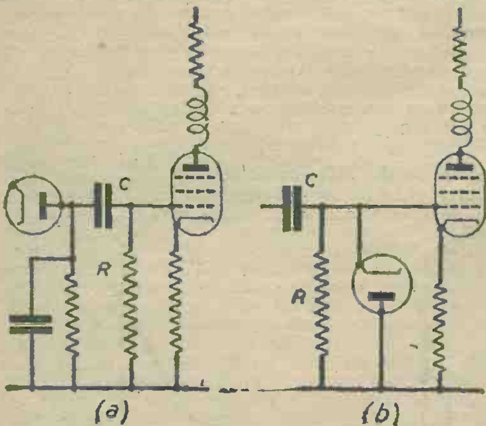


Fig. 16.—A resistance-coupled video stage at (a) with a D.C. restoration diode connected at (b).

is obviously equal to A. These signals have the D.C. component retained.

Now at (b) in Fig. 17 are shown the same two signals with the D.C. component removed. These signals, it will be noticed, have settled down to enclose equal areas on either side of the valve bias line. It is at once apparent that over a complete frame, consisting of many such variable lines, the change in amplitude on the grid of the video stage will be at least equal to A_1, which is considerably greater than A. With the D.C. component removed, therefore, the video stage has to handle a much greater grid swing and economical operation is lost, for a larger valve has to be employed. Again, in order to handle this large grid voltage excursion, the bias point of the valve must be about the centre of the $I_a.V_g$ characteristic as in audio technique.

On the other hand, with the D.C. component retained, the video stage need only be biased (for a negatively phased input) to the point of grid current cut-off; this accounts for the low bias resistance (40Ω) of the video-amplifier of Fig. 1. The signal then only swings the grid more negative and full economical operation of the valve is secured.

Fig. 16B shows a "trick" for reinserting the D.C. component before the video-amplifier if it is removed by a condenser coupling. A small diode is connected across the grid resistance R. This diode fakes in the D.C. component by preventing the signal from settling down to a steady state on either side of the bias line after the fashion of Fig. 17b. This method of D.C. restoration is adopted when the signal is of positive phase and the bias on the video stage is abnormally high, i.e., the valve is biased right back on the characteristic. When the signal is of negative phase—much preferable—a simple method of retaining the D.C. component is to omit the bias resistance of the video stage by taking the cathode directly to the earth line. The grid and cathode of the valve then act as a restoring diode. We shall deal further with D.C. restoration when synchronisation is discussed.

Coupling the Cathode-ray Tube

There are a great variety of ways of feeding the cathode-ray tube with the video signals, a few of which are shown in Fig. 18. Much depends on whether a video-amplifier is used or not, and much upon the type of tube employed. The object is, in any case, to apply the vision signals to the grid of the cathode-ray tube so that the spot is modulated in intensity and the picture tones are impressed upon the saw-tooth scanning motions.

I do not propose to go into the design of cathode-ray tubes at this point as much has been written elsewhere on the subject, but it might be as well to discuss briefly tube characteristics from the point of view of grid modulation on beam intensity. As in ordinary thermionic valves, the grid, or Wehnalt cylinder, of a cathode-ray tube controls the number of electrons passing from the cathode to the screen and therefore controls the intensity of the spot. By increasing the negative potential on the tube grid, a point is reached where the electron stream is completely suppressed and the spot disappears from the screen. For the average television tube some −25 volts is required to cut the beam to zero, though some especially sensitive types cut off with a grid potential as low as −10 volts.

Now, the graph of grid voltage against beam intensity is not linear for any tube; it is curved, as shown in Fig. 19. This means that for equal reductions in the grid voltage, equal reductions in screen brilliance are not obtained; due to the curvature in the characteristic the change in intensity for a given grid-voltage change is less in the dark regions of the image than in the bright regions. This leads to a loss of detail in the dark portions of the picture. The effect is very similar to the loss of detail in the bright portions of the picture brought about by overloading of the video-amplifier. Taken together, these "defects" lead to a very flat reproduction of the transmitted scene. The curvature of the tube characteristic cannot be avoided, of course, and in a reputable make it is not excessively pronounced in any case, but overloading of the video stage can and must be prevented if good picture contrast is to be secured.

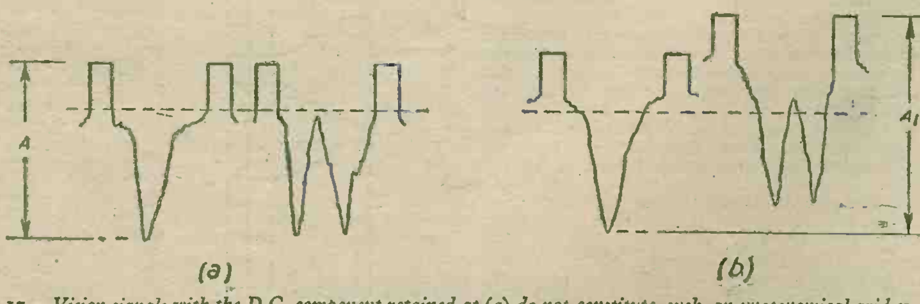


Fig. 17.—Vision signals with the D.C. component retained at (a) do not constitute such an uneconomical grid swing as those with the D.C. component removed as at (b).

Turning to Fig. 18: (a) shows a method of feeding the cathode-ray tube directly from the detector. This method is only adopted when the tube is more than normally sensitive and a fairly large output can be obtained from the detector. The output must be taken from the cathode of the diode so that it is in positive phase and therefore correct to apply to and modulate the cathode beam. Diagram (b) shows a voltage doubling type of diode detector stage, particularly suitable when the tube is being fed without video amplification. The circuit as shown is arranged to give an output in positive phase, suitable circuit values being $C=C_1=10$ $\mu\mu$F, and $R=2{,}000\Omega$.

Fig. 18 (c) shows a video-frequency stage following the detector, the cathode-ray tube being fed directly

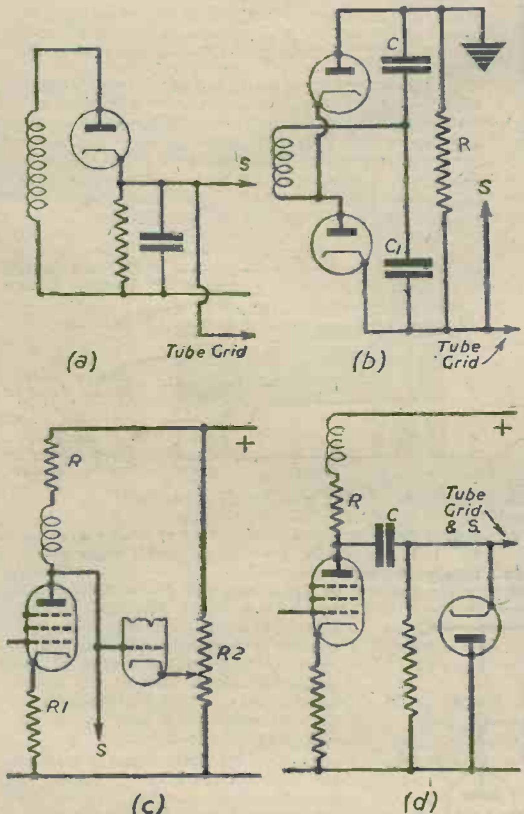


Fig. 18.—Four typical methods of feeding the grid of the cathode-ray tube with the vision signals.

from the anode of the former. This method of feed is quite satisfactory, uses few components, and the D.C. component of the signal is retained throughout. Provided, too, that the input capacitance of the tube is small, the value of R, the video coupling resistance, can be made higher than usual, with a resulting increase in the stage gain. A disadvantage of the system, however, is this: the normal tube bias developed across R_2 is such that the cathode of the tube is some 200 volts above earth, that is, it must be about 30 volts—the usual bias on the tube in the absence of signal modulation—above that present upon the anode of the video-amplifier when no signal is being received. This latter is quite likely to be at least 170 volts, assuming a 250 volt H.T. supply. During normal operation this condition is quite satisfactory, but should the heater of the video-amplifier fail or an open circuit develop in R_1 so that the valve ceases to conduct, the anode will at once rise up to full H.T., thus carrying the grid of the cathode-ray tube some +50 volts above the cathode. Such a condition will almost certainly damage the tube.

On account of this, and several smaller points, it is generally wiser to feed the tube through an ordinary resistance-capacity coupling as shown in Fig. 18(d). The coupling condenser C removes the D.C. component of the signal, of course, and so it becomes necessary to re-insert it immediately afterwards by the dodge of the diode, as shown. This valve rectifies the mean vision modulation to produce a bias equal to the mean carrier amplitude, and so controls the mean illumination of the picture to correspond with the transmission.

The output circuit and tube feed of Fig. 1 is a good typical design of the latter form of circuit. Referring back to Fig. 1 we have the video-amplifier V_7 resistance-capacity coupled to V_9, a triode stage from the cathode of which the tube grid is fed. The diode V_8 is the D.C. restoring valve. The output of the video-amplifier is in positive phase and suitable, therefore, to apply to the tube grid. V_9 is actually a cathode-

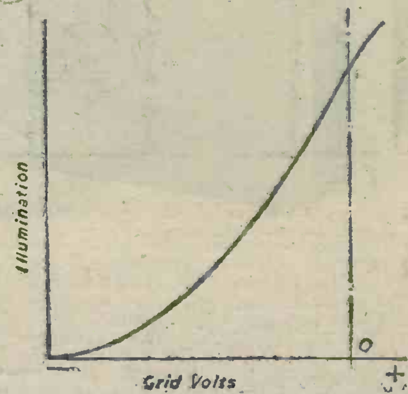


Fig. 19.—Due to non-linearity of the tube grid-brilliance characteristic the picture loses contrast in the dark regions.

follower, outputs being taken from the anode and cathode circuits. The grid input of this valve is in positive phase, as is the cathode output which goes to modulate the grid of the C.R.T., but the anode output is in negative phase. This output goes to the synch separating network, which latter will be described later on.

The tube is normally biased by a preset control, R_{50}, so that the spot is just blacked-out in the absence of a signal; on the application of the positively phased vision signals from the cathode of V_9 to the grid of the tube, the spot is brightened in accordance with the signal amplitude, 100 per cent. giving full brilliance by just overcoming the bias voltage developed across R_{50}. No coupling condenser is used between V_9 and the grid of the tube, so that the D.C. component of the signal is retained and the bias conditions are easily obtained. During the negative synch pulses, which correspond to the spot fly-back period between lines and between frames, the tube grid is carried more negative than the standing cut-off bias already present, and so the spot is completely suppressed during these intervals.

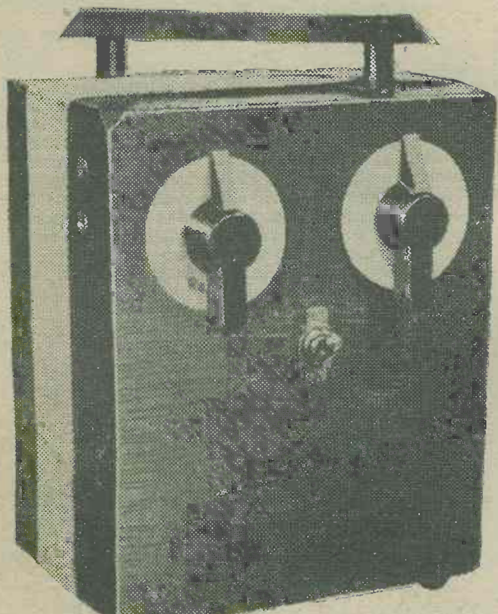
Suitable experimental component values for the circuit of Fig. 1 are: R_{11}, $R_{12}=1\text{M}\Omega$, $R_{13}=10{,}000\Omega$, $C_5=0.1$ μF. V_8 may be an Acorn diode and V_9 a medium-impedance triode such as the Cossor 41 MHF. These values should prove suitable for tubes of average sensitivity, though R_{11} and R_{12} are open to experiment and need not be equal in value.

In all the diagrams of Fig. 18 an output lead is shown marked S; this lead goes to some form or other of synch separator such as will be discussed next month.

Two-valve A

A Neat, Light-weight Recei

By



The Complete Portable.

SOME months ago we gave details of a single valve portable set, the outstanding feature of which was the extremely low H.T. needed to work it.

The original set suffered from a number of drawbacks which may be briefly summarised.

1. The L.T. supply was soon exhausted. This was due to the fact that the L.T. was taken from the grid-bias batteries employed for H.T. In the set which is about to be described it will be appreciated that a separate L.T. supply is provided.

2. The volume was rather limited. This difficulty has been overcome by the addition of a second valve. The increase in size of the new set is not excessive. At the same time such an arrangement results in a set which is much easier to tune and which gives a large increase in the number of stations received.

Circuit

The circuit diagram is given in Fig. 1. It will be seen that the circuit is built around a couple of 1C5GT/G valves. The advantages of using such a valve are these:

1. The 1C5GT/G valve is only $2\frac{3}{4}$in. in length. This helps to keep the set small.

2. Such a valve requires only some 15 volts H.T. and 1.5 volts L.T. in order to function well. The 15 volts H.T. is supplied by two G.B. batteries connected in series, and an arrangement like this will help more than anything else to keep the size of the finished set down to the very minimum. Since two valves are employed, the circuit is so constructed that the L.T. needed is 3 volts, although each valve only needs 1.5 volts.

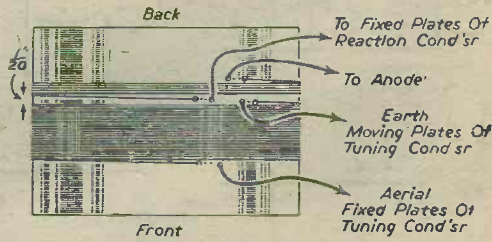


Fig. 3.—Details of the Coil.

The number of parts used still remains small and the cost, even if all the components are bought new, still remains low. Finally, a most important point must be taken into account—namely, that of upkeep. An arrangement such as has been outlined allows one to maintain the set at an extraordinarily low cost, as the following details show:

During its tests this set was worked for three hours a day regularly over a period of four months. At the end of this time the H.T. batteries were as good as new—in fact, it was even found that distortion occurred if the full H.T. voltage i.e., (18v.) was applied. The L.T. battery was changed at three-weekly intervals. The amount of money spent on H.T. and L.T. batteries during this period came to 7s. 1d. or $5\frac{1}{4}$d. per week. This would work out at $\frac{3}{4}$d. per day.

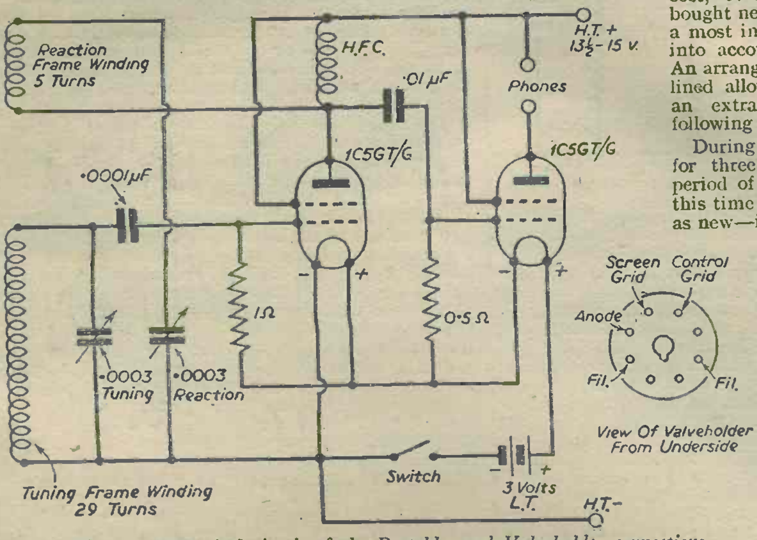


Fig. 1.—Theoretical circuit of the Portable, and Valveholder connections.

Construction

The set is designed to be as light and compact as possible. The components are housed in a wooden cabinet which is made either from 3-ply wood

l-dry Portable

Jsing the Popular I.C.5 Valve.

ASPERS

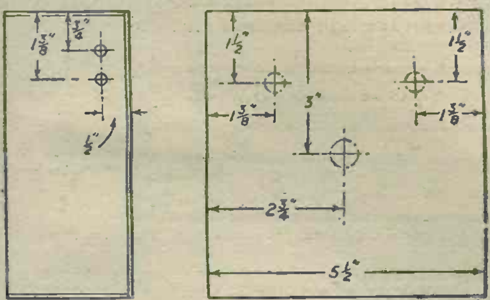
or preferably 3-ply oak, which is somewhat thicker and helps to ensure a better job. The number of pieces of wood and the size of each piece is given in the following table (the figures given are for the 3-ply oak, which is slightly thicker than the ordinary 3-ply.

Top and bottom (5½in. x 3¾in.) : 2 pieces.
Front and back (5½in. x 6½in.) : 2 pieces.
Sides (6⅛in. x 3¾in.) : 2 pieces.

These pieces should then be drilled for holding the switch, condensers and 'phone sockets. The necessary data for this part of the construction is given below.

Fig. 2(a) shows the left-hand side of the set as seen from the front. The holes for the plug sockets are both drilled ½in. back from the front of the set and ¾in. and 1⅜in. down from the top of the set respectively.

The front of the set is shown in Fig. 2(b). Two holes for the tuning and reaction condensers and one for the switch are drilled in this piece of wood. Those for the condensers are drilled 1½in. down from the top of the set and 1⅜in. in from the sides. The switch is fitted into a hole 3in. down from the top of the set and 2¾in. in from the sides.



(a) (b)

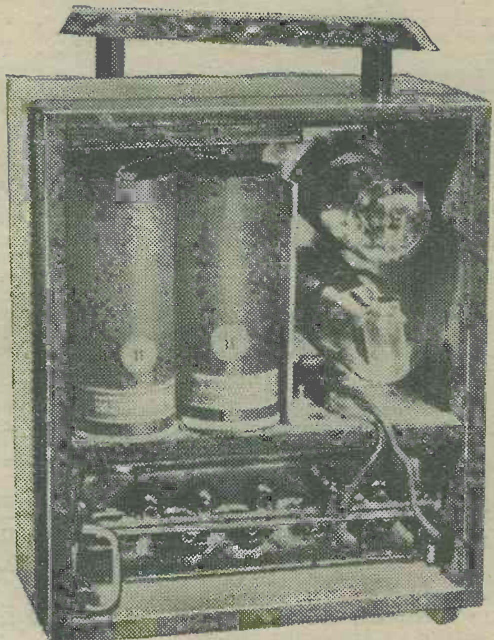
Fig. 2.—Cabinet side and front, with drilling details.

It is quite a good idea to use panel pins for fitting up the case. At this stage only the sides, top and bottom should be joined together. When this is finished it is advisable to make quite sure that there is sufficient room for the G.B. batteries to lie in the set. Assuming that the fit is good a further piece of wood 3¾in. x 5in. is cut to fit above the G.B. batteries. This piece of wood is *not* yet fixed into position with panel pins, for at a later date components have to be screwed into position on it. The front of the set is also left off for the time being so as to facilitate wiring up.

A strip of metal is now cut to fit behind the front of the set. It is then drilled in the appropriate places in order to allow the condenser spindles to pass through, when the variable condensers are fitted into position (i.e., through the holes which have already been drilled in the wood). In this way the metal strip which should measure 4¾in. x 2in. acts as a common earth to both variable condensers.

At this point some mention must be made about the valveholder strip (Fig. 4). This is constructed from aluminium or any other suitable material and should measure (4½in. x 2in.). The strip is then bent along the dotted lines and cut so as to give the result seen in the illustration.

Finally, a holder for a No. 800 battery (L.T. battery), is also constructed from metal. This is shown in Fig. 5.



Inside view of the Portable.

Once this has been done the valveholder strip and the L.T. holder may be mounted on the strip of wood which fits above the G.B. batteries. However, before finally screwing down the valveholder strip it is advisable to screw the two valveholders into position and then insert the valves in order to make quite sure that the valves do not project beyond the back of the set. The upper end of the strip may be secured to a suitable piece of wood which in turn is glued to the top of the set.

The Aerial

The frame aerial is now dealt with. This consists of 29 turns of wire which act as a grid winding, and five

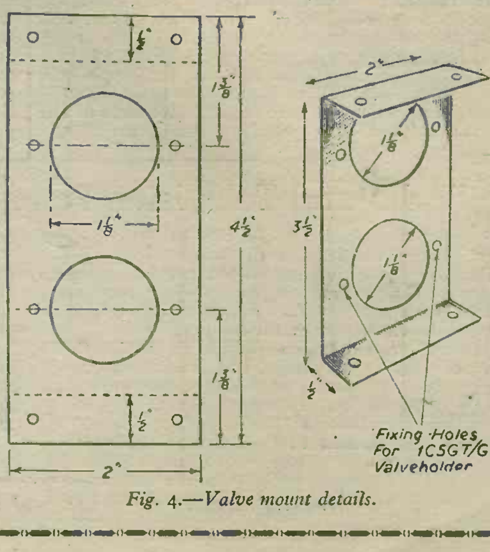


Fig. 4.—Valve mount details.

turns of wire acting as a reaction winding. The turns are wound on the outside of the set as shown in Fig. 3. The wire used is 24 gauge silk-covered. In winding the turns great care is taken to see that the wire is tightly wound on and that the various turns lie adjacent to one another. A gap of 1/20in. is left between the grid and reaction windings. The ends of the frame aerial are soldered to the tags of a terminal strip which is fitted up inside the set. A suitable form of strip can be made by breaking off a small portion of a resistance board.

The components are now wired up. The wiring should be kept as short as possible for this helps to ensure greater all-round efficiency. In addition all joints are soldered and care is taken to make a firm joint. All earth connections may be taken to a single point on the metal plate which fits behind the front panel. The advantages derived by not fitting the front of the set into position until now will be appreciated. In the first place the wiring up of the set will be greatly eased, and in the second the length of wiring between the front panel and the rest of the set can be kept to a minimum.

As a final additional precaution it is advisable to check up all wiring from the circuit diagram and also the direction of the coil windings.

Connecting Up the Batteries

Some mention must now be made concerning the method employed in wiring up the G.B. batteries. It has already been stated that the H.T. is supplied by two G.B. batteries joined in series.

The all-important point to be remembered is that the —9 volts shown on the grid bias battery must be taken as TRUE NEGATIVE. From this it follows that the —7 volts corresponds with 1½ volts positive, —6 volts corresponds to 3 volts positive and so on.

COMPONENT PARTS

- Two .0003 mfd. variable condensers.
- One .0001 mfd. fixed condenser.
- One .01 mfd. condenser
- One 1 megohm grid resistance.
- One half megohm grid resistance.
- One H.F. choke.
- Two 1C5GT/G valves.
- Two valveholders for above valves.
- One Bulgin on-off switch.
- One pair 'phone plugs.

If this point is kept in mind no undue difficulty should arise in the interpretation of the drawing shown (Fig. 6).

Between the H.T.+ and the H.T.— there is a difference of potential of 15 volts, but the set will work quite well on a slightly lower voltage (13½ volts), and if distortion occurs it is advisable to step the voltage down a little.

The L.T. is supplied by a No. 800 battery, which delivers 3 volts. The battery fits into the holder already described, making contact with the negative strip at the side of the battery. The positive terminal at the top of the battery should be allowed to make contact with a strip of metal which then acts as the L.T.+ terminal.

Tuning

The tuning dial is first set approximately to the station it is desired to receive and the reaction control is then advanced until a soft hiss is heard in the 'phones. At this point the set is in its most sensitive condition. The tuning dial is next rotated until the carrier wave of the station is heard. Then the reaction condenser is eased back until the station is rendered intelligible.

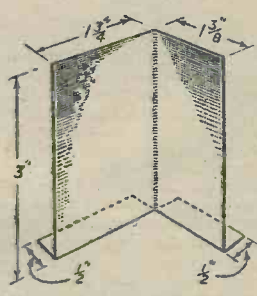


Fig. 5.—Details of the battery compartment.

Should oscillation be erratic—

(a) Check up on all battery connections. Make sure they are firm. Make sure that the L.T. battery is in good contact with the holder.

(b) See that the H.T. voltage is not too high.

(c) Look at the frame aerial. The gap between the grid and reaction coils should not be more than 1/20in.

(d) Finally look at the wiring and make quite sure that all joints are good and firm.

Additional Improvements

There is a danger that the frame aerial might become worn if the set is left in this state after the wiring up is completely finished.

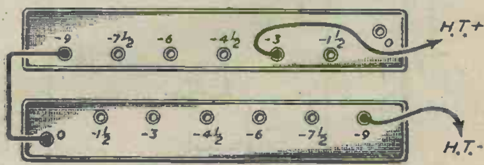


Fig. 6.—Connections for the two grid-bias batteries.

Good results are obtained, and this difficulty is overcome, if some form of webbing is wrapped around the frame aerial. In addition it is found advantageous to raise the whole set off the ground by fixing rubber stops to the base.

Further, it is suggested that the set be polished or stained in some way, and that a handle is added. French polishing will help to preserve the wood if the set is exposed to damp conditions, and will also give a good finish to the completed article. This is especially true if three-ply oak is used, for a really fine effect can be produced.

600 Radio and Television Patents and Inventions Negotiated

THE Philco Corporation in the U.S. has just licensed the Radio Corporation of America to use 600 Philco patents and inventions relating to radio and television receivers and electrical gramophones. This bald statement heralds a move of world-wide importance to the entire radio industry.

The corresponding Philco patent rights in Great Britain are licensed to Airmec, Ltd., manufacturers of Philco radio and television receivers. Airmec is a subsidiary of Radio and Television Trust.

Leading in importance in the inventions covered by the agreement is the new Philco Advanced FM system. This is an entirely new system of frequency modulation detection and it is considered one of the fundamental advances in the radio art. Philco Advanced FM offers the important advantage of greater clarity in reception because it ignores natural and man-made noise and also provides a marked gain in fidelity.

The agreement just concluded between Philco and R.C.A. is the first general patent licence issued by the Philco Corporation. It covers the results of almost 20 years of research and development work in the field of radio and television.

Speaking of the agreement, Mr. J. B. Ballantyne, President of the Philco Corporation, said: "The technical progress in radio, television and electronics in recent years is extraordinarily great, and with our research and engineering facilities increased and strengthened, Philco is desirous of co-operating with others in the radio and television industries to share the fruits of its research. Such co-operation was practised energetically during the war to speed victory, and the new licensing agreement with R.C.A. represents the first translation of that spirit to commercial operations."

New Midget Valves

Details of Some New Valves from U.S.A. and a Midget Receiver Built Round Them

THE heart of the smallest radio receiving set being commercially produced is the post-war development of the valve that made possible the amazing performance of the VT fuse. Details concerning these sub-miniature radio valves, only $1\frac{9}{16}$in. long, have been released by Raytheon Manufacturing Co., Newton, Mass.

The five Raytheon plug-in valves used in the Belmont pocket receiver weigh about a half ounce and occupy less than a cubic inch total volume, yet they perform all the functions of normal size valves found in conventional superheterodyne sets.

Each valve in the series has the same physical dimensions, measuring $1\frac{9}{16}$in. by .400in. by .300in., or approximately the cross-sectional area of an oval cigarette. Yet one of these valves (a converter) has nine active surfaces between the two glass walls which are only ¼in. apart.

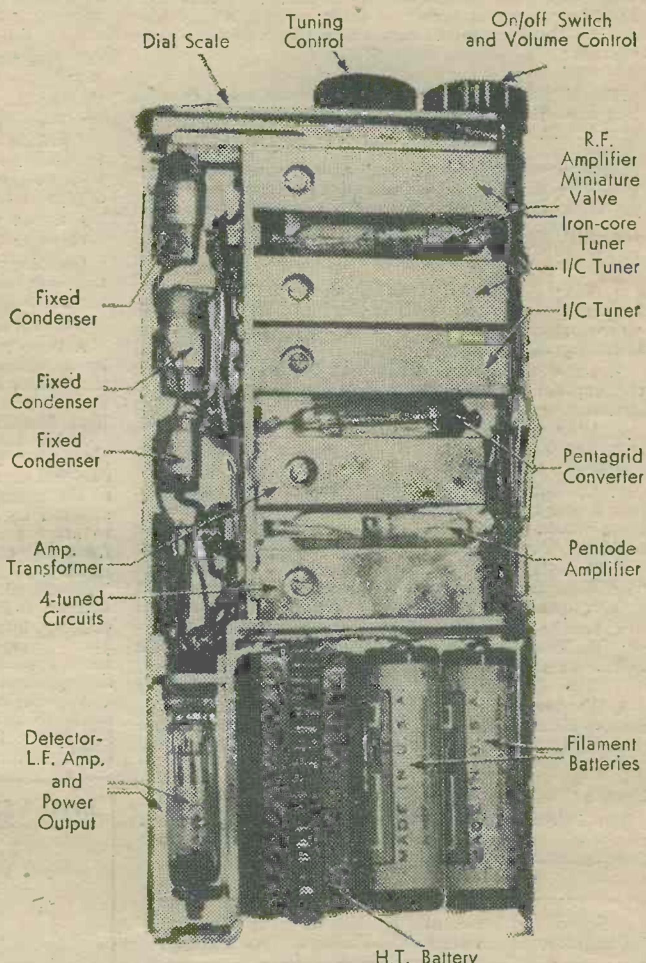
These amazing sub-miniature valves are already finding wide application. As standard receiving valves in the Belmont pocket set, in hearing aids and special medical equipment they are demonstrating their reliability and performance.

Weight of the individual valves varies between .07 and .09 oz., depending upon the type of valve. They may be mounted directly by their leads, which will easily support the valve body, or by using commercially available sockets.

The elements of Raytheon sub-miniature valves, the filaments, grids and plates are all located and held together at top and bottom by very thin pieces of mica which have previously been punched with extremely accurate locating holes. All metal parts are held together by welding. The filament is made from wire, less than a thousandth of an inch in diameter, made by being drawn through fine diamond dies. These valves contain more parts than those used in proximity fuses or hearing aids. About 30 separate parts go to make up one valve. Greatly improved performance will be the immediate benefit to users of equipment requiring small components of this type.

Of the five valves used in the Belmont set, two are radio frequency amplifier pentodes, one is a triode-heptode frequency converter, one a diode-pentode detector amplifier, and the fifth is an output pentode similar to the type used in hearing aids. Two of the valves are actually combinations of two valves in one envelope. All five require less than one-third of a watt to operate and require a miniature H.T. battery of only 22½ volts.

Standard Raytheon sub-miniature valves have long life, require little battery power and operate from low battery voltages. Performance compares in every way with their larger counterparts. Because they are manufactured on automatic machinery these sub-miniature products will find wide application at little increase in cost. Belmont's pocket radio is one of the first examples of their application in things to come.



Interior of the new Belmont Pocket Radio Receiver. This measures 3in. wide, 6¼in. high, and is only ¾in. thick. It weighs 10 ounces with batteries. The complete set may be seen on page 443.

Radio Amateurs' Examinations

Sample Test Paper and Details of the Results in the First Examination

MANY readers are anxious to know what type of questions may be set in the official examinations set by the City and Guilds of London Institute, which must be passed before a G.P.O. Transmitting Licence can be obtained. So far there has only been one of these examinations, when the following paper was set:

Candidates should attempt as many questions as possible. The maximum possible marks for each question are shown in brackets.

1. A 100-ohm resistor and a 300-ohm resistor are joined in parallel and connected to a battery of e.m.f. 7.5 volts and negligible internal resistance—
   (*a*) What is the total current taken from the battery?
   (*b*) What power is dissipated in the 100-ohm resistor? (10 *marks.*)

2. What do you understand by the term "resonance"? If an inductance of 100 μH is connected in parallel with a capacitance of 100 $\mu\mu$F, what is the resonant frequency of the circuit? (10 *marks.*)

3. Draw a diagram of a self-oscillating valve circuit and explain simply its method of functioning. (10 *marks.*)

4. Why are quartz crystals frequently used in radio transmitters? Describe, with diagram, a typical crystal-controlled oscillator. (10 *marks.*)

5. Explain why "standing waves" are undesirable in a feeder system connecting a transmitter to an aerial. How would you detect their presence and minimise them? (10 *marks.*)

6. Describe an "artificial aerial" How can an "artificial aerial" be used to measure the power output of a transmitter? (10 *marks.*)

7. In what ways may a low-power transmitter interfere with radio and television reception? What precautions should be taken to minimise such interference? (20 *marks.*)

8. What are the conditions laid down by the Postmaster-General for the frequency measurement and control of amateur transmissions? (20 *marks.*)

Results

The following general report is given on the papers as a whole and is not necessarily applicable to the work from individual schools.

No. of Candidates	No. of Passes	No. of Failures	Percentage of Failures
182	145	37	22.2

This examination was the first of the series and was arranged at fairly short notice, so that entrants had not much time for preparation. In view of this, the standard of the papers was very satisfactory, 77.8 per cent. of the entrants obtaining a pass. The balance was fairly equally divided between the very poor and the excellent. It is worth recording that, apart from the few candidates whose knowledge obviously was insufficient to enable them to tackle questions, the vast majority found time to attempt all the questions. Comments on the questions individually are as follows:

Question 1 (*a*) was answered well.

Question 1 (*b*).—A number of candidates encountered difficulties here, some of them calculating the total power expenditure, instead of that in the 100-ohms resistor alone.

Question 2.—The term "resonance" was fairly well described and the numerical calculation was well done.

Question 3.—Most candidates could draw the diagram, though the description of how it functioned tended to be confused.

Question 4 was well done, though there was a tendency to stress the high "Q" of the quartz crystal, whereas the principal reason for using it is the high degree of frequency stability.

Question 5 was fairly well done.

Question 6 was quite well done.

Question 7.—A limited number of the students answered this question extremely thoroughly. The majority of the others did it quite well.

Question 8 was also well done.

A large number of students illustrated their answers by excellent diagrams, but a number handicapped themselves by failing to give any diagrams at all.

Next Examination

It has been decided to hold the next examination on November 15th, 1946, from 7 p.m. to 10 p.m. This decision has been reached to satisfy the requirements of the many radio amateurs whose activities have been affected by war conditions and who are now anxious to acquire a transmitting licence. It is intended that from 1947 onwards the examination will be held annually in May.

In accordance with the usual custom, the examination will be held at a number of centres throughout the country, and intending candidates should apply to their local technical colleges. The Institute's examination fee is 10s., and examination centres may charge a small accommodation fee in addition.

Applications for entry to the examination should be made to examination centres not later than October 8th, 1946. In view of the fact that a further examination will be held in May, 1947, no late entries can be accepted.

Practical Hints

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay half-a-guinea for every hint published on this page. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints."

SPECIAL NOTICE

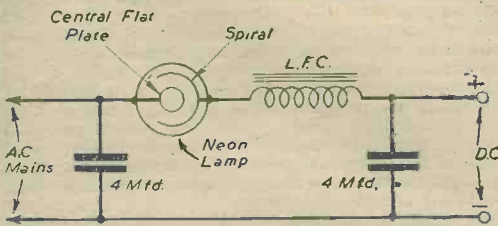
All hints must be accompanied by the coupon cut from page iii of cover.

Using a Neon Lamp as a Small Rectifier

IT is possible to use the normal "beehive" neon lamp as a small H.T. rectifier when "doctored" in a certain way, and here is how it is done. First of all soak the base of the bulb in methylated spirits for three to four hours, to loosen the cement which holds the base to the bulb, and then hold a soldering iron across the two contacts and pull the bulb away from the base. Inside will be found a small resistance in series with one of the leads, remove this and join a piece of wire, to make up for lost length, in its place.

Then solder the two wires to the contacts again, and cement up the bulb. It is now ready for use.

Here is the theoretical diagram to illustrate the method of connecting up.



Mr. Allonby's rectifier circuit

The spiral element of the neon lamp is the positive D.C. connection, and the central flat plate is connected to the mains. The output is only small, being about 35-40 v. at about 1 mA., but sufficient power to provide for a midget one-valve set or oscillator.

The L.F. choke may conveniently take the form of the primary of an old L.F. transformer.

In the event of any short circuit, the most that can happen is that the lamp will light up, or possibly become damaged. Care should, of course, be taken to ensure that this does not happen.

A mains switch and fuse were incorporated in the original, in case the 4 mfd. condenser on the mains side of the rectifier broke down, but these are, of course, optional.—G. ALLONBY (Windermere).

Novel Test Prod

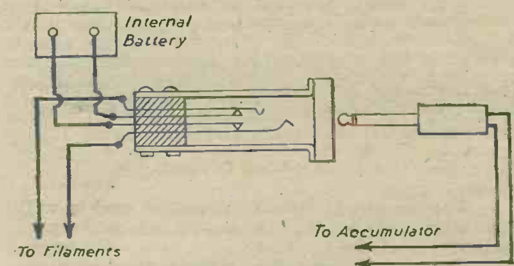
I HAVE found this general purpose test prod to be very useful. Valve pins can be fitted with crocodile clips, to fasten to coil terminals, etc. The idea may interest readers who, like myself, are physically handicapped. I have only one hand, but I still manage to make my own coils, chokes, continuity test gear, etc.—J. H. HATFIELD (Perivale).

A novel test prod made from an old fountain-pen or pencil.

L.T. Switching

WHEN building a short-wave receiver, requiring it to be battery driven and also easily portable, I decided to use a dry battery for the L.T. supply. However, in order to save this battery when operating the set indoors, I evolved the following easy method of changing from the dry battery to the accumulator and vice versa.

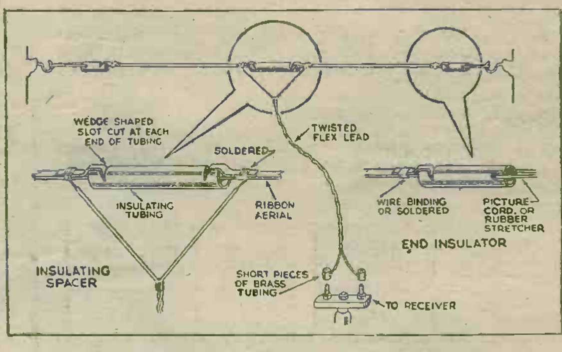
A circuit break-in type of jack is fitted to the case, and wired in the manner as shown in the diagram. All that is necessary to do when changing is to connect a jack-plug to the accumulator and then simply push this into the jack. This automatically cuts out the internal dry battery.—H. J. B. DAY (S.W.20).



An improvised switching arrangement.

Simply Constructed Indoor Aerial Insulators

FOR those amateurs experimenting at this time on the ultra-short-wave bands, the sketches show simple and quickly made aerial insulators for indoor aerials of the doublet type, using ribbon aerial. The tubing used may be of any good insulating material, and are simply cut to half their diameter with wedge-shaped slots. Through these the ribbon is passed, turned back, and bound by copper wire, which is finally soldered. The end insulators are drilled with holes, as shown, for cord or rubber stretchers, the latter material, if obtainable, being useful to keep the aerial taut.



Simply-made indoor aerial insulators.

The simple method shown of connecting twin lead to the receiver via a commercial type of pedestal insulator, may be found useful where the sockets themselves are needed for experimental connections.—R. L. GRAPER (Chelmsford).

High Fidelity Electrogram de Luxe

Advance Details of a New Type of Gramophone Record Reproducer

IN sound reproduction the term "high fidelity" has been applied to conditions in which the entire range of frequencies existing in the original performance are present in the reproduction, and the changes in amplitude of these frequencies are at all times exactly the same in reproduction as in the original sound.

It is not, however, always appreciated that other factors than a mere response, quantitatively as well as qualitatively, to the frequencies existing in a sustained note are of importance in obtaining realistic reproduction. It is a technical fact that a good deal of the special quality associated with particular instruments depends on the initial pulses of sound which they give out at the instant at which a new note is sounding. These pulses are known as transients, and it by no means follows that instruments which are capable of reproducing all the frequencies comprised in a steady note are able to reproduce the very complex starting and stopping transients which may exist. These transients are particularly important in the case of instruments of a percussion type, among which must be classed the piano, and also in a complex organisation such as a large orchestra.

Separate Units

In "His Master's Voice" Electrogram de Luxe, not only has great attention been paid to the full range of frequency coverage of steady notes from 30 to 12,000 cycles per second, but elaborate precautions have been taken to ensure high fidelity to transient response. This has been achieved by designing a complex chain for the reproduction, from pick-up to loudspeaker. A new pick-up is employed (Model 15) of the ordinary electromagnetic type with a very large gap, light needle-pressure and very low inertia. Most of the drawbacks of the early type electro-magnetic pick-up are overcome, although naturally the output is reduced considerably. The amplifier takes care of this and is designed on liberal lines with two KT66's in push-pull in the output stage. Negative feedback is included, and the output is then taken to the speaker network.

All the above equipment, plus a new type record changer is included in a single cabinet, with four controls, their functions being—filter control consisting of an 8-way rotary switch provided for variable top cut and filtering of surface noise; bass balance control which is in two stages, the first giving pre-set bass lift and the second giving variable bass balance. The remaining controls are the main switch and volume control.

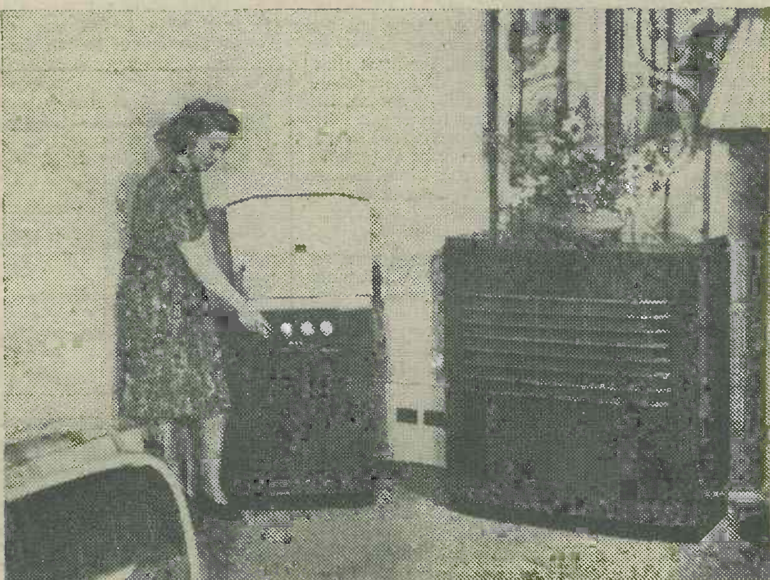
Push-buttons beneath the main controls operate the automatic record changer and are "Off," "Auto," and "Manual." Similar push-buttons are provided inside the amplifier cabinet.

The record changer is of a new design which incorporates many improvements on previous models.

Speaker Design

The loudspeaker is of a complex nature, consisting of a well-built cabinet somewhat larger than the ordinary type of radiogram cabinet, in which are three speakers. Two of these are of the elliptical cone moving-coil type for reproduction of the bass, and from about 3,000 cycles upwards a new-type speaker takes care of reproduction. This consists of a ribbon (very similar to the ribbon-type microphone) suspended at the mouth of an exponential metal horn. By this means the higher frequencies are radiated over an arc in front of the cabinet, instead of being directed in a more or less thin cone as with the ordinary type of speaker. The cabinet housing these three speakers is packed with glass wool to kill resonances, and a multi-cable connects the two cabinets together.

The results are certainly a revelation. At a demonstration which we recently attended various records were played, including some special test records designed entirely for "test sound" effects. Transients were produced perfectly, and even a 1937 record of the organ was reproduced with a degree of realism which we have not heard before.



The new Electrogram in typical room setting, showing the "player" unit opened to reveal the interior lighting effect for ease of placing the pick-up on the record.

Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

THE high spots of the post-war television programmes up to now have undoubtedly been the "actuality" transmissions of topical and historical events. These outside television broadcasts have been well selected, the commentaries first class and the technical results, on the whole, very good. But, in my opinion, the principal factor which has led to their overwhelming success has been their psychological effect on the viewer, who has enjoyed that exhilarating sense of being "present" at each of the events. All viewers have experienced this phenomenon and have remarked upon its absence when watching a televised film of the same event, or of seeing a news reel of it at the cinema.

Mass Emotion

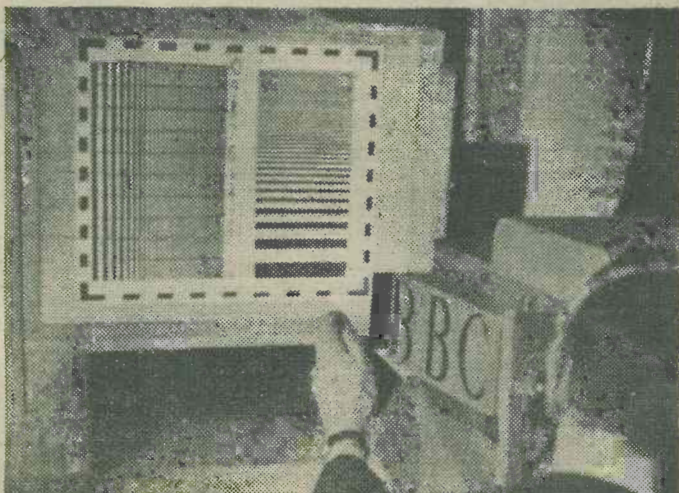
The very success of these outside television broadcasts must be something of an embarrassment to the programme designers at the Alexandra Palace. They tend to throw the programmes out of balance, not only by their vitality, but also owing to the fact that the best of them are usually only available during the daylight hours, for the afternoon transmissions. Here is something the cinema cannot give. The event itself may or may not be of particular interest to every viewer, but the mass reaction of the spectators or audience is most vividly conveyed via ether, especially with certain commentators. But the producer is a most important man, too. Unseen and unheard, he is the man in control of the transmission, and on his judgment depends the editing of the transmission while it is actually going on, the fading from one television camera to another for long shots and close ups, and the "mixing" of sound, commentary, audience reaction and music. With films, this editing of sound and picture is the craft of technicians of the most patient type, who are able to build up a dramatic situation or a topical event with all the laborious care that is required by a jig-saw puzzle, a crossword, or the writing of a prayer within the area of a threepenny bit. The television producer or editor, however, must be a man capable of instant decisions, whose artistic flair and dramatic sense (born, no doubt, from hard experience) enable him to anticipate all unrehearsed situations so that he can "put them over" with all the smoothness of a well directed and well edited film. These super-men will in time be the unseen stars of television, the equivalents of composite Sydney Box - Compton Bennett-Jack Harris-es of the film production world. May the television producers' pay packets never grow less!

The Theatre and Television

Theatrical, variety and film managements continue to be unhelpful to the television service—with a few notable exceptions. Curiously enough, one of the principal "opponents" is the great Stoll Theatres Corporation, presided over by Prince Littler, one of the most enterprising and progressive figures in the entertainment world. This is a complete change of policy as compared with before the war, when the late Sir Oswald Stoll co-operated with the B.B.C. by allowing the televising of several shows from the London Coliseum. Sir Oswald was interested in television and presented one or two of the earliest demonstrations of Baird television experiments in the form of a variety turn on the stage of the great theatre. His son, Dennis, with Leigh Henry, also produced in 1935 a revue called "Televariety," an odd mixture of variety turns, sketches and ballet, presented within the framework of a scenic artiste's idea of a huge television screen of the future, complete with microphone announcements and commentary. Ballet was the principal feature of the show, however, and with such names as Lydia Sokolova, Harold Turner, Maude Lloyd and Stanislas Idzikowski creating new ballets especially for the production, it seems strange to recall that it was a commercial failure. But that was before the West End theatre-going public caught the ballet fever. Sir Oswald Stoll was presented by his staff with a luxury model television-radiogram in 1938, and was a keen viewer at his home in Putney until television ceased at the outbreak of war. And now, the Stoll organisation says "No!" to television; but I feel sure that when Mr. Littler produces a show which he considers particularly suitable for television, he will grasp the opportunity of making use of the publicity thus provided. Personally, I feel that his present Coliseum show, "The Night and the Music," comes within this category! Any television viewer seeing a few excerpts from this production, especially of the wonderful spectacular scenes and ensembles, would put the name of the show down on his "Must See!" list.

The Cost of Television Programmes

It is no secret that the cost of putting on television programmes is far, far higher than the "old-fashioned" sound radio programmes. Settings, lights, technicians, stage hands and a large outlay in technical plant all add up to a huge figure, without taking into account additional rehearsal time which is really necessary (but rarely achieved at present). The costs of making films in cinema studios is high—far higher than before the war, and I expect that the costs at the Alexandra Palace studios have risen in like manner. But at some film studios the making of a film is retarded by temperamental directors, ca-canny shop stewards and



A B.B.C. television engineer focusing a special Test Chart, designed to reveal faults in any part of the complete television network.

general lack of co-operation to such an extent that a film which would take 36 days to make in Hollywood requires about 100 days here! All British studios are not afflicted with this peculiar disease, which, I am told, is one of the by-products of the operation of E.P.T. coupled with the control of labour. The managements tended to think "What does the cost matter—the profits will be taxed away in any case"; the workers tended to think "What's the hurry? They can't sack me, anyway!" Fortunately, the disease hasn't yet reached the Alexandra Palace.

Sponsored Television Programmes

It will be a difficult job keeping up a really high standard of programmes unless the studio space at the Alexandra Palace is considerably extended and there is a much larger allocation of money for artistes and scripts, not to mention additional equipment. I feel that the solution to the problem would be to allow the B.B.C. to televise sponsored programmes on two or three evenings each week. I do not advocate blatant advertising programmes with the names of pills or soap being thrust down one's dipole every few minutes! But the televising of stage plays from West-end theatres, which already occurs all too infrequently, can be considered to be in the "sponsored" list, and nobody objects to this—excepting some of the theatrical managers. But with one or two rival "sponsored" programme teams at work, enterprise would be encouraged and the art of television production would progress, to the gratification of all who subscribe their annual £2 for a licence.

Long-distance Television

Happening to be in the Torquay neighbourhood a week or so ago, I took the opportunity of calling upon Mr. Swaine, of Babbacombe, who was reputed to have received television sound and picture at his home. I walked down his road, scanning the horizon for signs of an elaborate aerial array, with multitudes of directors, reflectors and so forth, on the lines of the Daventry stations. To my surprise, there was a house with an ordinary dipole and reflector fastened to one of the chimneys, and this was the house of Mr. Swaine. Watching his set, which was a standard Pye, I was surprised to see a picture which was quite good. Occasionally, sound or picture faded down and back again, and it was rather disconcerting that the fading on the picture usually occurred at a different time from the fading of the sound. When such fading was in progress, interference troubles were experienced, particularly from something which might have emanated from diathermic apparatus, and radar from an aeroplane was also picked up. This was to be expected when receiving television at a distance of over 200 miles. Nevertheless, there were long periods during which the television image was excellent, and I couldn't help wondering what the results would be like with better and higher aerials at both receiving and transmitting ends. If the Alexandra Palace aerial was raised another two or three hundred feet, it would solve a lot of problems. Still, that might happen yet, *if* the great Exhibition of Industry is held at the Alexandra Palace, and *if* they decide to build a London edition of the Eiffel Tower there.

New Books

THE CATHODE-RAY TUBE HANDBOOK. By S. K. Lewer, B.Sc., Executive Vice-President of the Incorporated Radio Society of Great Britain. 100 pp., 35 illustrations. Price 6s. Published by Pitman.

THE object of this little book is to explain fully and clearly the function of the C.-R. tube and its application in modern equipment. There are eight chapters dealing with Picture-Drawing by Electronics, Electrons and Electric Currents, Construction of the C.-R. Tube, The C.-R. Tube and its Circuit Connections, Valve Amplifiers and Thyratons, The Linear Time-base, The Complete Oscillograph and the Oscillograph at Work. The illustrations show, in addition to theoretical circuits, examples of modern commercial equipment, and the book is very well written and free from complicated mathematical formulæ.

BASIC MATHEMATICS FOR RADIO STUDENTS. By F. M. Colebrook, B.Sc., D.I.C., A.C.G.I., of the Radio Division, National Physical Laboratory. Foreword by Professor G. W. O. Howe, D.Sc., M.I.E.E., of Glasgow University. 270 pp., 77 illustrations. Price 10s. 6d. Published by Iliffe & Sons, Ltd.

IN mathematics, as in many other activities, it is the first step that counts, and in this book the author has selected in each branch of the subject those elementary but fundamental ideas which years of experience have shown to be definitely necessary or specially useful.

Although written primarily for radio-engineers, the book is suited to students—and perhaps even to some teachers—of other subjects.

The first six of the seven chapters into which the book is divided are quite general, and it is only in the final chapter that mathematics are applied to radio problems, and even these are largely of a general character that will interest students of any branch of engineering or physics. The author has tried at each stage to link up basic mathematical ideas with the real world of sensory experience.

Chapter contents include: Elementary Algebra: The Fundamental Ideas—Indices and Logarithms—Equations: Complex Numbers—Continuity: Limits: Series—Geometry and Trigonometry—The Differential and Integral Calculus—The Application of Mathematical Ideas to Radio. Each section contains examples and the answers appear at the end of the book.

B.S.R.A. BULLETIN

THE current issue of the Bulletin of the British Sound Recording Association has recently been published, and is an enlarged 21-page number. Its contents include the first part of a glossary of disc-recording terms, selected answers from the queries dealt with by the Information Bureau, and personal news of members concerned with recording, either as a hobby or profession.

The Association hopes to arrange an exhibition of sound-recording equipment in London in the autumn. A new leaflet, giving details of the revised membership fees and the activities of the organisation can be obtained from the Technical Secretary, D. W. Aldous, British Sound Recording Association, BCM/BSRA, London, W.C.1.

Frequency Modulation—2

This Month C. A. QUARRINGTON Discusses the Effects of F.M. on Quality Reproduction

TO complete the sideband picture discussed last month it is necessary to take into account two factors:

(a) Sidebands due to low modulation frequency produce a series of sidebands at relatively small frequency intervals from the carrier, but retain a relatively high amplitude as they recede from the unmodulated carrier frequency.

(b) Sidebands due to high modulation frequency produce a series of sidebands at relatively large frequency intervals from the carrier, but quickly lose amplitude as they recede from the unmodulated carrier frequency. For normal purposes any sidebands less in amplitude than 1 per cent. of the unmodulated carrier can be disregarded.

As a postcript to the above analysis of the frequency modulated waveform it will perhaps be advantageous to make one further observation for the benefit of those readers who take an above-average interest in the mathematical side of radio. Such readers may, after reading the foregoing, have some difficulty in appreciating how the vector sum of this complex sideband array can possibly combine with the carrier so that a constant amplitude is maintained, a condition which is, of course, vital to the success of the system. The clue to this problem lies in the fact that the polarity of odd-numbered sidebands is opposite to the polarity of even-numbered sidebands.

Noise/Signal Ratio

The advantages and disadvantages of frequency modulation are often drawn up and expressed in a form quite devoid of details of arbitrary values on which quoted figures are based and often without proper reference to the fundamental principles on which certain advantages depend. Loose phraseology when comparing the advantages and disadvantages of principles sometimes give the impression that the advantages are inherent; while this is sometimes true, it is not the case with frequency modulation.

The practical advantages of frequency modulation are obtained by taking advantage of opportunities which the system offers. For example, the great increase of signal-to-noise ratio which is the main advantage of the system is achieved partly by an inherent peculiarity of the system, but also by increasing the bandwidth employed. Under given reasonable conditions, it is possible for frequency modulation to give a signal-to-noise ratio superior to amplitude modulation, by more than 375 : 1 or, if a further consideration is taken into account, which is to some extent economic in character, this increase is doubled.

The increase of signal-to-noise ratio of 375 : 1 is not achieved entirely by inherent physical advantages but by three separate factors, only one of which, the smallest, is inherent in the system; the second is obtained by taking advantage of an opportunity, and the third by what virtually amounts to a trick. It is desirable, to expand this philosophy a little further and to examine the several factors which contribute to the increased signal-to-noise ratio, and to record the extent to which each contributes to the overall gain. Before doing so, however, it is necessary to make some reference to the "Limiter" stage, even though a full description of this device must necessarily appear in a later article.

The second detector in a frequency modulated superhet receiver is replaced by an amplitude limiter and a frequency amplitude converter. The purpose of the latter device is to convert the frequency modulated carrier into amplitude modulation in order that the original broadcast material can stimulate the human ear by means of a loudspeaker and ancillary equipment. Immediately before the converter is placed the amplitude limiter, the sole purpose of which is to prevent any amplitude modulation, however caused, from reaching the frequency amplitude converter. This, at first sight, would seem to effect a 100 per cent. noise elimination, provided, of course, that the wanted signal was powerful enough to operate the limiter effectively; unfortunately, however, this state of perfection is not realised, since the presence of amplitude modulation (of which noise is almost entirely composed) causes phase modulation which exhibits certain of the characteristics of frequency modulation.

Effects of the Limiter

It is not considered desirable to enter into a mathematical analysis of the wave-form that appears in the limiter anode, since it will be more advantageous to take the strictly practical viewpoint and summarise the effect of the limiter which in its most popular form is a high-slope short grid-base pentode valve biased by the incoming signal and working with very low anode and screen voltage. An incoming signal of adequate strength biases the valve in a manner corresponding as nearly as possible to the amplitude modulation shape of the incoming signal; the low screen and anode voltage causes the valve to saturate easily, and if correctly designed the gain will be inversely proportional to grid bias, and output will remain at a constant level for any input above a certain minimum level. Amplitude variation, although suppressed by the limiter, causes phase modulation which has the effect of introducing a percentage of noise in a form that amounts to fre-quency modulation, depending on carrier deviation; assuming that such deviation is equal to an audio frequency range of 15 kc/s, the tentative standard, the increase of signal-to-noise ratio over an amplitude modulated receiver working under equivalent conditions is roughly 3 : 1. Certain forms of noise, such as the impulse noise caused by automobile ignition, results in a condition whereby

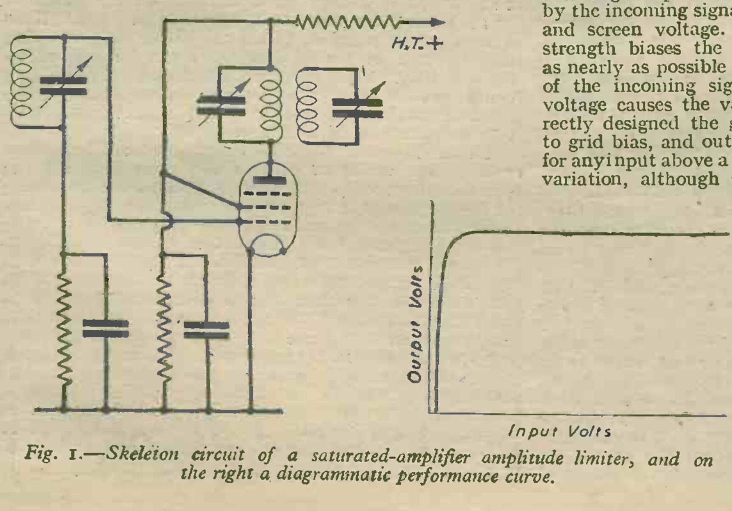


Fig. 1.—Skeleton circuit of a saturated-amplifier amplitude limiter, and on the right a diagrammatic performance curve.

a signal-to-noise ratio gain, substantially better than 3 : 1, is obtained; clearly, this factor is of a special significance where television is concerned, and furthermore, impulse noise will normally form a significant part of total noise. It follows, therefore, that in normal conditions the above quoted figure of 3 : 1 may be conservative.

It is not necessary or even desirable to confine the carrier deviation to the maximum audio frequency to be modulated; clearly, then, noise can be further increased by increasing carrier deviation, so that deviation due to noise is rendered proportionately less significant. The tentative standard for frequency modulation in this country is a maximum audio modulating frequency of 15 kc/s, and maximum carrier deviation (i.e., caused by the expression of both audio frequency and volume) of 75 kc/s. This, as explained in the previous article, gives a deviation ratio of 5 : 1, which in turn gives an increase in signal-to-noise ratio of 25 : 1. It will be recalled that the gain due to the action of the limiter valve was 3 : 1, while the second factor, the use of a high deviation ratio, gives an increase of 25 : 1. Combining these two gains, a total gain is achieved in signal-to-noise ratio of 75 : 1. On reflection, it may appear that the gain obtained from increasing the bandwidth will to some extent be offset by permitting additional sidebands due to noise; while this is in fact the case, it has no practical significance, since such additional noise interference will be outside the range of audible frequency providing that the carrier amplitude is greater than noise amplitude.

The Third Way

It was suggested in an earlier paragraph that the increase of signal-to-noise ratio obtained by frequency modulation was achieved in three ways. By an inherent advantage of the system, the action of the limiter valve; by taking advantage of the opportunity to increase the bandwidth; and thirdly, by means of a trick. The first two ways have already been described in detail. The third way, is by emphasising the high notes of the audio-frequency band at the transmitter, and effecting a corresponding high-note attenuation at the receiver; this procedure is called pre-emphasis and de-emphasis, at the transmitter and receiver, respectively. The higher audio frequencies of even the very best quality reproduction are low in amplitude, compared with the middle and lower frequencies, and it is the higher end of the audio frequency range where the bulk of unwanted noise is present. It is, therefore, quite a simple matter to give a rising audio frequency characteristic to the transmitter, and equally simple to bring about a corresponding falling off at the receiver. Providing that the rise at the transmitter and the fall at the receiver is equal, no loss of quality will result, but the falling characteristic of the receiver will bring about a corresponding reduction in noise. Clearly, the gain in signal-to-noise ratio obtained in this manner will vary with the type of noise experienced and the extent of pre-emphasis used at the transmitter which will be inversely imitated in the receiver; a gain of 5 : 1 is, however, easily obtainable. By combining this gain with that due to the limiter valve (3 : 1) and the use of deviation ratio of 5 : 1 (giving a signal to noise gain of 25 : 1) the resulting total is $3 \times 25 \times 5 = 375 : 1$.

The use of a bandwidth five times greater than the highest audio frequency to be transmitted may seem somewhat reckless when it is increasingly difficult to find frequency space for the innumerable radio stations that desire to operate. It is necessary, therefore, to compare frequency and amplitude modulation from this particular standpoint. It will be recalled that when two amplitude modulated transmitters are working on adjacent frequencies, interference in the form of an audible note, or heterodyne will result if the separation between the two carrier frequencies is not greater than the limits of audio frequency; such interference will, of course, depend in volume on the selectivity characteristic of the receiver and the relative power of the two stations. As a rough guide, it may be said that the wanted station must be greater in amplitude than the unwanted by at least 10 : 1 for comfortable enjoyment of the spoken word, while for the enjoyment of music this figure must be perhaps five times greater. Even if the carrier frequencies of amplitude modulated transmitters are spaced sufficiently far apart to prevent a continuous whistle being introduced, interference will still be present due to the sidebands of the unwanted transmission inter-acting with the wanted carrier; such interference is colloquially called "monkey-chatter," and will be all too familiar to the reader.

Station Separation

Attention can now be turned to the behaviour of frequency modulated transmitters working on adjacent frequencies. It is first of all necessary to become acquainted with two facts. The interference arising

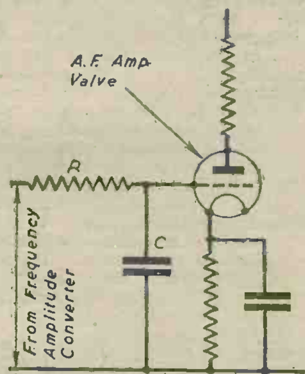


Fig. 2.—De-emphasis can be accomplished by a single top-cut filter, R and C.

between two frequency modulated transmitters brings about interference that is (a) equal in frequency to the carrier frequency separation, and (b) directly proportional in *amplitude* to the carrier frequency separation; (b) is most significant since it means that the closer are the carrier frequencies to each other, the smaller will be the amplitude of the resulting interference; in practice, however, mutual interference reaches the maximum nuisance value when the carrier frequencies are spaced by about 5 Kc/s, and even at this critical separation, interference begins to be tolerable when listening to the spoken word, as the amplitude ratio of wanted to unwanted transmitter becomes better than 2 : 1, which is a very great advance on the figure of 10 : 1 quoted for amplitude modulation. Both these figures can be regarded as the minimum ratio at which an exchange of the spoken word can be carried on conveniently. To summarise, for an equivalent set of conditions the interference area of an amplitude-modulated transmitter, is greater than the interference area of a frequency-modulated transmitter.

There is one further advantage of frequency modulation, which in effect still further increases the signal-to-noise ratio but as intimated at the beginning of this article, it is to some extent more economic than technical in character. The power amplifier of a transmitter using amplitude modulation should be designed to permit 100 per cent. modulation, which means that the D.C. supply must be double that required when the carrier is unmodulated; since the amplitude of a frequency modulated carrier is constant, it follows that amplitude for amplitude the power amplifier will only require half the D.C. supply which means that for a given strength at the receiver, under given conditions, the input power for the frequency modulated transmitter is half that required for a similar amplitude-modulated installation. From the economic point of view, this advantage is enormous; not of course,

(*Continued on page 482*)

The "Fluxite Quins" at Work

"We'll finish this job before tea,
Thanks to FLUXITE and solder and ME!
Lift me up just a spot,
Just a bit, not a lot . . .
NOT TEN FEET! HEY, STOP IT!"
bawled EE.

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

Ask to see the **FLUXITE POCKET BLOW LAMP**, price 2/6.

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—but IMPORTANT.

The FLUXITE GUN puts FLUXITE where you want it by a simple pressure. Price 1/6, or filled, 2/6.

ALL MECHANICS *WILL* HAVE

FLUXITE

IT SIMPLIFIES *ALL* SOLDERING

Write for Book on the ART OF "SOFT" SOLDERING and for Leaflets on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE, also on "WIPED JOINTS." Price 1d. EACH.

FLUXITE LTD. (DEPT. W.P.), BERMONDSEY ST., S.E.1.

PRATTS RADIO

1070 Harrow Road, LONDON, N.W.10

(Nr. SCRUBS LANE)
Phone: LADbroke 1734.

FOR THE SUPERHET CONSTRUCTOR Weymouth 3-Wave Coil Packs, 38/6 each. L. M. & S. Wave Coils, A & Osc., 465 K/cs., 12/6 per set. Wearite P Coils in Stock. Standard I.F. Transfrs., 15/- pair. Wearite Midget Iron Cored I.F.'s, 21/- pair (all 465 Kc/s.). Padding Condensers, 50/500 pf. or 50/250 pf., 1/8 each. Trimmers, 5/50 pf., 9d. each. Diagrams with all Coils we supply. 4 Pole 3-Way W/C Switches, 3/6 each.

FOR THE T.R.F. CONSTRUCTOR L. & M.W. Coils with Reaction, 9/- pair. M.W. Coils, 5/6 pair. Midget 2 pole 2 way W/C Switches, 3/- each. Dials, 2/- each. Set of 3 S.W. Coils, 12-80 metres, 9/-. Dual Range Coil with Reaction, 4/6.

L.F. COMPONENTS Speakers, P.M. L/Tr., 2½in. 24/-. 3½in. 28/6. 5in., 21/-. 8in., 22/6. P.M. W/Tr., 10in., 37/6. Speaker Transfs., Midget or Standard Pen, 5/9. Universal, 6/-. Multi-ratio, 7/6. 30 Watt Multi-ratio, 19/6 each. Phone Jacks, 4/6. Volume Con. L/sw., 3/3. With Sw., 5/-. Class B Driver Trans., 7/6 each.

POWER UNIT COMPONENTS Mains Transfrs., 350-0-350, 4v., 4v. or 5v., 6.3v. C.T., 24/- ea. L.F. Chokes, Midget 360 ohm., 5/9. 380 ohm 20 hy. 60 m/a, 6/9. Linecord .3 amp. 2 Way 7d. ft., 3 Way, 8d. per ft. Voltage Droppers, .2 amp., 4/9; .3 amp., 5/-, with ft., etc. Electrolytic Con., 8 mfd., 3/9; 8 x 8 mfd., 5/6; 16 x 8 mfd., 6/6; 16 mfd., 5/-; 4 mfd., 3/-. (All 450v.).

MISCELLANEOUS Valve Bases 7d. each. Amphenol, 9d. Bias Con., 25 mfd. 25v., 1/9; 50 mfd. 12v., 2/3; 50 mfd. 50v., 3/-.

VALVES. Large Selection inc. 14F6, 25A6, 6A7, 6J7, 6K7, 25Z4, U31, 1C5, 1H5, 1N5, 77, 78, PX4, PX25, 6K8, 6A8, 25Z5, 25Y5G. S.A.E. for List or Enquiries. Orders over 15/- Post Free. C.W.O. or C.O.D. Buses 662, 664, 18B Pass Door. Open 10-6.

NEW UNUSED GOODS ONLY.

E. POWELL OFFERS YOU MORE BARGAINS

All new goods

ELECTROLYTICS.—8 mfd. 500 v. dry cans with fixing base 2/9 each, 23/- per dozen. Cardboard tubulars, 3/3 each.
CENTRALAB VOL. CONTROLS.—50,000 ohms less switch, 2/6 each; .5 meg. with switch 4/6. Other types: .25 meg. with switch, 3/6; 100,000 ohms with switch, 3/6.
COILS.—"P" type, high gain, medium-wave T.R.F., 3/9 per pair. Long wave, 3/6 per pair.
HEAVY DUTY BLOCK PAPER CONDENSERS.—10 mfd. 450 v., 9/6; 4 mfd. 750 v., 8/-.
CABINETS.—Utility receiver, 13×12×6ins., 18/6 each.
VALVE BASES.—Paxolin, int. octal, 4½d.; other types, 7d.
TUNING CONDENSERS.—2-gang, small, 10/6 each; 3-gang, 9/6 each.
TUBULAR CONDENSERS.—.01, 600 v., .02, .1, .25, .5 mfd., 350 v., 5d. each, 4/6 per dozen.
MISC.—Slow-motion drives, 2/3. Tone controls, 100 k., 2/3. Push-back wire, 2d. per yard. Line cord, .3 amp., 60 ohms. per ft.: 3-way, 6d. per ft., 2-way 5d. per ft. Square plain dial and drives with glass and escutcheon, 10/6 each. Large coloured, all-wave dials, 1/6. Midget paper, M. and L. dials, 6d. Trimmers, 3-30 mmfd., 5d. each.
COMPLETE KIT for 200-250 v. A.C.-D.C. T.R.F. Receiver, including valves 6K7, 6J7, 25A6, 25Z6. Drilled aluminium chassis, 5in. speaker, S.M. Drive. Coloured ivorine dial. Polished wood (walnut) cabinet, 11¾×7½×6¼ins., Wearite coils, and absolutely everything required down to last nut. Circuit supplied. Medium wave, £7 5s. Medium and long wave, £7 12s.

C.W.O., otherwise C.O.D. Postage extra.

E. POWELL,
19, LIDGET HILL, PUDSEY, LEEDS, YORKS.

LONDON CENTRAL RADIO STORES

ELECTRIC DRILLS

SKILSAW ⅜in. special duty Drill, model 141, low speed, high torque. A.C./D.C. 220 v. 3 amps. Up to 60 cycles. Speed 200 r.p.m. .. **£16.10.0**

CHICAGO PNEUMATIC TOOL CO. 1" DRILL

Model A., size 985, A.C./D.C., 200/230 v. 4.25 amps. Speed 300 r.p.m. .. **£21.10.0**

SIGNALLING TORCHES

Ex-Admiralty, 3-cell (type U2). Coloured lenses (red, green, and amber), easily unscrewed for use as ordinary torch. Powerful beam. Strong metal case. Highly plated 2in. reflector, ½in. lens with 3.5 v. bulb and spare bulb. Less batteries **12/6**

SAFETY CAP LAMP

Bakelite moulded case. Diameter 3in., fitted with double filament 2.5 v. 1 amp. and .75 amp. gas-filled bulb, with 2-way switch. Complete with 10 a. hour accumulator in metal case, with webbing head-band and waist strap. Uses alkaline electrolyte solution **£3.3.0**

Ex-R.A.F. Type R1155 COMMUNICATION RECEIVERS

Comparatively new. These receivers are made to the stringent specification of the Air Ministry and are fitted with a large-scale dial calibrated from 7.5 mc/s to 1,500 kc/s. Complete with 10 valves, including magic eye. Fitted in a strong metal cabinet. They require only a power pack to be ready for immediate operation **£15**

Latest hand telephone sets, in bakelite, ... **17/6**

Universal 5 wt. A.C./D.C. Amplifiers, ... **£8.10.0**

Microammeters. Centre zero reading. 100 micro-amp each side **£2.10.0**

8-v. V.H.F. Receivers. 100-125 mc/s. Type 71. Complete with valves .. **£4.5.0**

TRANSMITTER for above. Complete with 7 valves .. **£3.10.0**

3-v. R.F. AMPLIFIERS V.H.F. 100-125 mc/s. Type 24. Complete with valves **35/-**

EX-ARMY BATTERY 3-VALVE MINE DETECTOR AMPLIFIER PANELS, size 5⅝in. x 6½in. (less Valves). Uses the latest type Baseless Midget Valves. Ideal for use as pre-Amp. tone unit, etc. Components include 9 tubular condensers, resistors, 3 Ceramic Valve Holders, Midget Transformer, Volume Control and a heavy duty 12-way connector strip. Bargain **15/-**

We still have a stock of R.A.F. valves, every one guaranteed: EK32, EF36, EF39, VL63, X66, ECM35, MHLD6, SP41, EBC33, EB34, EL32, E1192. All at 5/6 each. 8D2, D1, EA50, EF50, KTW62. All at 7/6 each. Ask our price for three, six and twelve dozen lots. We also have a large supply of the following: PT15, £3; VT105, 10/-; VT61A (twin triode), 15/-; High voltage rectifiers, VU111, VU120, VU133, all at 10/6 each.

You are invited to call and see the stocks of R.A.F gear we have for sale. It will pay you!

N.B. We do not issue lists and cannot deal with correspondence on the goods we offer.

Closed Thurs. 1 p.m. Open all day Sat.

23, LISLE STREET
LONDON *GERrard 2969* **W.C.2.**

Further Points for the S.W. Constructor

In this Article "EXPERIMENTER" Deals with Various Forms of Instability, Volume Control, etc.

AFTER dealing with the simplest points which confront the S.W. constructor—such as insulation and wiring—a number of other factors remain. Amongst these may be mentioned the various forms of instability which may arise from faulty layout; points to bear in mind when modifying published designs for experimental or other reasons, etc.

Instability in R.F. Stages

The symptoms of oscillation in an R.F. stage will be a whistle when tuning through stations. These whistles may be quite faint and may not be present at all on some frequencies of the tuning range; reducing the gain of the R.F. stage by the V.M. volume control may stop the instability if it is not very serious.

This trouble is caused by feed-back from the anode circuit of the R.F. stage (in which must be included the tuned circuit of the next stage) and it is only by removing this feed-back that a real cure will be effected.

One of the most likely causes is coupling between the coils in the R.F. and detector circuits, especially if the coils are not screened. Although satisfactory results may often be obtained if the coils are at least 6in. apart, with some metal object between (such as the ganged tuning condenser), if the trouble persists a metal screen may be erected between the coils. This screen should not be near either coil or the tuning range will be affected, and it should extend well beyond the coils in each direction.

Where fixed or switched coils are used it is often possible to arrange these so that the chassis provides screening. To avoid trouble caused by the switch, leads to each stage should be kept well apart or a switch with two or more separate sections used.

R.F.-Detector Feed-back

Feed-back from the anode circuit of the detector to the grid circuit of the R.F. stage usually results in instability only arising when the reaction condenser is advanced. If a meter is connected in the anode circuit of the R.F. valve (it should be included on the H.T. side of the anode coupling component and by-passed by means of a .1 mfd. non-inductive condenser) and the R.F. grid coil shorted, this will show whether the R.F. valve is oscillating by a change in deflection.

The cure lies in a good layout with reaction leads well clear of leads in the R.F. stage. Anode decoupling and by-pass condensers to prevent R.F. straying into the A.F. circuits will also be of value. In some cases screening the leads to the reaction coil will remove the trouble.

A.F. Instability

This usually shows up as hooting, burbling and whistling noises which scarcely vary at all with adjustment of tuning and reaction controls. It shows that feed-back is occurring in the A.F. parts of the circuit.

When searching for a cure the decoupling should be improved by using a larger decoupling condenser or larger decoupling resistor if there is any doubt as to the suitability of the components used.

If more than one A.F. transformer is used, reversing the secondary connections of one may improve matters. Speaker and 'phone leads should be kept clear of the aerial and other wires in the set.

Modifying a transformer-coupled stage to R.C.C. will generally cure this trouble, especially if the set was originally intended to have R.C.C. and the constructor had included a transformer to secure greater gain.

I.F. Instability

Due to the complete screening of the transformers this does not usually arise except in receivers with more than one I.F. stage. If it does, the screening cans may not be properly earthed, or leads to the transformers may be longer than necessary. It is quite in order to screen the leads, if necessary, as they are not required to handle signals of S.W. frequencies.

Coupling through V.M. bias circuits may also cause the trouble and the V.M. feeds to the transformers should be decoupled, a .1 megohm resistor and .1 mfd. condenser being suitable. It may also prove of advantage to lessen coupling between the transformer windings where this is adjustable.

Acoustic Instability

This is caused by direct vibration or the sound waves from the speaker impinging on R.F. components or wiring. Solid construction is helpful, although the simplest cure is usually to house the speaker in a separate cabinet. It seldom arises except in very sensitive receivers and a T.R.F. set operated with reaction at its most sensitive point is more prone to it than a superhet.

Modifying Designs

This is usually done for experimental reasons or to use parts readily available. It is often quite satisfactory provided circuit requirements are not overlooked, when disappointment may result. For example, replacing a triode detector by a S.G. or pentode detector may not give improved results unless the impedance of the anode load is also increased—a 100,000 ohm resistor or high-impedance choke or transformer being used. And, as an anode resistor of this value will reduce the anode voltage, a screen voltage of as low as 30 may be best, although the same valve may require 70 or more volts in an R.F. stage.

Coils

The various makes of plug-in coil can be used to replace one another, provided the holder is re-wired according to the data sheet of the particular coils used. Similarly, 6-pin coils may be used instead of those of the 4-pin type by omitting the primary winding connections. Four-pin coils may sometimes be used instead of 6-pin coils, but there will, of course, be no primary so that the aerial must be connected *via* a small condenser to the grid coil, or tuned-anode or tuned-grid coupling used instead of R.F. transformer coupling between R.F. and detector stages.

Valves

Replacing 4-pin types by 7-pin types, and *vice-versa*, presents no difficulty unless the circuit requires that the suppressor grid should not be connected to earth, as it is (*via* the filament leg) in 4-pin types. In the output stage a triode may replace a pentode, but the reverse is not always possible as instability may arise.

Reaction and Tuning Condensers

The capacitance of reaction condensers may be changed if it is remembered a larger capacitance will give a more coarse control, while a smaller capacitance may not be large enough to provide sufficient reaction. Values from .0001 to .0003 mfd. are usually quite suitable.

The capacitance of the tuning condenser will govern the range tuned, and above .0002 mfd. is unsuitable for S.W. operation. Larger condensers make tuning difficult, and results are not good when the component is approaching its maximum position. Apart from this, such a component will have a higher minimum, and a good condenser of about .00015 mfd. is usually best.

Volume Controls

V.M. controls may be between 10,000 and 100,000 ohms, but if the potentiometer forms part of a voltage dropping network, as is sometimes the case, the results of modifying the value shown should be considered. Rather lower values will naturally impose a greater drain upon the G.B., or H.T. supply in the case of S.G. volume control.

For A.F. volume control it is not wise to deviate much from the nominal value of .25 or .5 megohms, otherwise loss of volume and inferior tone will result.

Screen Supplies

Frequently, R.F. screens are supplied through a voltage-dropping network, and this can usually be omitted if desired, a separate connection to the H.T. battery being used in the case of battery sets. In some cases, however, instability may be caused, and decoupling by a .1 mfd. condenser from screen to earth should be used. In addition, it may be necessary to add a decoupling resistor of from 10,000 to 100,000 ohms in series with the screen lead.

Mains Receivers.

Although many modifications may be made when constructing a mains receiver, alterations which will result in changed current consumption (e.g., output valve changes) should only be undertaken when it is known that other valves or components will not be damaged as a result. Likewise, voltage-dropping networks should be retained and valves of the specified types used.

News from the Clubs

The Surrey Radio Contact Club

AT a recent meeting of the club, 36 members attended to hear Mr. C. Crook, G5BT, give a talk on Cathode-Ray Oscilloscopes. The chair was taken by the president, Mr. H. Bevan-Swift, G2TI.

Mr. Crook went into the various uses of Oscilloscopes at amateur stations, and also went into the design of various types of time bases. Two C.R.T.s were used to illustrate his points, one being used to show the wave-forms of the other. Hon. Sec.: L. Blanchard, 122, St. Andrew's Road, Coulsdon.

The South Shields Amateur Radio Club

THE activities of the above club are going ahead rapidly. New members keep coming in, and the interesting lectures and demonstrations are still main features.

Recently G8VV gave an interesting talk on crystals, their types and uses. Newcomers to short-wave working were very interested, and it is the aim of the club to encourage new Hams. Secretary: W. Dennell, 12, South Frederick Street, South Shields.

Medway Amateur Transmitters Society

THE post-war plans of the society are now well in hand, and showing considerable progress with groups of members busy on the construction of club gear. A 100 kc/s crystal oscillator is complete and available for calibration work, together with Lecher wire equipment for V.H.F. The society's transmitter is well under way, and will soon be heard on C.W. on the ham bands with the club call-sign, G2FJA. Reports would be welcomed. A full programme of interesting talks and lectures has been arranged, and will cover a wide range of subjects. A "brains trust" evening which proved very successful recently is due to be repeated at frequent intervals. Several of the members are called upon to answer technical questions put to them, and they are expected to provide between them a satisfactory answer no matter how elementary or otherwise the query. Many of the members are active on all the ham bands, including G6NU, G5FN, G3JV, G6RQ, G2FAQ, G2FYD and G2DOH.

Meetings are held every Monday at 7.30 p.m. at the Co-operative Employees Welfare Club, 207, Luton Road, Chatham, and all interested in radio, including servicemen stationed in the area, can be sure of a welcome. Hon. Secretary: Mr. S. J. Coombe, "Stanvic," Longhill Road, Chatham.

Bradford Short-wave Club

THE above club has now obtained permanent H.Q. at 1,374, Leeds Road, Bradford, and all future meetings will be held at that address. Meeting night at present is Monday, but when settled down it is expected to open most nights during the week.

Application has already been made for the renewal of the club's transmitting licence (G3NN), and it is hoped before long to get on the air. Hon. Secretary: V. W. Sowen, G2BYC, 6, West View, Eldwick, Bingley.

Sheppey Amateur Radio Club

AT the July meeting of the above club, sufficient evidence of keenness in amateur radio on the island was displayed by the promising gathering of members for a discussion on the reformation of the club and its future activity and policy.

The response of the "licensed hams" on the island was not as great as was expected, nor as was desired, but it is hoped that the re-formation of the club will offer suitable attraction to increase its membership, in spite of a weak wave of pessimism which has been created.

The future programme was discussed, and an agenda was laid down embracing such items as Theory Classes in Transmitters and Receivers, Morse Classes, Lectures, Visits to places of Radio Interest, Exchange of visits to other Clubs, etc., etc. A resolution was passed unanimously to extend a cordial invitation to all S.W. enthusiasts on the island to become members, and at the next meeting the election of officials will take place.

Full information and particulars can be obtained from the Hon. Secretary: F. G. Maynard, G4OU, 160, Invicta Road, Sheerness, Kent, who will likewise be pleased to see any S.W. enthusiast interested at his QRA, at any time.

Stoke-on-Trent and District Amateur Radio Society

A NEW Radio Society has been formed: "The Stoke-on-Trent and District Amateur Radio Society."

At the last meeting the chairman, Mr. T. Rudge, gave a talk on modern deaf-aids and their uses, followed by a discussion on television aerials.

Later on it is hoped to organise morse classes for would-be key-tappers.

All with an interest in radio are welcomed, especially ex-Navy, Army and R.A.F.—not forgetting the ladies' Services: W.R.N.S., A.T.S. and W.A.A.F.S.

Any local reader wishing to join the "happy band" should contact the Secretary, Dan Poole, at 13, Oldfield Avenue, Norton-le-Moors, Stoke-on-Trent, Staffs.

The Wirral Amateur Transmitting and Short-wave Club

THE Wirral Amateur Transmitting and Short-wave Club has been re-formed. Will past and prospective members in the areas of Birkenhead, Wallasey and West Cheshire communicate with the Acting Secretary, B. O'Brien (G2AMV), "Caldy," Irby Road, Heswall, Cheshire, with a view to calling an early meeting.

Impressions on the Wax

Review of the Latest Gramophone Records

"MIRACLE IN THE GORBALS" is one of the most striking ballets to be added to the repertory in recent years. The scene is laid in the notorious riverside slum area of Glasgow, known as "The Gorbals." Against this grim backcloth Robert Helpman, who conceived the ballet, has placed a modern miracle play. The curtain rises upon *The Street*, and we see the sordid life of the area; sailors from the docks, lovers, sinister youths in slouch caps, degraded by their surroundings and ready to use a razor on any provocation. The *Girl Suicide* enters, driven to the last search for oblivion for some incurable sadness. The *Young Lovers* pass across the stage, wrapped up in each other, and claiming some of the tenderest music in the score. Then the suicide's body is discovered and brought from the river. The *Stranger*, a raggedly-dressed man whose air of authority and dignity yet subdues the crowd into uneasy silence, brings the dead girl to life and the *Dance of Deliverance* follows. In the end, however, the stranger is attacked and killed by a razor gang, suborned by a Judas of the Gorbals. The whole conception is remarkable, and those who saw Helpman himself dance the part of the divine stranger will not easily forget it. Arthur Bliss's score was specially written for Helpman's production, and the scenes given in this new recording by the Covent Garden Opera Orchestra under Constant Lambert provide an intimate survey of the brilliant music. The records are *Columbia DX* 1260-1.

Strauss Waltzes

MANY of the waltzes of Johann Strauss contain introductions of great beauty, fixing the atmosphere of the main piece before the main tune gets under way. "Tales from Vienna Woods" is one of these, with a short prelude strongly suggestive of early-morning mist clearing before the sun in the woods near the city. Both this and its companion "Voices of Spring" are accorded the virile treatment they require by Kostelanetz and his talented body of players on *Columbia DX* 1263.

"The Ruler of the Spirits," recorded this month on *Columbia DX* 1262 by the Philharmonia Orchestra under the able baton of Walter Susskind, is one of Weber's earlier works, but it clearly shows the command of orchestration and the sense of drama that have made the later dramatic works of Weber so famous. There are some delicious passages for woodwind, delicately interpreted by the talented musicians of the Philharmonia Orchestra. Walter Susskind shows complete sympathy with the freshness of Weber's orchestral writing.

Charles Shadwell's New Orchestra

FOLLOWING on the remarkable success of "The Dancing Years," Ivor Novello created a new "best-seller" in "Perchance to Dream." He composed it, wrote the libretto, and plays the lead in it. The story deals with the incarnations of a lover through three generations—Regency, Victorian and Modern. There is plenty of romance and humour, with the charm of Novello's music running all through the piece. The generous selection of tunes from the show on *H.M.V. C*3501 is beautifully played by Charles Shadwell and the orchestra he has formed and is taking on tour after leaving the B.B.C. Few artists could be better qualified to interpret the score of "Perchance to Dream," which is theatre music at its best.

Alan Rawthorne's "Street Corner" Overture, recorded this month by the Philharmonia Orchestra conducted by Constant Lambert, on *H.M.V. C*3502, is a short and brilliant overture commissioned for ENSA symphony concerts for war-workers. Its purpose was to provide a short opening-piece playing not more than ten minutes or so to begin a concert, showing off the brilliance of the modern orchestra and putting the audience in the frame of mind to listen to more substantial fare.

"The Pearl Fishers"

HEDDLE NASH, tenor, with the Liverpool Philharmonic Orchestra, conducted by Dr. Malcolm Sargent, chooses two arias from "The Pearl Fishers" and "La Favorita" for his latest recording on *H.M.V. C*3409. They are: "In Memory I Lie Beneath the Palms and Dream of Love," and "Spirit so Fair." At the point in Act I of "The Pearl Fishers" where the first aria comes, a pearl-fisher, Nadir, feels his former love for the priestess Leila returning, as he recalls in his mind all the memories of his first sight of her "beneath the palms."

Donizetti's opera "La Favorita" deals with a young man, Fernando, who forsakes the monastic life for love of Leonora, a king's mistress who is married to the hero as a reward for military services rendered. Fernando does not know Leonora has been the king's love and on learning the truth his horror is such that he determines to re-enter the monastery. Leonora comes to him, dying of remorse and grief, and he forgives her.

Variety

ANNE ZIEGLER and Webster Booth have this month recorded two songs from their latest film "The Laughing Lady" on *H.M.V. B*9490. "Laugh at Love" and "Love is the Key" is a very charming record and is typical of these two famous duettists.

Leslie A. Hutchinson ("Hutch") has chosen two popular songs for his latest recording on *H.M.V. BD*1137. They are "Bless You" and "Time after Time" both of which are played in the "Hutch" style.

Another vocalist who is becoming increasingly popular is Jean Cavall, the French Canadian singer. This month he sings "Prisoner of Love" and "Encore un jour qui passe" (Another Day is Over) on *H.M.V. B*9491.

Paul Fenoulhet with the Skyrockets Dance Orchestra, now starring in the London Palladium show "High Time," play "Primrose Hill," with vocal by Cyril Shane, and "Bless You," with vocal by Doreen Lundy, on *H.M.V. BD*5938, whilst Joe Loss and his Orchestra have recorded "It Couldn't Be True" and "Save a Piece of Wedding Cake for Me," on *H.M.V. BD*5936.

Sinatra fans will be pleased with his latest recording of "I Only Have Eyes for You," coupled with "I Don't Know Why," on *Columbia DB*2226, or if you like Turner Layton's style of singing you should not miss "Primrose Hill" and "If I Can't Help Somebody," sung by him on *Columbia FB*3234.

Another vocalist, who has been likened as "the English Bing Crosby," is Steve Conway, and accompanied by Jack Byfield and his Orchestra he has this month recorded "Beautiful Dreamer" and "Temptation," on *Columbia FB*3233.

In the swing section there is a formidable array of dance bands. First we have the Benny Goodman Sextet with Benny Goodman on the clarinet, Slam Stewart (bass), Teddy Wilson (piano), Mike Bryan (guitar), Morey Fields (drums) and Red Norvo (vibraphone) with two numbers, "She's Funny That Way" and "Rachel's Dream," on *Parlophone R*3008, and Count Basie and his Orchestra playing "Lazy Lady Blues" and "Stay Cool," on *Parlophone R*3009. Finally we have the one and only Gene Krupa and his Orchestra playing "Apurksody" and "Ta-ra-ra-Boom-de-Ay," on *Parlophone R*2905.

Programme Pointers

Further Notes on the National Memorial. By MAURICE REEVE

JUST as I had finished writing about my suggested acquisition of a West End theatre as the Henry Wood Memorial Hall, came news of plans adopted and an outline of the shape this seems likely to take.

Firstly, the site is to be on Marylebone Road. This seems little, if any, advantage over Kensington, which is not only the present centre of the nation's musical life and activities, but is where the Shakespeare National Theatre contemplated raising its head some years ago. Land, I believe, was bought for the purpose.

One of the objections to the Royal Borough is its lack of that stimulating atmosphere for concert-giving and concert-going, which the neighbourhood of Langham Place and Wigmore Street possesses in such a marked degree. This is a very important point and of equal interest whether you are out for pleasure or profit. The neighbourhood of Madame Tussauds and Dr. Watson's practice may be less atmospheric even than the Albert Memorial and Exhibition Road. At least the Albert Hall can claim to have borne on its boards all the greatest musicians from Wagner to Jeanette Macdonald over a period of something approaching a century. The new hall will have to build and create its own atmosphere and tradition during the passage of the years—no easy task.

The second point, as great an advantage as the other is a disadvantage, is that, starting from scratch, the organisers will be able to create a hall embodying every conceivable device and modern invention for the honour and glory of music. In fact, there are to be no less than three halls, seating 3,000, 1,200 and 600 respectively.

Booking complications are easily imaginable here. In the old days, top grade concerts used to be given, simultaneously, in Queen's Hall (Langham Place), Wigmore Hall (Wigmore Street), and Aeolian Hall (New Bond Street); competition between the rival artists was largely cancelled out by the distances between, although critics, sometimes to the mortal harm of the recitalists, used to lumber between the three places with feelings little short of malice aforethought.

Whether it will be possible to house, successfully, three such events on the same evening in the same building may be an entirely different kettle of fish.

The whole thing is to cost £450,000, of which £42,000 have already been raised.

The Proms.

The present series of what we must now and in future call the Henry Wood Promenade Concerts raises questions which should not avoid answers, were more than the finances of the season in dispute. The programmes have grown far beyond what was either the original intention behind the concerts, or what is capable of being produced at the highest possible standard. Either two symphonies and a concerto or two concertos (by the same soloist) and a symphony, plus overtures, arias, suites and what not, every night for forty-eight consecutive nights is more than can either be adequately rehearsed, perfectly presented or critically listened to.

We must not forget that these concerts now compete with the most famous series of symphony concerts. They are, in fact, symphony concerts. Or perhaps I should say super symphony concerts. They are "Promenade concerts" in name only. And, as such, they naturally invite criticism and comparison with any other series. No excuses on the unique conditions and circumstances of their offering or reason for existence should either be offered or accepted. Many know that the greatest masterpieces of symphonic music are performed at them after only the most perfunctory rehearsing; nothing else is possible. New works and concertos get most of the rehearsal time available.

The Critical Public

It would be deplorable, on all counts, if the concert-going public ceased to be a musical public—that is to say, a body of people whose critical faculties and whose powers of comparison as between one performance and another, a body with acute perceptions and preferences, likes and dislikes, knowledge and discretion—and just degenerated into concert-goers cum picture-goers. When people reach the stage—if they ever do—that they "go to a concert" because it has become one of a number of entertainments provided in every community, but with little knowledge of what is on and less still of how it is put over, then, indeed, a sad day will have arrived.

There are ominous signs, one of which is this massed herding to listen uncritically and indiscriminately. The foreign competition, which has already begun to come along, will do much to check it. We mustn't become so champagne-thirsty that we quaff it out of any old tea-cup or tin mug that may be within reach so long as we get it down somehow. But we must ever bear in mind that it is not "champagne" but merely another intoxicating liquor unless drunk in the right time, the right place and the right conditions.

Solomon's Return

Solomon's name was missed from this season's "Proms." He returns from an extensive tour of Australia and South Africa in November. Many important dates have been fixed for him during the winter. We miss pianists of his calibre. And more still those like Casals and Toscanini. The cancellation of the latter's concert this summer was a big blow to the music lover of discrimination, though he is to come in the winter. It made us realise that even musicians err and have unbalanced judgments at times. What a pity they can't place their art first and above all things, and take the point of view that it is much more important that the world hear their incomparable art than that some tenth-rate hoodlum rules in God knows where. Their presence and art in current English musical life would do incomparably more to revive our critical faculties and perceptions, and to increase the fame of their otherwise discredited countries, than all their "strikes" and feeble protests. When will people learn sense.

A story of Toscanini's demand for perfection, though perhaps going too far in the reverse direction, well illustrates the comparison with what I have just remarked. He was to have conducted the Ninth Symphony during the Beethoven centenary celebrations. But after more than thirty hours of rehearsing, he laid his baton down on the desk in front of him and said to the orchestra and choir: "Ladies and Gentlemen, next year!" He demanded the same standards that were demanded of him.

M. WILSON LTD

SUPER-HETERODYNE 3-WAVEBAND COIL UNIT

16-47, 200-540, 800-2,000 m.

Midget Iron-cored, high Q, very selective Litz-wound coils mounted in 18 s.w.g. aluminium screen, with all necessary padders and trimmers. Completely wired up to switch with colour-coded connections, ready to fit into receiver chassis. Aerial tested. **39/6**

FOUR NEW AMPLIFIERS

(1) 4 watts, 6V6 output (4 valves): £10 10 0

(2) 6 watts, PX4 output (4 valves): £11 11 0

(3) 12 watts, 2 6V6's in push-pull (5 valves): £12 12 0

(4) 18 watts, 2 6N7's in push pull (5 valves): £14 0 0

PLEASE PLACE YOUR ORDERS NOW as the prices quoted above apply only to this month's issue, and may be increased later owing to rising costs of production.

All the above amplifiers are mounted on heavy-gauge aluminium chassis, and have the following dimensions: 7½ x 6 x 7½ins. They are especially designed with a view to high-quality hum-free reproduction.

Specifications and delivery on application.

OUR POLICY

QUALITY is given priority in our effort to produce Radio Receivers better than most. Careful design, English craftsmanship, first-class components and rigid inspection combine to give you something really good.

MIDGET 2-GANG CONDENSERS, .00035 mfd. Ceramic insulation, 12/6.

MIDGET IRON-CORED PERMEABILITY TUNED COILS 460 Kcs. Wavebands cover the following standard ranges: 16-47, 200-550, 800-2,000 m., A., H.F. Osc., 3/- each coil.

SMALL IRON CORED PERMEABILITY TUNED IF. TRANSFORMER. Screened, 460 Kcs, 15/6.

VARIABLE CONDENSERS. 25 pf. ceramic plate midget single—can be ganged, 4/6; .00015 ceramic plate, 2-gang, small, 12/6; .0005 ceramic insulation, 2-gang, small, 12/6; .00015 standard, 2 gang, S.W., 12 6. Reaction condensers, .0003 mica dielectric, 3/-.

TRIMMERS. 3/30 ceramic base, air spaced, new, 2/-; 40 pf. S.W. pre-set neutralising cond., 2/-; T.C.C. air spaced straight line 5/35 pf., 1/-; ceramic postage stamp type, 30/80, 1/-; 50/120, 1/-; 150/250, 1,9.

MAINS TRANSFORMERS. 350-0-350 4 v., 4 a, 4 v. 2 a, 80 m.a., 30/-: also 6.3 v. 5 a., 5 v. 2 a., 30/-; 350-0-350 4 v. 4 a., 4 v. 2 a., 6.3 v. 5 a., 5 v. 2 a., 80 m.a., 35/-; All 200, 220, 240 v. primary. 375-0-375 6.3 v. 4 a., 6.3 v 4 a., 5 v. 2 a., 175 m.a., £2 12s. 6d.; 10-0-200, 230, 240 v. primary, L.F. chokes 20 hy., 500 or 1000 ohms, 100 mA. interleaved, with mounting feet, 21/-.

TO OVERSEAS TRADERS

Wholesale and retail enquiries are invited.

Orders can be executed for B.A.O.R., C.M.F., and S.E.A.C. customers.

307, HIGH HOLBORN, LONDON W.C.1. 'Phone: HOLborn 4631

RADIO SPARES

MAINS TRANSFORMERS. Primaries 200/250 volts. Secondaries 350-0-350 volts.

TYPE C. 100 ma. 4v. 5a., 4v. 3a. ...	34/6
TYPE D. 100 ma. 6.3v. 5a., 5v. 3a. ...	34/6
TYPE E. 120 ma. L.T.s as Type C. ...	37/6
TYPE F. 120 ma. L.T.s as Type D. ...	37/6
TYPE H. 200 ma. Three L.T.s of 4v. 6a. +4v. 3a. Rectifier	47/6
TYPE I. 200 ma. Three L.T.s of 6.3v. 6a. +5v. 3a. Rectifier	47/6
Secondaries 500-0-500	
TYPE J. 200 ma. Three L.T.s of 6.3v. 6a +5v. 3a. Rectifier	52/-
TYPE K. 200 ma. Three L.T.s of 4v. 6a. +4v. 3a. Rectifier	52/-
TYPE L. 250 ma. Three L.T.s of 6.3v. 6a. +5v. 3a. Rectifier	56/-
TYPE M. 250 ma. Three L.T.s of 4v. 6a. +4v. 3a.	56/-
Secondaries 400-0-400.	
TYPE R. 120 ma. 4v. 5a, 4v. 3a., ...	40/-
TYPE S. 120 ma. 6.3v. 5a., 5v. 3a. ...	40/-

SPECIAL UNITS MANUFACTURED TO FRIENDS' REQUIREMENTS

Please note Types H to M have 2 of the L.T.s centre-tapped. Owing to dimensions and weights of these types, kindly add 2/6 for carriage and packing.

HEAVY DUTY MULTI-RATIO OUTPUT TRANSFORMER

120 ma. 15 watts, tappings for 6L6s in push-pull, PX4s in push-pull, low impedance triode, low impedance pentode, high impedance triode, 27/6; complete instructions with each unit.

OUTPUT TRANSFORMERS. Special offer. Multi Ratio 30 : 1, 45 : 1, 60 : 1, 90 : 1, 6/-.

SMOOTHING CHOKES. 20 henrys, 100 or 120 ma., 10/-; 20 henrys, 150 ma., 12 6; 30, 35 or 40 henrys, 200 ma. or 250 ma., 21/6.

Orders accepted by post only. Please help us to eliminate clerical work by sending cash with order. Please include postage with order.

WOULD FRIENDS PLEASE NOTE THAT OWING TO DEMAND FOR OUR TRANSFORMERS AND CHOKES WE HAVE CEASED TO STOCK OTHER RADIO COMPONENTS.

H. W. FIELD & SON,
Colchester Road,
HAROLD PARK - ESSEX.

Test Equipment from Vallance's

Universal. Avo-Minor. 22 Ranges. £8/10/-. Taylor 90A 1,000 ohms/volt A.C. and D.C., 40 Ranges. £15/15/-. E.I.C. Universal, 1,000 ohms/volt A.C./D.C., £8 10/-. Walsall, Model 845, 2,000 ohms/volt, with low ohms range, £14/6/8. Taylor 120A Junior A.C./D.C., 21 Range, 1,000 ohms/volt, £8/10/-. Hunts. C. and R. Bridge. 0.00001 mfd.-50 mfd., power factor 50 per cent., 50 ohms to 5 meg., Insulation test, £18/18/-. Taylor C. & R. Bridge, 110A ; capacity measurements up to 120 mfd., resistance 120 ohms-12 meg., power factor measurements on all capacity ranges, £14/14/-. Mullard C. & R. Bridge, 10 m.mfd.-10 mfd., and 10 ohms-10 meg., power factor, £15/15/-. Avo. 40 range, A.C./D.C., 1,000 ohms/volt. £17/10/-. Taylor, 85A-90 range. A.C./D.C., 20,000 ohms/volt, £19/19/-. G.E.C. Selectest, A.C./D.C., 1,000 ohms/volt, £19 5/-

B.P.L. SIGNAL GENERATORS.
Frequency Ranges, 100-250, 250-650, 650-1,600 kc/s, 1.6-4.5, 4.5-12, 12-30 mc/s. Accuracy of Calibration 1 per cent., internal modulation, 400 cycles, 6-step Multiplier and Attenuator, £21. A.C. Mains, 200/250 volts or 105-115 volts. 50/60 cycles.

MEGGERS.—Wee Megger Insulation Tester, 500 volts, 0-20 meg. and infinity £9/10/-. Record Minor Insulation Tester, 500 volts, 0-20 meg. and infinity, £11/2/3.

VALVE TESTERS.—Taylor 45 A/S., latest model, covering tests on all modern valves, £18/10/- (limited stocks).

METERS.—Pullin 0-1 m.a., with 4½in. dial flush mounting, calibrated volts/m.a./ohms, £4/9/-, for building your own test meter. Shunts and Multipliers shortly available. B.P.L., 0-1 m.a., 2½in. diam., 52/6 ; B.P.L., 0-1 m.a., 3½in. diam., 65/-. Also Thermo-couples, micro-ammeters, etc., in a wide range of first-class makes.

Everything in radio for the amateur, constructor or professional. If it is available, Vallance's have it. Stockists for best makers, including Raymart, Eddystone, Belling-Lee, Radio-Aid, Hamrad, Bulgin, Cyldon, Denco, Woden, etc.

Prompt attention to orders and enquiries. Speedy postal service. Payment: Cash with Order or C.O.D.

Send your wants to—
VALLANCE'S 144. BRIGGATE, LEEDS, 1

"WALKIE-TALKIES!"

THE Famous Canadian Type 58 Mk 1 Chassis & Case—BRAND NEW—at this amazing low figure. **35/-** (Carriage 2/6)

This Transmitter-Receiver comprises an 8-valve circuit operating on the 33-50 metres band. It was built regardless of cost, for high performance, and the chassis contains a host of perfect components worth well over £15. Dimensions 14in. x 6¾in. x 5½in. Instruction book with each set.

WE ALSO OFFER THE COMPLETE RANGE OF ACCESSORIES FOR THE WHOLE EQUIPMENT, all of which have innumerable uses for the serious Experimenter and Constructor:

POWER SUPPLIES.

Complete vibratorpack, self contained in metal case with 2 lead acid accumulators. Only £4.
2-volt vibrator 7-pin type R76. Only 15/6.
10 amp. vibrator fuses. Only 6d.
6ft. battery charging cable. Only 2/6.
Battery box with power cables and plugs. Only 10/6.

DRY BATTERY, long shelf life, comprising L.T., H.T., and Bias, all in one pack, to fit battery box. Only 20/-.

Haversack with shoulder strap and belt. Only 5/6.
Complete battery power supply assembly, packed in haversack. Only 34/-.

VALVES.

Set of 8 valves. Only £5 10s. per set.
Individual valves, of types 1S5, 1T4, 1R5, 3D6, 1299. Only 17/6 each.
NOTE.—We can also supply other miniature types.

PHONES.

Headphone and Microphone Assembly complete. Only 22/6.
Mic. is of differential noise-excluding type, phones padded. Assembly complete with lead and plugs to fit either battery box or vibrator.

AERIALS.

16 sectional Rod type, in web pack. Only 12/6.
102in. Telescopic type, collapses to 15½in. Only 15/-.
25ft. wire aerial with binding post. Only 2/6.

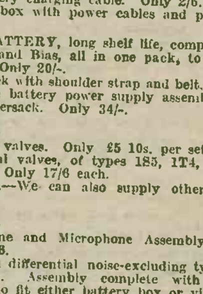
OR

The Trans-Receiver as a complete Battery Operated Working Unit, with Valves, Aerials, Phones and Battery, representing a value at above prices of £12 14s. Only £10 10s.

OR

The Trans-Receiver as a complete working unit with Vibratorpack, two sets of Valves, Aerials, Microphones, etc., representing a value at above prices of £22 12s. 6d. Only £14 19s. 6d.

WAVEMETER



WAVEMETER

Special offer of EX-GOVT. Class D, No. 1 Mk. II* Wavemeters. Frequency ranges 1,900-4,000 kcs., 4,000-8,000 kcs. and Check frequencies at intervals of 1 mc. up to 25 mcs. Oscillator crystal check. Battery operated. Supplied with spare vibrator, spare valve and Instruction book. Illustrated leaflet available. Only £6 15s.

C.W.O., add postage under £1 (S.A.E. for lists and enquiries).

THE JOINT PURCHASE OF LARGE QUANTITIES OF THE ABOVE EQUIPMENT MAKES THESE OFFERS POSSIBLE BY

U.E.I. Corp., 32, St. Gabriels Rd., London. N.W.2.

M.O.S., (Mail Order Supply Co.) 24, New Road, London, E.1.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A Belgian Reader's Results

SIR,—When I received your August issue, I managed to build the super economy as a one-valver. After achieving satisfactory results, I began trying to improve it.

There are some amendments which could eventually interest your readers. Instead of a simple triode, I put in a double grid valve, actually an A441N. At first this valve may seem unusual to British readers, but it has many British equivalents, such as the PM4DG Mullard, DZ1 and AB4 Mazda, 210 and 410 DG Cossor and BG4 Osram.

After a series of experiments by the trial and error method, I settled upon a circuit which was a complete success.

I tried to maintain Mr. Baldwin's very low voltage and to reduce the overall dimensions. So I fitted a 50,000 ohms potentiometer across the reaction winding, and removed the R.F.C., shunting the 'phones with a .002 condenser.

A 3 megohm resistor, shunted by a .00015 condenser inserted between the first grid and the grid coil, was a further improvement.

Both these values aren't critical. Filament and H.T. supply is drawn from a midget battery made following Mr. Dobbs's hint in PRACTICAL WIRELESS, March issue.

Three 1.5 volt cells are used for filament heating while three more supply H.T. and grid bias. The battery is housed in the set, allowing a very neat and compact layout. As a simplification, the variable pre-set is replaced by a .0001 fixed one, giving good results along the whole band.

I found that reaction was much finer if both coils are wound in the same direction and the plate put on the far end of the reaction coils. I haven't yet tried the set on the higher frequencies, since my coil is now soldered, but I think it would do very well on the S.W. bands.

Just as it is now it works perfectly, selection being very fair and many foreign stations coming out at good volume, even with the finger as an aerial. Since I read your magazine, I have been increasingly successful and satisfied.

I wish PRACTICAL WIRELESS to continue this good line and express herewith all my gratitude.—PHILIPPE LEDENT (Brussels).

Super-regenerative Sets—A Warning

SIR,—On reading through the correspondence in your "Open to Discussion" columns, I have observed that quite a number of short-wave listeners are using super-regenerative receivers on the 28 mc/s band.

Probably some of these listeners are not aware that this type of receiver, by virtue of its super-regenerative circuit, radiates a very considerable form of interference which can cause severe interference to amateur transmitting stations.

Although I have no wish to discourage short-wave listeners—on the contrary, I am most anxious to see their numbers increase—I feel that on behalf of the transmitting fraternity it is only right to point out that this interference, particularly in densely populated areas where large numbers of such receivers may be in operation, can be a serious menace. It is realised that the possession of a modern communication receiver or an ordinary short-wave superhet does not come within the range of everyone's pocket, but a "straight" circuit with reaction, particularly if a buffer H.F. stage is used in front of the detector, would not only provide better reception on weak signals, but would greatly help in reducing interference on the already far too crowded narrow wavebands allocated for amateur transmission.

I am not speaking as one of the newly licensed amateur stations, for G5CV has been regularly on the air since before 1930, and during that time all reports from short-wave listeners—and many hundreds have been received—have been answered with the station's QSL card, even though only a small percentage of reports have been of any material assistance.

Whilst on this subject, I might mention that if listeners sending reports would bear in mind the following few suggestions they would stand a better chance of receiving a QSL card from some of those stations which are apt to frown upon listeners' reports:

(1) Send sufficient reply postage—it becomes expensive when forty or fifty reports a week are received.

(2) Give a full report of reception, with details of conditions prevailing at the time.

(3) Remember that reports are not usually required from listeners living in the vicinity of the transmitting station, but on 58 mc/s, generally speaking, reports from all distances over 20 miles are useful.—DOUGLAS WALTERS, G5CV (Godalming).

Service Engineers

SIR,—This is my first correspondence to you, and I sincerely regret having to utilise it in criticism.

I am one of those unfortunates Mr. A. S. Knight describes in the August issue of PRACTICAL WIRELESS as having a six-months course, followed by practical work which is more in the nature of a "muddle through."

I would like to voice the opinion of many others in "my street" and decry his self-opinionated record of his own skill and ability, and lack of intelligence that he assumes we have in being able to service a civilian receiver.

What was so intelligent in diagnosing the "interesting fault" with which he concludes his letter? I presume he knew it was "that kind" of distortion that led him to the grid circuits, for there are several reasons for "distortion," each distinguishable from the others.

Being an unashamed learner, six years ago I often consulted someone with this gift of "higher intelligence" (obtainable only in "civvy street"), but often much to my regret.

Naturally, I agree that the more one gains knowledge, the more practical experience one gets, but surely that does not make us so much less intelligent. I venture to say we *can* diagnose, carefully and systematically, and repair and restore the set to its former standard, also stating the exact reason for the original breakdown which to my knowledge and experience is rarely done by the many "self-taught" so-called radio engineers.

I have had many dealings with radio service engineers as a customer, and I would like to conclude with one of *my* most recent experiences.

My friend's set was collected for repair by a local service man. After keeping it several weeks, he went to them and told them about some difficulty in being able to obtain certain parts, and offered to let them have a radio set to use temporarily. A few more weeks elapsed and he turned up again with the set, but not repaired, saying it was beyond repair, and tried to persuade them into purchasing the second-hand set he had lent them which, incidentally, had gone u/s. a few days after they had it.

At this juncture I was called in. As the set was an old one (Alba, A.C. Model 78) and I could not obtain a service sheet for it, I commenced tracing the circuit, and completed the entire diagram of it on paper. The output valve being u/s and from observation of the power supply and output circuit, pointed out a great deal of the trouble. I purchased a new valve (equivalent) removed the existing biasing arrangement and incorporated components, the values of which I had to calculate to suit the valve's working conditions—renovated the speaker and incorporated the speaker and field system in the present-day conventional manner. On top of this three of the wavechange switch contacts were broken. As the only material I could obtain was slightly thicker it necessitated making ten contacts.

The set was working from the moment of switching on, and with the aid of an "Avo" service oscillator I re-aligned the set, I.F.s, L.W. and M.W.

My moral to this letter is: "Live and let live"; it is so easy to criticise.

I myself could raise quite a number of incidents of gross inefficiency where these "pre-war experience" men are concerned.

We remain unperturbed of the professional jealousy thrown at us incessantly, but we would appreciate a "leg-up" by the periodical, which has helped so many of "our kind" into jobs and out of difficulties. I naturally refer to PRACTICAL WIRELESS which I consider my greatest asset.—A. ROGERS (Baldock).

B.B.C. Transmitters

SIR,—Now that all things mysterious to us during the war years are being gradually taken off the Secret List, don't you agree with me that it is high time for the B.B.C. to "come clean" and give a complete list of their stations working, with powers used and wavelengths. So far I am unaware of any such particulars being published since this last spot of trouble we have had.—J. ROBERTSON (Wick, Caithness).

Radio SEAC

SIR,—I am sitting at the control-desk of the transmitter to which you refer in a recent issue.

We radiate the programme "Radio Seac" from our 100 kW. Marconi S.W.B.18 short-wave sender. It is not true to say that it is the most powerful short-wave sender in the world, as the B.B.C. has many senders of this type. It is *one* of the most powerful, although as far as actual power is concerned the B.B.C. senders put out more, as they are tuned up to 13 amps. in the final stage at 11 kV., whereas we only work at 10.5-12.5, depending on the frequency.—E. L. HITCHCOCK (Ceylon).

An Amateur's Views

SIR,—I have noticed in recent months several very interesting Amateur Band Logs published in PRACTICAL WIRELESS, but should be interested to know why so few listeners give any worthwhile data, such as times of reception, telephony or C.W., antenna designs, type of receiver in use, and so on.

The log of Mr. Cox in the August issue is one of the most complete, but even this most enthusiastic amateur gives us no idea whether the hams he received were on 'phone or C.W., at any rate, not the Americans on 28mc/s.

I would also suggest that Mr. Bagley, in the same issue, takes a rather narrow view of the G.P.O.'s retention of 7 and 14 mc/s, since to restore these bands, as he suggests (and which has now been carried out) cannot possibly stop the pirating, since I consider a large proportion of unauthorised activity on these bands is due to people who are completely unlicensed to operate a Tx on any band—not to mention the "ordinary public"—bless 'em!—who have paid their £15 or so for a walkie-talkie and mean to have some fun with the thing, which covers the 7 mc/s band, at the expense of the true spirit of amateur radio.

With a sunspot maximum expected in 1948, and the increasing number of hams being licensed, notably in Europe and the United States, it would seem that 1.8, 7, 14 and 28 mc/s are *all* going to be positive headaches with QRM in the next two years! I've half a mind to take up photography or something! Best wishes to PRACTICAL WIRELESS and staff.—P. W. BARNETT (St. Albans).

Station Information

SIR,—I am writing to give answers to a few queries of some of your correspondents in the September issue of PRACTICAL WIRELESS. First of all to reply to J. S. Dyer (Ilford), the two stations he mentions on C.W.—GFA/2 is an R.A.F. C.W. station and the QRA is Air Ministry, Whitehall, London, and the other one, JEYK, is a U.S. Army C.W. Station, and is located at U.S. Army H.Q., Germany. It is used to communicate with New York and carries Press. Although I haven't the QRA of RN1SX, this is a Royal Navy call and is used by an amateur who is on board ship in the Adriatic Sea and operates on 14 mc/s. It may be of interest to readers to learn that Radio Australia has now started a programme solely for DX-ers and S.W. fans. It consists of news and talks on DX-ing and gives the latest up-to-the-minute news on DX conditions. This programme is beamed to the British Isles and is at 15.45 G.M.T. or 4.45 p.m. B.S.T. every Saturday over VLA3 on 30.99 m. It is repeated for N. America at 10.10 G.M.T., 2.10 a.m. B.S.T. on every Sunday morning over VLC9, 16.82 m. Radio Australia started this new programme on July 28th, and will welcome reports of reception and comments.—B. HAYES (Bletchley).

A.C. or D.C.?

SIR,—If I may be permitted to add a few lines to the "heated" discussion now taking place in your "Open to Discussion" column, I should like to take sides with Mr. G. House, of Bradford, whose letter appeared in your July issue. Mr. House's statement re "voltage doublers" seems to have raised an unwarranted storm of protest. It must be admitted that voltage doubling with D.C. may not be a worthwhile commercial proposition in view of the number of components involved, but it is far from being "impossible."

Have not Messrs. Harrison and the Experimenter of Chailey heard of the Inverter, so called by the Americans, I believe.

In order to accomplish voltage doubling with a D.C. supply presumably it is necessary first to convert the D.C. into A.C., in fact use a "D.C. transformer." If such a circuit is used, voltage "doubling" itself should not be necessary, as the "D.C. transformer" can be arranged to step up the supply to the required voltage.

A satisfactory circuit can be built around two gas-filled triodes operating as a push-pull oscillator. If the experimenter wishes I would be prepared to go into reasonable detail, but I recommend that he applies himself to one of the standard works on radio for a few moments where, no doubt, power push-pull oscillators using gas-filled triodes are described as being a method by which D.C. may be "stepped up."—J. COPLEY-MAY (Richmond).

SIR,—I have been following keenly the discussion as to the relative advantages possessed by the A.C. receiver over the A.C./D.C. receiver.

Apart from hum elimination and other disagreeable noises, a study of the respective receivers' power supply will reveal the superiority of the A.C. receiver.

In my town the regulation is 250 v. A.C.—and yet only 18 miles distant it is 175 v. A.C., hence all that is normally required on the A.C. receiver is to move the power lead to a lower tapping on the mains transformer.

This simple remedy, however, does not exist on the A.C./D.C. receiver—nor on the voltage-doublers, unless a transformer is employed—and this we desire to eliminate.

In fairness to all I agree that not all A.C. mains transformers have such a low tapping point, but such can be obtained and, once fitted, can be made to serve for all voltage regulations without any further alterations—in contrast to the A.C./D.C. receiver.

Mr. R. G. Harrison's remarks in the September issue of your excellent journal is to me further evidence in support of the A.C. receiver.—F. C. PALMER (Truro).

"Technical Notes"

SIR,—I wish to point out an error in the article by "Dynatron" in the September issue of PRACTICAL WIRELESS.

In referring to his Fig. 1(a), he states that the voltage amplification will be the same as if the resistive load were in the anode. This is not the case. The voltage across the cathode load subtracts from the input voltage, being in phase with it. If the input had been applied from grid to cathode, from the secondary of a transformer, for example, then his statement would have been correct. For all practical purposes the circuit in 1(a) is a cathode follower, as the cathode swing cannot exceed that of the grid, so that the effective output impedance and the percentage of feedback are substantially equal in each case.

In the section dealing with "output impedance," "Dynatron" expresses the commonly held view that a cathode follower in the output stage must be matched as though it were connected in an ordinary manner.

To match a cathode follower output stage for optimum results the transformer ratio should depend on the available input voltage. As long as the valve does not reach anode current cut off, the ratio is not too low. As the circuit supplies virtually a constant output voltage, for varying load, a reduction in the turns ratio is an advantage, as it provides greater speech coil current for the same input. It would take about 240 volts, peak to peak, to swing the grid of a normal output valve fully, when connected as a cathode follower, if the valve were matched as an ordinary triode (valves necessarily behave as triodes in cathode follower connection, of course). This grid voltage can be reduced to 150 volts by matching to about a quarter of the normal optimum load impedance, while still feeding back two-thirds of the input voltage. This has been checked on an oscilloscope.

"Dynatron" also states that the cathode follower provides 100 per cent. negative feedback. This is not quite correct, as some voltage is required to drive the valve, which fraction of the grid to earth potential subtracts from his percentage; 70-90 per cent. are practical figures for cathode follower circuits.—J. L. SARKEY (London, N.W.3).

[*Our contributor, "Dynatron," makes the following comments on Mr. Sarkey's criticism :—*

I MUST thank Mr. J. L. Sarkey for writing to point out the obvious error in my Fig. 1(a). Though correct in my copy, the wrong diagram sheet somehow came to be sent in with this article. A first sheet (the one printed) had been prepared, but for a different wording of the text—1(a) and 1(b) were set as "problems" for the experimenter. For the text as it stands, the input cct. of 1(a) should have been an alternator, returned to cathode.

Fig. 1(a), of course, represents a cathode follower. As Mr. Sarkey states, "the voltage across the cathode load subtracts from the input voltage, being in phase with "—*actually, in* phase-opposition, *from the "earth" end of the load! I hope to deal more fully with particular cathode follower circuits in another article.*

Although I do not quite follow all the arguments adduced in reference to optimum load, I think that what Mr. Sarkey says is perfectly correct. With restricted drive, the advantages of lowering the load from the normal optimum value are pretty clear. But he must remember that I was mainly concerned to show why the apparent internal impedance (with respect to changes in load impedance) has itself little to do with load matching. I agree, of course, that the illustrations used were inadequate to take account of all the factors in an actual output stage.

I do not follow your correspondent's point about "100 per cent. feedback." If Eo is the output voltage *of an amplifier, and a fraction, β, of this is negatively fed back, the resultant signal on grid-cathode is (Eg—Eo)—treating β as positive. In a cathode follower, β is obviously 1.0, or 100 per cent. Apparently, Mr. Sarkey regards it as a percentage of the* input voltage *Eg, which seems confirmed by his remark in par. 3 about "feeding back two-thirds of the* input voltage." *I should have said that, with 100 per cent. feedback, the overall voltage gain of a cathode follower is 0.7-0.9 (or 70-90 per cent.).*

I am glad I have such keen readers as Mr. Sarkey to help in debunking the obscurities with which many technicalities are wrapped. Though not intentional, perhaps the present error in Fig. 1(a) has been useful if it has led other readers to experiment and ask questions!

DYNATRON.]

A Level Response Amplifier

SIR,—No doubt G. W. Brown will be interested to know that I have adapted his "Level Response" Amplifier (published in PRACTICAL WIRELESS of August last) for use in a T.R.F. receiver I had constructed.

This receiver was affected by "motor-boating," and I had tried various forms of negative feedback in an attempt to cure it. So I altered the L.F. amplifier in the receiver in accordance with the circuit published in the article, making the necessary alteration for plugging-in a gramophone pick-up. The result is complete freedom from "motor-boating," and also satisfactory reproduction of gramophone records. Needless to say, I adhered to the values of the resistors and condensers as given, but the L.F. transformer has a somewhat higher ratio than that advised.—D. SMITH (Edgeley).

Old Circuits Reviewed

SIR,—I would like to take this opportunity of thanking W. Nimmons for his very interesting series of articles entitled, "Old Circuits Reviewed," and am writing to tell you of an intriguing experience which I recently had.

I was building a four-valve (1-v-2) battery set for a friend, and was testing it out, using my mains power pack to supply H.T.

On accidentally banging the mains plug (which was not inserted very far), one side of the mains became disconnected from my power pack. Immediately the programme came through more clearly, and the hum died out so that it was scarcely audible even when no station was tuned-in.

Can any reader explain this for me?—PETER CLARKE (Ealing).

Frequency Modulation

(*Continued from page 472.*)

primarily on account of the reduction of current, but the decrease in size of the transmitter generally. This more efficient form of transmission can be looked at the other way round, and the view taken that by using the same power for the two systems the strength will be increased at the receiver, in the case of frequency modulation, in which case it is fair to record a further gain in signal-to-noise ratio, making a grand total of 750 : 1.

The real potential advantage of frequency modulation over amplitude modulation, as a system for the transmission and reception of high-quality speech and music with a minimum of noise interference, can be epitomised in the following few words. *Frequency modulation permits better quality reproduction with improved signal-to-noise ratio whereas amplitude modulation permits increased quality of reproduction at the expense of increased noise interference.*

(*To be continued*)

CLASSIFIED ADVERTISEMENTS

LITERATURE, MAPS, etc.

RADIO SOCIETY OF GREAT BRITAIN invites all keen experimenters to apply for membership. Current issue "R.S.G.B. Bulletin" and details, 1/- below.

THE TRANSMITTING LICENCE. A new 32 page R.S.G.B. publication in the series "Amateur Radio," 9d., or 1/- post free ; below—

AMATEUR RADIO HANDBOOK (300 pages), paper cover, 4/- ; cloth, 6/6. Radio Handbook Supplement (140 pages), paper cover, 2/9 ; cloth, 5/-.—R.S.G.B., 28-30, Little Russell Street, London, W.C.1.

WEBB'S Radio Map of the World. Locates any station heard. Size 40in. x 30in., 4/6, post 6d. On linen, 10/6, post 6d.—Webb's Radio, 14, Soho Street, London, W.1. GERrard 2089.

MORSE & S.W. EQUIPMENT

MORSE Practice equipment for class-room or individual tuition. Keys, audio oscillators for both battery and main operation.—Webb's Radio, 14, Soho Street, London, W.1. Phone : GERrard 2089.

"H.A.C." Short-wave Receivers. Famous for over ten years. Improved one-valve model now available. Complete kit of components, accessories, with full instructions, now 19/3, postage 9d. Easily assembled in one hour. S.A.E. for free catalogue.—A. L. Bacchus, 109, Hartington Road, London, S.W.8.

RECEIVERS & COMPONENTS

EXCEPTIONALLY High Fidelity Amplifiers incorporating the new Cathode Follower output circuit and flexible bass and treble tone control, now available for Home Constructors. To Music Lovers these Amplifiers set a new high standard of reproduction. 7 watt and 3 watt amplifiers and Radio Tuner Unit. Full drawings and Point to Point wiring diagrams, 2/6 each ; 5/- the set of three. Separate components or complete kits of parts for all units available, including ready drilled chassis. Send stamp for details and price lists. All types of components available C.O.D. Send your requirements (post only) to : Charles Amplifiers, 14, Lapstone Gardens, Kenton, Middlesex.

CAR RADIO Transformer, 6 v., 12 v., 17s. ; Mains, 250-0-250 v. 60 mA. 6.3 v., 5 v., 22s. 6d.—Body, 22, Fabian Cres., Shirley, B'ham.

TELERADIO kit service. "Minor" 4 v. 2 wave TRF "E" valves, components, blueprint and instructions, £4. "Minor" battery, 3 v. 2 wave Mazda valves, components and blueprint, £3. 4 watt A.C./D.C. amplifier 3 valve with prints, 45/-. Valves, speaker and postage extra. Blueprints of any of above, 2/-. Midget 2 gang, 11/-. Wearite P coils, new price, 3/- ea. Full shrouded quality mains transformers, 350 v. 80 ma., 25/-. Multi-ratio spkr. trans. (24—117/1), 6/-. 3 waveband coil packs, aligned and tested, including circuit and all parts less 2 gang, 38/6. Cathode Ray tubes, 2in. to 12in. from £2. All wave full vision dials and drive 7½ x 4½, 10/6. Muirhead Battery oscillator Med., Long and IF, recently overhauled and re-calibrated, £5 10s. Silver mica condensers up to 600 pf. 9d. ; up to 5,000 pf, 1/3. Wire wound volume controls 2,500 to 25 k., 5/6. 16 plus 16 mfd., 6/3 ; 8 mfd., 3/3. New purchase of professional Midget cabinets similar to Pilot Maestro in walnut, rounded corners, 37/6. Plus postage under £2. S.A.E. for lists.—Teleradio Co., 157, Fore St., Edmonton, N.18.

MALLORY Vibrators. 6-v. 4-pin U.X. New and Guaranteed, 8/6 each.—H. English, The Maltings, Rayleigh Rd., Hutton, Essex.

RADIOGRAPHIC, LTD. (B.R.S. 12040), of Glasgow, are forging ahead in getting supplies of vital interest to all Radio Enthusiasts. Keep in constant touch for the latest news of still greater supplies. Transmitters, Transceivers, Valves (RX & TX), and all components.—Radiographic, Ltd., 66, Osborne Street, Glasgow, C.5.

A.C./D.C. 5-valve Super-heterodyne receivers. Excellent reproduction, 8in. speaker. Attractive walnut cabinets. Lacquered metal grill. Modern design. Retailing £15/10/6. Usual trade terms, facilities and service. Early delivery. Trade only.—Osborne & Co., Southview Road, Warlingham, Surrey

VALVES. HL2, PM2HL, 5/10. 1H5GT, HD24, MHL4, 9/2. 1C5GT, IN5G, VP2, SP2, W21, Z21, KT2, MU14, 11/-. XL, XD, AC/VP1, SP4, MKT4, 12/10. XY, 1.5 volt, 19/- Valveholders, 9d. Hivac, 4-pin, 7d. ; 5-pin, 8d. **CONDENSERS.** Trimmers, 50 mmfd., 9d. ; 100 mmfd., 1/-. Twin 500 mmfd., 2/-. Silver mica, 50, 100 and 500 mmfd., 9d. Tubular, 500 v. w., .0001 mfd. to .01., 8d. .025 mfd. to .1, 1/- ; .25, .5 mfd., 1/6 ; 1 mfd., 2/-. Electrolytics, 8 mfd., 500 v., 3/- ; 25 mfd., 25 v., 50 mfd., 50 v., 2/6. ; 50 mfd., 25 v., can type, 2/9. **RESISTORS.** 1 watt, 100 ohms to 1 meg., 7d. each, 6/- per doz. **SYSTOFLEX.** 2 mm., 3d. per yard. **WIRE.** Tinned copper, 16, 18, 20, 22, 24 g., 2/3 per ½ lb. New goods only. Write for full list of supplies.—**Radio Supplies, 56, Hughes Ave., Horwich, Lancs.**

OSCILLOSCOPE. Full constructional details and drawings, 3/6.—20, Malzeard Road, Luton.

"BUILD YOURSELF or YOUR FRIENDS a WIRELESS ! Complete constructional details of 4 valve Universal Mains Receiver, 2/6 post free. Complete kit (incl. very attractive cabinet) down to the last screw, £7/17/6. Advice free.—N. R. S., 66, Parkhill Road, London, N.W.3.

STILL Supreme in Radio.—O. Greenlick Ltd., 34, Bancroft Road, Cambridge Heath Road, London, E.1. 'Phone : STEpney Green 1334.

"OSCILLATOR KITS," 12 to 3,000 metres, modulated, 55/- complete, including chassis, components, valve, all new, coils and switch ready wired and tested, circuit. Details of oscillator and valve voltmeter, 1/6.—49, Booth Farm Road, Birmingham 22.

NEW First Quality Radio Components at competitive prices. Quick delivery. Lists Free. W. Leppard, Hamsey Road, Sharpthorne, East Grinstead, Sussex.

TRANSFORMERS, Chokes, etc., rewound Quick service.—Ellis, 135, High Street, Bromley, Kent.

EX-GOVT. Solid Mahogany Cases, suitable for Wireless instruments, etc. Weight approx. 5 lbs. Size 10¼ x 8¼ x 6½. All Brass fittings with carrying handle, lock and key. Price, including postage, 15/-. Radio Services (B'ham.), 123, Winson Green Rd., Birmingham, 18.

VALVE EQUIVALENT CHART.—Something New. Shows you alternative valve at a glance. P.O. 1/- post free. Trade also supplied. Also full list of components at competitive prices, 1d. stamp.—M.R.E.S., 126, Manningham Lane, Bradford.

REWINDING.—Mains, field coils, outputs, chokes, etc., rewound or altered to specification. Best quality work—quick service. Transformers for instruments, oscillators, etc., a speciality. Large transformers, etc., for amplifiers. Send us your requirements. Television H.T. transformers rewound from 25/-. For special trade rates, send card or business heading.—North West Electrical Co. (P.W.), 36, Rosslyn Hill, London, N.W.3.

KITS. Kits. Kits. Two waveband. All mains 4 valve. Tube line up, 6K7, 6J7, 25Z6, 25L6. Polished Aluminium Chassis. Really first-grade components. Station-named dial. Delivered complete to last nut. Full wiring instructions. Price, £7/8/- C.W.O. or C.O.D.—Isherwoods, Reme House, Plungington Road, Preston, Lancs. Tel. : 3348 Preston, Radio Repairs. Est. 1936.

WEARITE "P" type coils now available Aerial, H.F. transformer and oscillator coils for 16-47, 200-557 and 700-2,000 metres at 3/- each. Ivorine dials, marked in metres and with station names for medium and long-wave, 1/6. Varley dry accumulators, V40, 16/8 ; V60, 18/3. Silvered mica condensers, 2,000 vt. test, 5, 10, 15, 20, 25, 30, 50, 75 pf. 7½d. 100, 150, 200, 250, 300, 350-500 pf. 9d. .001, .002 mfd., 1/3. Mains trans. formers, 250-0-250 70 ma. 4vt. 3 amp. ct. 4 vt 2 amps. 250-0-250 70 ma. 6.3 vt. 2 amps. 5 vt. 2 amps. Both types, 22/6. Porthminster 30 watt output transformers, 10 ratios from 20-1 to 140-1. All ratios for push-pull if required, 22/6. Multi-ratio output transformers, 6 ratios from 24-1 to 117-1, to suit 2-3 ohm speakers, 7/-.—T. W. Comins, 399, Chiswick High Road, London, W.4. Phone : Chiswick 4530.

HUTCHESON RADIO
COTTINGHAM ROAD, HULL
New Goods Only.
VALVES SPECIAL. VMS4B. DH63. D41. 80. TV4A. EBS33. EF6. VP133. TP2620. FC13. 7B. 12SA7G1. 43. 9D2. 78. 25Z6G. KT2. 202YPB. CCH35. 3525GTG. C1C. 125G7. HL13. Just a few of the thousands available.
ELECTROLITIC's. Hunts Type L31, 25 mfd., 25 v.W., 3/- ; 450 v.W., 8 mf., 4/6. Type L32. 16 mfd., 450 v., 6/6.
Carbon Resistors. Mullard. Morganite & Erie. All values available. ¼ watt, 3d. ; ½ watt, 6d. ; 1 watt, 1/- ; 2 watt, 1/6.
Soldering irons. Solon electric, 13/4 each. Abingdon King Dick Spanners. Ring spanners from 4/10 ea. Open from 2/9 ea. Adjust. from 4/6 ea. Socket sets from 42/-. We have too little a space to advertise all our goods, so please send us a list of your requirements and let us quote pro forma. Satisfaction guaranteed or money back. Terms C.W.O., C.O.D. or pro forma. Orders over £2 post free. No C.O.D. under £1.

NEW. Amateur's disposal 25 w., 36 watt amplifiers, crystal, M.C. mikes, 10in. P.M. speakers, heavy duty and other transformers, Avo oscillator, components, mostly boxed.—S.A.E. for details from Box No. 131, "Practical Wireless," Tower House, Southampton Street, W.C.2.

CHASSIS. Plated and drilled. Heavy steel. 13in. x 8in. x 2½in., 5/- ea. 6in. x 4in. x 3in., 1/6 ea. 10½in. x 3½in. x 2in., 1/6 ea. Flat Chassis, 11½in. x 17½in., 3/- ea. Midget Chassis, 6¾in. x 4¾in. x 1in., drilled, 1/- ea. ; 9/- doz. ; or with 7-7 pin midget Ceramic V.Hs fitted, 5/- ea. Louvred amplifier cases with slide-in chassis, 13in. x 11in. x 7in., finished grey enamel, 7/6 ea. Screens, 4in. x 9in. x 4½in., 1/- ea. Terminal panels or control brackets, 3in. x 1½in., 2/- doz. Corner mounting brackets for Electrolytics or V.H., 2in. x 2in., 2/- doz. Panel with resistance, condenser and V. Clip, 1/-. 3 trimmers on panel with sockets, 1/-. Speaker Transformer clamps with terminal blocks, 6d. ea. Angle strip, 16in. x 1½in., 6/- doz. Special quotations for quantities. R.C.A. Midget Valves, I.T.4, 12/- ea. Miniature deaf-aid triodes, 12/- ea.—H. English, The Maltings, Rayleigh Rd., Hutton, Brentwood, Essex.

SOUTHERN RADIO'S WIRELESS BARGAINS.
LATEST RADIO PUBLICATIONS: *Radio Valve Manual.* Equivalent and alternative American and British types, with all data, 3/6. *Radio Circuits.* Fully illustrated receivers, power packs, etc., 2/-. *Amplifiers.* Fully descriptive circuits, 2/-. *Radio Coil and Transformer Manual,* 2/-. *Short Wave Handbook,* 2/-. *Manual of Direct Disc Recording,* 2/-. *Test Gear Construction Manual,* 1/6. *Radio Pocket Book.* Formulas, tables, colour code, etc., 1/-. *Ten Hows for Radio Constructors,* 1/-. *Radio Reference Handbook.* Cloth bound, comprehensive and up-to-date, covering all branches of radio, 12/6. *American Service Manuals.* Sparton-Emerson, Crosley-Belmont (Part 1 and 2), Stewart-Warner-Fada, Emerson, 12/6 per volume. *Radio Resistor Chart.* Colour codes at a flick, 1/- each. *Bulgin Radio Service Manual,* 2/6. *Radio Constructors' Manual,* 3/-. Postage extra.
YAXLEY Type 2-way Rotary Switches, 5/-. Tubular Condensers, 0.1+0.1+0.1 (cans), 2/6. Resistances, brand new, wire-ended, ¼, ½ and 1 watt, assorted values, 30/- per 100 ; ¼ watt only, assorted values, 20/- per 100 ; ½ watt, 22/6 per 100.
ACE "P.O." Microphones complete with transformer, usable with any receiver, 7/6. Permanent Crystal Detector, 2/6. Insulated Push Back Wire, 25 yards, 5/-. Insulated Sleeving, assorted sizes and colours, 3/6 per dozen yard lengths ; Single Screened Wire, 7/6 per dozen yards ; Twin Screened, 15/- per dozen yards. Aluminium Panels, undrilled 16 gauge, 18 inches x 7 inches, 3/6 ; 18 inches x 9 inches, 4/6. Ceramic and Paxoline Postage Stamp Trimmers, 30pf., single, 1/3 each ; double bank, 2/-. Cutler Harmer Power Rheostats, 30 ohms, 4/6. Power Rheostats, 10 ohms, 4/6.
LUFBRA Adjustable Hole Cutter for use on metal, wood and plastics, etc., 5/- each, including postage.
A Large Assortment of ex-Government Material in Stock.
R.A.F. 1155 Receivers available from Stock. These have been pre-tested and guaranteed. Complete with plug, £15 15s. (Carriage and Packing, 7/6 extra). Spare 1155 Plugs, 8/6.
SOUTHERN RADIO SUPPLY CO., 46, LISLE STREET, LONDON, W.C. Gerrard 6653.

FRED'S RADIO CABIN
OFFER THE FOLLOWING BARGAINS.
Long-wave coils, 3/- pair. Permanent crystal detectors, 2/6. Three-wave coils superhet, 10/- pair. Wire-wound potentiometers, 400 and 5,000 ohms, 2/6 each ; 25,000 ohms, 4/6. Solon irons, soldering ; straight 13/6, pencil 14/6. T.C.C., .01 mfd., 8/- doz. ; .01 mfd. mica, 1/- each ; .0001 mfd. mica, 1/- each. G.E.C., .1 mfd., 350v. w., 8d. each, 7/6 doz. Bias condensers, 50 mfd., 12v. w., 1/9 ; 25 mfd., 30v. w., 2/-. 1 watt first-grade resistances, 6/- doz., ½ watt, 4/6 doz. ; our selection. Resin core solder, 3/9 lb. reel. Multicore, 5/6 lb. reel. .3 and .2 amp. droppers, 5/6 each. Replacement field coils, 1,000, 2,500, 6,500 ohms, 6/6 each. 2 gang .0005 mfd. condensers, with trimmers, 12/6. Knobs, 6d. ; 5/6 doz. ; green milled edge. Brown pointer knobs, 8d. each. Octal valveholders, 8d. each. Sleeving, 2mm., 3/- doz. yds. Moving-coil spiders, 5/6 doz. On-Off toggle switches, 1/9 each. 2 Meg. vol. control with switch, 3/9. 2 Pole 6-way switches for meters, 3/6. Croc. clips, 3/- doz. Large UX 7-pin Ceramic valve-holders, 1/3 each. Hivac valve-holders, 4-pin 7d., 5-pin 8d., 2-pin baseboard coil-holders, 4d. Dial bulb-holders, clip and bracket type, 6d. Weymouth coilpack all-wave, 38/6. I.C. I.F. coils, 465 kc/s., 15/- pair. Many other bargains for callers only.
FRED'S RADIO CABIN, 75, Newington Butts, Elephant and Castle, London, S.E.11. (One minute from Tube.) Rodney 2180.

R.A.F. R1155 Receivers and R.A.F. T1154 Transmitter Power Packs. S.A.E. for details and components list. Please note new address. Any components supplied by Mail Order. Jarvis, 12, Chatsworth Road, Chorlton-cum-Hardy, Manchester. Certificated radio engineer.

SPARKS' DATA SHEETS
Provide full constructional details, theo. circuit, full-size detailed prints of drilling, assembly and wiring plans of **TESTED and GUARANTEED DESIGNS.** A wide range of Data Sheets is available. See Sept. issue for more details, or send stamp for complete list.
ALL-DRY 3-VALVE PORTABLE.—New design, No. LO/S., just released ; self-contained M/L wave aerial, and speaker ; powerful sigs., Data Sheet, 2/6.
MIDGETS.—Amplifiers, Sets, etc., for Mains or Battery operation, available in Data Sheet form.
L. ORMOND SPARKS, The Constructor's Consultant, 9, **Phoebeth Road Brockley, S.E.4.** 'Phone : Lee Green 0220.

RELAYS
for
A.C. and D.C.
The wide range of Londex Relays covers especially the Wireless and Electronic fields.

Relay L.F.

Ask for details and leaflet 205/PW.

LONDEX LTD.
Anerley Works, 207, Anerley Road, London, S.E.20. 'Phone : SYD 6258/9.

A FREE BOOK
for all interested in

MORSE CODE TRAINING.
There are Candler Morse Code Courses for Beginners and Operators.
Send for this Free "BOOK OF FACTS"
It gives full details concerning all Courses.

THE CANDLER SYSTEM CO. (5.L.O.)
121, Kingsway, London, W.C.2.
Candler System Co., Denver, Colorado, U.S.A.

CHARLES BRITAIN (RADIO) Ltd., lines of interest and special offers, **PAGE MIDGET SPEAKERS,** 5in. less trans., 22/6 ea. Midget chassis drilled for 5 valves, 2/6 ea. Two-gang condensers with feet, less trims, 12/-. .1 tubulars 8,000v wkg., 9/6 ea. Metal cased .1 tubulars, first class quality 350v, wkg., 5/6 doz. ; .5 350v. wkg., 6/- doz. ; .01 1,000v. wkg., 4/6 doz. (Note : Please order in dozens) ; also Metalmite midget .01 350v. wkg., 6/- doz. Mains droppers 850 ohms .3 amp., 5/- ea. ; 1,000 ohms .2 amp., 4/6 ; both have two adjustable sliders and fixing feet. Volume controls with switch, 4/6, less switch, 3/- ; most values in stock.
SPECIAL OFFERS.—Parcel of resistances 1 gross asst'd ¼, ½ and 1 watt, £2. Parcel of tubular condensers 1 gross of asst'd from .001 to .5, £2/8/0. Parcel containing new and used components, I.F. transformers, speaker trans., multi-way tag bars with new resistances and condensers, also 36 new tubular condensers, £1, worth double. Small moving-coil Mikes, undamaged, 3/6 ea., damaged, 1/6 ea. Moving-coil Voltmeters 0-40v. can be de-shunted, 10/- ea. .00016 short-wave condensers, to clear, 2/6 ea. Midget radio chassis wired and tested for long and medium wave, with speaker, for use on A.C. or D.C. mains. Note the price, £6/19/6. Send for List of Smoothing Condensers, Mains Transformers, Coils, etc., etc. Terms, cash or c.o.d. over £1.—**Charles Britain (Radio), Ltd., Radio House, 2, Wilson St., London, E.C.2. 'Phone : Bis. 2966.**

WANTED, S.T.900 A.C. Model.—F. Bronson, Turvey, Bedford.

FOR SALE.—Best selection of radio and electrical spares at low costs. S.A.E. for list to Dioptrical Vision Aerial Co., 17, Mill Hill, Deal, Kent.

WANTED. 44 s.w.g. Enamelled Copper Wire. Large or small quantities. Power Specialities, Ltd., Bath Road, Slough. 21367.

G.E.C. "Overseas" Model Radio for sale, splendid condition. 3 Interchangeable coils, covering 15-32 metres, 30-80 metres and 200-560 metre wavebands. Service, data included. Ideal for Amateurs.—Mrs. Hogsden, 108, Tolworth Rd., Surbiton, Surrey.

REPAIRS to moving coil speakers, cones, coils fitted, field rewound or altered ; speaker transformers, clock coils rewound, guaranteed satisfaction, prompt service.—L.S. Repair Service, 49, Trinity Rd., Upper Tooting, S.W.17. 'Phone : BALham 2359.

SITUATIONS VACANT

"ENGINEERING OPPORTUNITIES"—FREE 112-page guide to training for A.M.I.Mech.E., A.M.I.E.E., and all branches of Engineering and Building. Full of advice for expert or novice. Write for free copy and make your peacetime future secure.—B.I.E.T. (Dept. 242B), 17, Stratford Place, London, W.1.

TUITION

PRACTICAL Training in Radio Physics. A three months Laboratory Course is now available at The British National Radio School, a long established and highly successful institution specialising in converting "Operators" and "Mechanics" into Radio Engineers. Correspondence courses in Radar, Radio and Television. Ask for details of our unique "Four Year Plan" leading to Brit. I.R.E. and I.E.E. examinations with five City and Guilds certificates as interim rewards. Studies Director, B.N.R.S., 66, Addiscombe Road, Croydon, Surrey.

RADAR, WIRELESS, TELEVISION, etc. Be prepared for tremendous peace-time developments. Students of both sexes trained for appointments in all branches of radio. Boarders accepted. Low fees. 2d. stamp for prospectus. Wireless College, Colwyn Bay.

THE Tuitionary Board of the Institute of Practical Radio Engineers have available Home Study Courses covering elementary, theoretical, mathematical, practical and laboratory tuition in radio and television engineering ; the text is suitable coaching matter for I.P.R.E. Service entry and progressive exams. ; tuitionary fees at pre-war rates—are moderate. The Syllabus of Instructional Text may be obtained, post free, from the Secretary, 20, Fairfield Road, Crouch End, N.8.

Practical Wireless

BLUEPRINT SERVICE

PRACTICAL WIRELESS		*No. of Blueprint.*
CRYSTAL SETS		
Blueprints, 6d. each.		
1927 Crystal Receiver	—	PW71*
The "Junior" Crystal Set ..	—	PW94*
STRAIGHT SETS. Battery Operated.		
One-Valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A*
Beginners' One-valver	—	PW85*
The "Pyramid" One-valver (HF Pen)	—	PW93*
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF) ..	—	PW76*
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2LF (Trans)) ..	—	PW10
Summit Three (HF Pen, D, Pen)	—	PW37*
All Pentode Three (HF Pen, D (Pen), Pen) ..	—	PW39*
Hall-Mark Cadet (D,LF,Pen (RC))	—	PW48*
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	—	PW49*
Cameo Midget Three (D, 2 LF (Trans))	—	PW51*
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53*
Battery All-Wave Three (D, 2 LF (RC))	—	PW55*
The Monitor (HF Pen, D, Pen) ..	—	PW61*
The Tutor Three (HF Pen, D, Pen)	—	PW62
The Centaur Three (SG, D, P) ..	—	PW64*
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	—	PW72*
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	—	PW82*
F. J. Camm's Oracle All-Wave Three (HF, Det. Pen) ..	—	PW78*
1938 "Triband" All-Wave Three (HF, Pen, D, Pen)	—	PW84*
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	—	PW87*
The "Hurricane" All-Wave Three (SGD, (Pen), Pen)	—	PW89*
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet) ..	—	PW92*
Four-valve : Blueprints, 1s. each.		
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17*
Nucleon Class B Four (SG, D (SG), LF, Cl. B) ..	—	PW34B*
Fury Four Super (SG, SG, D, Pen)	—	PW34C*
Battery Hall-Mark 4 (HF, Pen, D, Push-Pull)	—	PW46*
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	—	PW83*
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	—	PW90*
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	—	PW67*
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18*
Selectone A.C. Radiogram Two (D. Pow)	—	PW19*
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23*
D.C. Ace (SG, D, Pen)	—	PW25*
A.C. Three (SG, D, Pen)	—	PW29*
A.C. Leader (HF Pen, D, Pow) ..	—	PW35C*
D.C. Premier (HF Pen, D, Pen) ..	—	PW35B*
Ubique (HF Pen, D, Pen), Pen) ..	—	PW36A*
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50*
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54*
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen) ..	—	PW56*
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70*
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20*
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45*
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47*
SUPERHETS		
Battery Sets : Blueprints, 1s. each.		
£5 Superhet (three-valve) ..	—	PW40*
F. J. Camm's 2-valve Superhet ..	—	PW52*
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43*
D.C. £5 Superhet (Three-valve) ..	—	PW42*
F. J. Camm's A.C. Superhet 4 ..	—	PW59*
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	—	PW73*
SHORT-WAVE SETS. Battery Operated		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver ..	—	PW88*
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A*
The "Fleet" Short-wave Two (D (HF Pen), Pen)	—	PW91*
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A*
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63*
The Band-spread S.W. Three (HF Pen, D (Pen), Pen) ..	—	PW68*
PORTABLES		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65*
Parvo Flyweight Midget Portable (SG, D, Pen)	—	PW77*
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86*
MISCELLANEOUS		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A*

AMATEUR WIRELESS AND WIRELESS MAGAZINE		
CRYSTAL SETS		
Blueprints, 6d. each.		
Four-station Crystal Set	—	AW427*
Lucerne Tuning Coil for A.W.427*, 6d.		
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450*
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387*
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans) .	—	AW388*
Full-volume Two (SG det. Pen) ..	—	AW392*
A modern Two-valver	—	WM409*
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans) ..	—	AW412*
Lucerne Ranger (SG, D, Trans) .	—	AW422*
£5 5s. Three De Luxe Version (SG, D, Trans)	—	AW435*
Transportable Three (SG, D, Pen) .	—	WM271
Simple-Tune Three (SG, D, Pen) ..	—	WM327*
Economy Pentode Three (SG, D, Pen)	—	WM337
"W.M." (1934 Standard Three (SG, D, Pen)	—	WM351*
£3 3s. Three (SG, D, Trans) . .	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen) ..	—	WM389*
Certainty Three (SG, D, Pen) ..	—	WM393
Minitube Three (SG, D, Trans) ..	—	WM396*
All-wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
Self-contained Four (SG, D, LF, Cl. B)	—	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2LF) .	—	WM381*
The H.K. Four (SG, SG, D, Pen) ..	—	WM384
The Auto Straight Four (HF, Pen, HF, Pen, DDT, Pen) ..	—	WM404*
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF Class B)	—	WM340
Mains Operated		
Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C. .	—	AW403*
Economy A.C. Two (D, Trans) A.C.	—	WM286
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans, A.C.) ..	—	AW383*
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374*
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	—	WM401*
Four-valve : Blueprints, 1s. 6d. each.		
All-Metal Four (2 SG, D, Pen) ..	—	WM329
Harris' Jubilee Radiogram (HF, Pen, D, LF, P)	—	WM386*
SUPERHETS		
Battery Sets : Blueprints, 1s. 6d. each.		
'Varsity Four	—	WM395*
The Request All-Waver	—	WM407
Main Sets : Blueprints, 1s. each.		
Heptode Super Three A.C. ..	—	WM359*
PORTABLES		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393*
Family Portable (HF, D, RC, Trans)	—	AW447*
Tyers Portable (SG, D, 2 Trans.)	—	WM367*
SHORT-WAVE SETS. Battery Operated		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	—	AW429*
Roma Short-Waver	—	AW452*
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det Pen)	—	WM402*
Home-made Coil Two (D, Pen) ..	—	AW440
Three-valve : Blueprints, 1s. each.		
Experimenter's 5-metre Set (D, Trans, Super-regen)	—	AW438
The Carrier Short-waver (SG, D, P)	—	WM390*
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans) ..	—	AW436*
Standard Four-valver Short-waver (SG, D, LF, P)	—	WM383*
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	—	WM397*
Mains Operated		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen), A.C.	—	AW453*
Three-valve : Blueprints. 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352*
Four-valve : Blueprints, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	—	WM391*
MISCELLANEOUS		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387*
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392*
Radio Unit (2v.) for WM392 (1/-)	—	WM398*
Harris Electrogram battery amplifier (1/-)	—	WM399*
De Luxe Concert A.C. Electrogram (1/-)	—	WM403*
New Style Short-wave Adapter (1/-)	—	WM388
Short-wave Adaptor (1/-) ..	—	AW456*
B.L.D.L.C. Short-wave Converter (1/-)	—	WM405*
Wilson Tone Master (1/-) ..	—	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408*

SPECIAL NOTICE

THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk beside the blueprint number denotes that constructional details are available, free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

HINTS COUPON

This coupon is available until October 7th, 1946, and must accompany all Practical Hints.

PRACTICAL WIRELESS, October, 1946

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C. printed in England by W. SPEAIGHT & SONS, LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zeal[illegible] GORDON & GOTCH (A/sia), LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rates including post Inland 10s. 6d. per annum. Abroad 10s. per annum. Registered at the General Post Office for the Canadian Maga[illegible]