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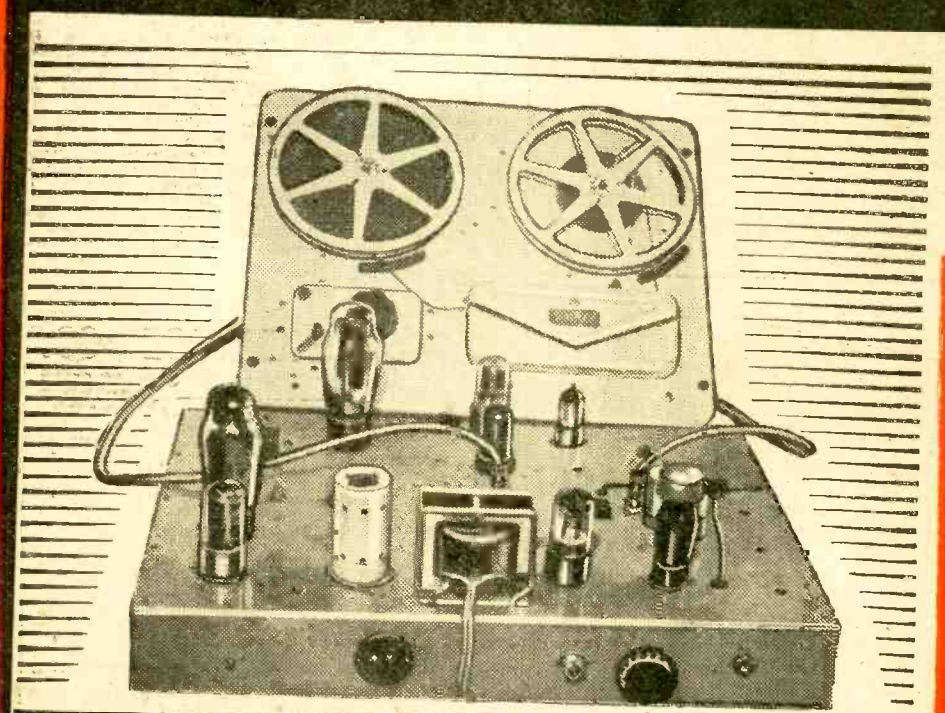
EDITOR:
F. J. CAMM

PRACTICAL WIRELESS



A TAPE-DECK AMPLIFIER

IN THIS ISSUE:

Practical Wireless

EVERY MONTH
VOL. XXVIII, No. 550 AUGUST, 1952

Editor F.J.CAMM

20th YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

VHF Broadcasting

IN view of the recommendations in the Beveridge Report that the BBC should develop very high frequency broadcasting as soon as possible, it was somewhat surprising to read a statement on VHF in the U.S.A. which has been printed and circulated by a British receiver manufacturer to all Members of Parliament. It is an illuminating document and it analyses the present state of FM broadcasting in America as it exists to-day, after 15 years of operation. The conclusion is that it is a bad system, and that it has a long way to go before perfection is reached. The statement says that the analysis should be considered before Great Britain becomes too deeply involved in a similar system. It says that the position might have been improved if amplitude modulation had been employed.

This report is in such contradistinction to the findings of the Beveridge Committee, which listened to a great amount of technical discussion on the matter, that we are surprised it should be raised at this time, when a certain amount of progress has been made towards implementing the recommendations. We hope to be able to print a summary of the analysis and report on VHF in our next issue.

LORD REITH ON SPONSORED PROGRAMMES

LORD REITH'S expected attack on the Government's proposals to admit commercially-sponsored television was duly delivered within the privileged precincts of the House of Lords. With typical acerbity he described the policy as "foolish and pernicious," "cock-eyed finance," "offering worthless safeguards," and "selling the BBC down the river." Reduced to quintessence his criticisms amounted to a plea that, although he is no longer Director-General of the BBC, it should continue in perpetuity on the same lines as he laid down. Lord Reith has a fine conceit of himself in presuming that his policy was so sound that it is incapable of improvement or change. It is generally conceded that to-day the BBC programmes, its attitude, its policy and its desire to please listeners are far better than during his 16 years of office. The Postmaster-General pricked his verbose bubble when he said, "As a great administrator he has always been one who liked his own way." Indeed, from the vigour of Lord Reith's attack it might be presumed that he still *is* the Director-General responsible for BBC policy. Said Lord Reith, referring to Sir William Haley, who has just vacated his post as Director-General of the BBC to take up the editorship of "The Times": "He treats me with great courtesy when we meet, but he knows I do not agree with everything that happens now." It is of no consequence to anyone but Lord Reith whether he approves present BBC methods or not. They are no concern of his and his remarks savour of a disgruntled ex-servant rather than as real criticisms of matters which need criticism.

THE P.W. 3-SPEED AUTOGRAM BLUEPRINTS

THE price of the two sheets of full-size blueprints for the P.W. 3-speed Autogram has been increased to 7s. 6d. as from July 10th. All orders received up to that time will, of course, be supplied at the old price.

PREMIUMS FOR TECHNICAL LIGHTING

THE R.I.C. panel of judges, which will award premiums to the authors of technical articles submitted in accord with the rules previously given in this journal, has now been appointed. Results will be announced and cheques presented at the National Radio Show. Premiums of 25 guineas each up to six a year are offered, and they apply to the authors of articles published during the first six months of the year. Only non-professional writers contributing to journals available to the public are eligible to compete. The names of the judges are published elsewhere in this issue.

THE NATIONAL RADIO SHOW

THE National Radio Show takes place this year from August 26th until September 6th. This journal and its companion journals, *Practical Television*, *Practical Mechanics* and *Practical Engineering*, will be represented on our stand as usual, together with a selection of our technical books and blueprints.—F.J.C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended 30th April, 1952.

Region	Number
London Postal ..	2,389,000
Home Counties ..	1,677,000
Midland	1,772,000
North Eastern	1,958,000
North Western ..	1,652,000
South Western ..	1,085,000
Welsh and Border Counties	748,000
Total England and Wales	11,281,000
Scotland	1,154,000
Northern Ireland ..	212,000
Grand Total ..	12,647,000

Car Radio Pirates

CARDIFF G.P.O. has started an all-out drive to trace "pirate" motorists—those without licences for their car radios.

One method used by the Post Office representatives is to park their cars in the city's short-time parking spaces, seeing which cars have aerials, and then awaiting the drivers' return to check that they have a licence.

The numbers of car radio licences in Wales must be increased by 5,500 in a year, the P.M.G. has instructed. There has already been a big jump so far this year.

Successful house radio licence prosecutions in Cardiff now total 1,623.

Marconi Veterans Meet

ONE hundred and forty veterans, many of whom can recall wireless in its infancy, met at Caxton Hall recently to meet old friends and discuss past history. They were members of the Marconi Veterans Association attending their 16th Reunion and Annual General Meeting.

In the chair was Mr. W. I. McGhee, one of the first twelve Radio Officers to be appointed by The Marconi International Marine Communication Company, who had completed 41 years' service with the company before his retirement in 1945.

Mr. H. C. Van de Velde, deputy to the managing director of the Marine Company, paid tribute to another veteran, Mr. Raymond Dorrington Bangay, who this month is celebrating his fiftieth anniversary with Marconi's Wireless Telegraph Company. He is still active as foreign manager and has been responsible for wireless installations all over the globe.

Opening of Queensland Station

IT has been announced by Mr. Faragher, Director of Posts and Telegraphs, that it is expected that the new radio station at Mermaid Beach, near Southport, Queensland, will be in operation within a few months.

Radio equipment for the station has already been installed.

Secretary for A.P.G.

A G.P.O. statement says that Mr. J. Hodgson has been appointed as private secretary to Mr. David Gammans, M.P., Assistant Postmaster-General.

New V.H.F. D/F.

AIR MARSHAL C. E. GIBBS, C.I.E., C.B.E., M.C., Commander-in-Chief Indian Air Force with Group Captain Rajaram, D.F.C., Station Commander, Palam, inspected the first Marconi V.H.F. direction finder (AD 200) installed by Marconi's Wireless Telegraph Co., Ltd., at Palam Airport, New Delhi, recently. This equipment, in addition to being used by the Indian Air Force, will provide bearings for all international airliners arriving at New Delhi, including the B.O.A.C. "Comet."

Teachers' Vacation Course

ANOTHER vacation course for teachers of radio and television is to be held at the Borough Polytechnic, London, from Monday, September 8th to Saturday, September 13th, resident students assembling on Sunday, September 7th.

The course is again arranged jointly by the Ministry of Education and the Radio Industry Council and follows the lines of the courses held in previous years.

"Bill" Davies, who shortly celebrates his golden jubilee at sea, receiving one of the Cossor "Melody Maker" sets from his former shipmate, Harry Roberts (general sales manager of A.C. Cossor, Ltd.).

The programme includes visits to a valve factory, to BBC studios, the terminal of the London-Birmingham television link, a receiver factory and a component factory. Students will lunch as guests of the Radio Industry Council on September 13th, the final day.

Queen Grants Patronage

HER MAJESTY THE QUEEN has been graciously pleased to grant her Patronage to The British Institution of Radio Engineers.

His Majesty the late King George VI became Patron of the Institution in 1946.

"By Cable—By Wireless"

A NEW G.P.O. booklet, "By Cable . . . By Wireless" describes in a concise form the history and operations of this great system of world-wide telecommunications. Packed with information, the booklet should prove a splendid source of reference.

The practical information is of great help to the users of the services. For example, there is a chapter on the cost of cabling and another chapter on how to make the fullest use of the services at the smallest cost.

New President

MR. K. A. RUSSELL, B.Sc., A.M.I.E.E., Chief Engineer of British Relay Wireless Ltd. and associated companies, was unanimously elected president of the Society of Relay Engineers at its eighth annual general meeting held recently in London.

Decca Radar Section

MR. R. F. HANSFORD, of the Admiralty Signal and Radar Establishment and Sperry Gyroscope Co., has joined the radar applications division, a new section of Decca Radar Ltd.

The new division will concentrate on the study of marine and harbour radar.

New Search for Saucers

REPORTS from America indicate that the United States Air Force is to reopen its investigations into the question of flying saucers, employing all the latest radar equipment and special cameras.

Over 800 reports have reached the Air Force from people who claim to have seen strange objects speeding across the sky.

The developments follow a long period of "silence" since the Air Force officials declared the matter closed eighteen months ago.

Company Equipped with V.H.F.

AN interesting example of the use of the V.H.F. radio in connection with power systems is given by the communications network which The General Electric Co. Ltd. supplied to The Hydro-Electrica do Alto Alentejo in Portugal.

At present, the power company has 13 radio stations, three with output powers of 100 watts and ten of 15 watts, five of the latter being mobile stations.

All the transmitter receiver stations work on telephony and, after more than two years of regular use, have proved to be of substantial value in the operation and maintenance of the power system.

EKCO/Victor Agreement

UNDER an agreement concluded with the Victor Animatograph Corporation of Davenport, Iowa, U.S.A., E. K. Cole Ltd. are to market in Great Britain and certain overseas territories the Victor 16 mm. film projector manufactured in this country.

The projector is already well known throughout the world, and the new marketing organisation which is being set up by E. K. Cole Ltd. to handle the product, under the direction of Mr. A. J. Brunker (general export manager), will pay special attention to the development of its potentialities in overseas territories. They will have the active co-operation of Mr. R. Kulka, a vice-president of the Animatograph Corporation, who will assist with marketing planning.

Mr. J. C. Rogerson has been appointed manager of the new department which will be known as the British Victor Division, with headquarters at 5, Vigo Street, W.1, the London offices of E. K. Cole Ltd.

Glider "Walkie-Phone"

GUESTS, listening to the loudspeaker system at the Royal Aeronautical Society's garden party at White Waltham Aerodrome, Maidenhead, heard Squadron-Leader E. J. Furlong, instructing a pupil in a two-seater glider a few thousand feet above the aerodrome.

Air Marshal C. E. Gibbs, C.I.E., C.B.E., M.C., inspecting the Marconi direction finder.

One of the Pye "Walkie-Phones" which will be used by the British team during the International Gliding Championships, will be wired into the glider's intercom. and will radio Squadron-Leader Furlong's instructions to the loudspeaker system via a Pye fixed station. Recent tests have shown that the Pye "Walkie-Phone" installed in gliders is capable of receiving and transmitting messages up to a distance of 60 miles.

High Definition Films, Ltd.

MR. NORMAN COLLINS (chairman and managing director of High Definition Films, Ltd.) and Mr. T. C. Macnamara (technical director) produced a paper during the recent I.E.E. convention on the new electronic system which has been developed by the company.

A film employing the system was shown, the first of its kind.

THE P.W. 3-SPEED AUTOGRAM

LINING UP AND ADJUSTING

(*Concluded from page 296 July issue.*)

HAVING completed the wiring and tested the multi-cord lead, the receiver is now ready for testing and this should be carried out before inserting the apparatus in the cabinet so that any necessary modifications may be more easily carried out. Make certain that the fuses are correctly fitted and of the right type, turn the volume control to its maximum position anti-clockwise until it clicks, and then insert the mains plug into a convenient mains socket. The valves should be inserted into the sockets as indicated on the chassis layout, in conjunction with the theoretical circuit, in which the valves are numbered as well as indicated by their type numbers. For the time being leave the gramophone motor mains plug out of the socket on the main chassis and ignore the pick-up leads. Plug in a short length of wire (about 10 or 15ft. of any kind of wire will do) and connect a lead from the earth socket to a good earth connection. For preference, and to improve signal strength and reduce hum, this lead should be taken to a really reliable earth, preferably a spike or metal sheet buried in the ground. Too little importance is often attached to the earth lead, but it plays quite a large part in obtaining "clean" signals and it should be remembered that it is actually part of the first tuned circuit, which consists of the aerial and the associated coil.

Lining-up

Screw a dial light into each of the holders on the dial and clip the holders into their position and switch on the mains socket. Now turn the volume

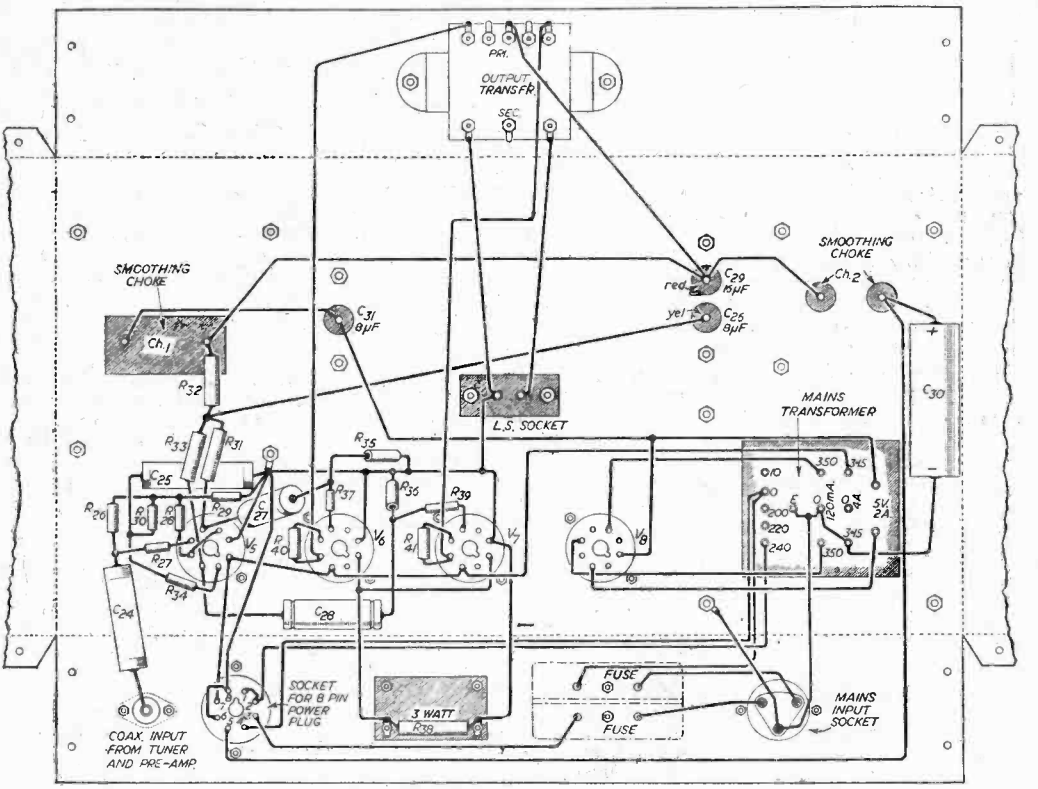


Fig. 1.—Wiring diagram of the power pack and amplifier.

control clockwise until it clicks and then leave the control at that position. This indicates that the on/off switch has operated and the volume control is at the position of minimum volume. The dial lights should light up as soon as the click is heard, and after a few seconds a breathing sound should be heard from the speaker. No hum or crackling, etc., should be heard, and if they are, it will be as well to switch off and switch off the mains supply whilst a further inspection is made of the wiring, firmness of the valves in their holders, etc. Wnen switched on with the volume control at minimum there should be great difficulty in hearing any sound from the speaker other than a faint liveliness which can only be described as a breathing sound. Provided this stage has been satisfactorily reached the radio-gram switch should be operated and a click should be heard in the speaker as it is turned from one position to the other.

The pick-up circuit is completed by the parallel resistor so no hum will be heard when turned to gram and if you are not certain which is the radio position and which gram you will have to rely upon a signal being tuned in, but an inspection of the wiring will show that, if similar connections are followed with the particular switch you have obtained, radio will be heard when the switch is turned anti-clockwise and gramophone when turned clockwise. Turn up the volume slowly and note the increase in background noises. On gramophone there will be no effect other than a slight increase in the breathing sound, so if no general crackling and similar noises are heard when the volume control is at maximum, turn back to minimum and operate the radio-gram switch. Turn the control about half-way on and then tune through the dial with the wave-change switch set to its central position, which is the medium waveband setting. The local station should be received, although

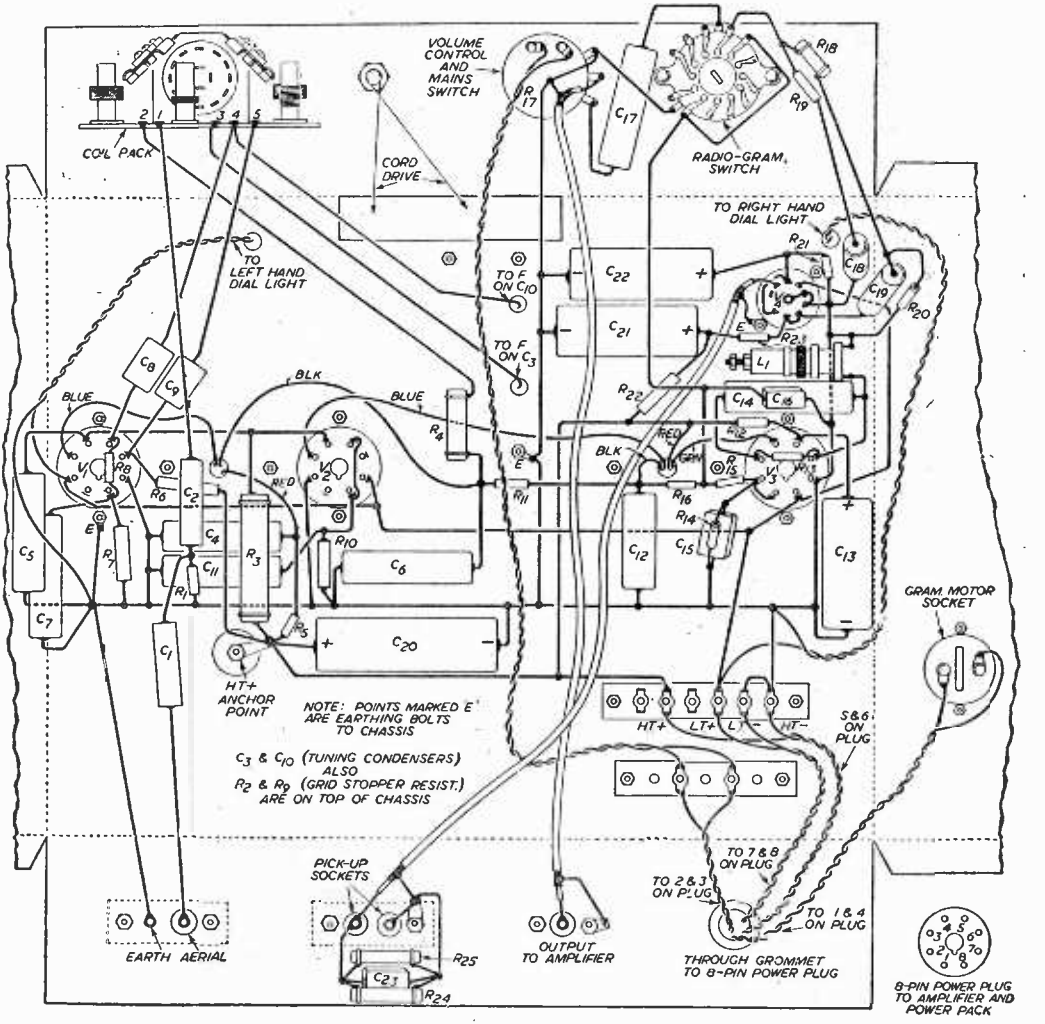


Fig. 2.—Wiring diagram of the tuner and pre-amplifier.

perhaps very distorted as the circuits will require lining up.

Adjusting the Coils

As sent out, the I.F. transformers and the coil pack are pre-set to approximately the correct positions, and it is quite possible to find that the stray capacities introduced by the wiring are so small that really good results are obtained immediately and very little re-adjustment is required, but we will assume that due to transit vibrations, etc., the adjustments are well out. Turning through the tuning range will then result in no signals being heard, other, perhaps, than a whistle or two or perhaps some code signal. In this case, remove the aerial lead and connect it by means of a clip to terminal 4 on the coil unit. Turning the dial now should enable at least one station to be picked up, and as soon as it is located turn down the volume until it can only just be heard. Now very carefully, with a sharpened knitting needle or wooden screw-driver, turn the screws of the I.F. transformers. Do this very carefully, and note the original settings so that if no improvement is effected the original setting may be obtained again. All four adjustments should be made in this way and they should, of course, all be adjusted for maximum volume, any improvement being counterbalanced by reducing the volume, so that at all times the signal is kept as weak as possible.

Peaking the Coils

Having lined up the I.F. transformers the coils must now be correctly aligned so that the tuning indicator is correct throughout the dial, and it should be remembered that the coils are provided with iron cores as well as padding or trimming condensers. The core adjustments affect the low-frequency end of the tuning scale, whilst the trimming condensers affect the H.F. end and the two adjustments must be made correctly or the scale will be found out at one end or the other. The makers' instructions regarding the lining-up cannot be improved upon and in conjunction with Fig. 4, they are as follows:

Medium Wave (190-520 metres)

1. Tighten trimmers C1 and C2 (taking care not to crack the ceramic washers), then loosen half a turn.

2. Switch to M.W. and set pointer at 98 deg. Tune in Home (330 metres), by adjusting core of L1 (M.W. oscillator).

3. Adjust core of L2 (M.W. aerial) for maximum output.

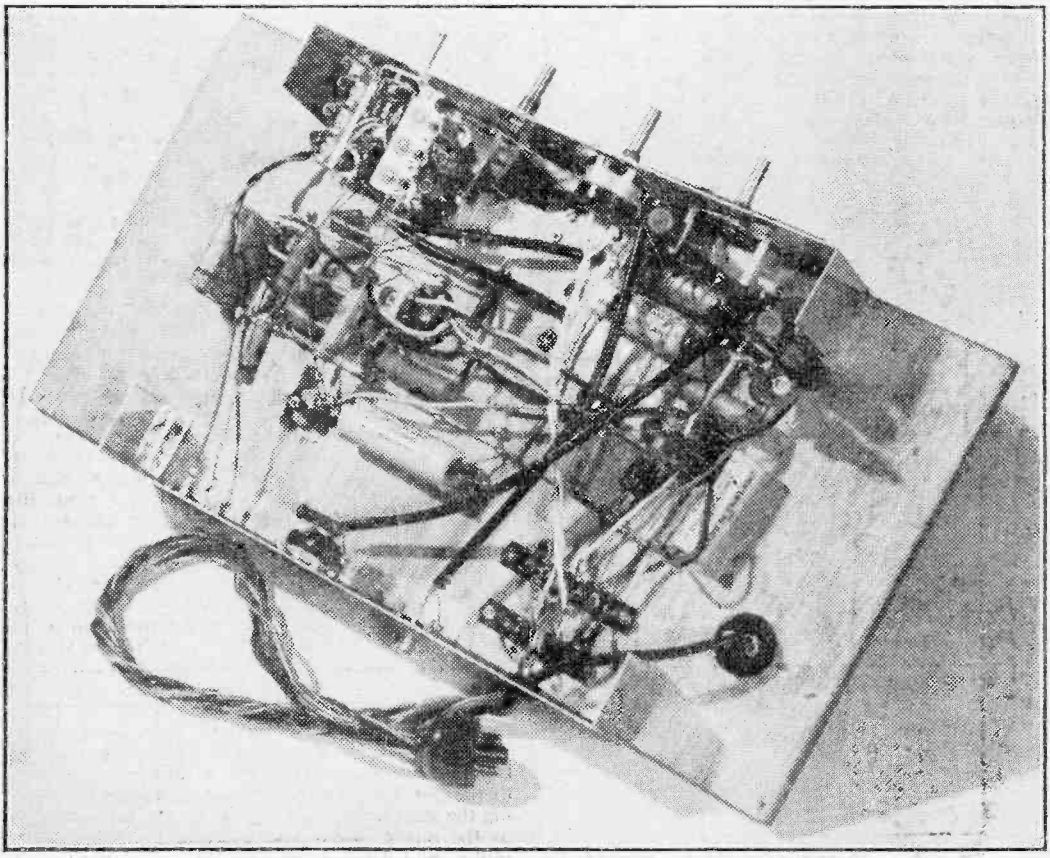


Fig. 3.—Photograph of underside of tuner unit using baseboard construction.

4. If the I.F.s have not already been peaked at 465 kc/s, they should now be tuned for maximum.

5. Set pointer at 140 deg. and tune in the Light programme (247.1 metres) by adjusting C2 (oscillator trimmer). Adjust C1 (aerial trimmer) for maximum.

6. Set pointer at 47 deg. and tune in N. Regional (434 metres) by adjusting core of L1 again. Tune core of L2 for maximum.

7. Repeat 5 and 6 several times until the positioning and strength of these stations become constant.

8. Make a final adjustment of L2 on any *weak* station around 30 deg. Make a final adjustment of C1 on any *weak* station around 160 deg.

Long Wave (800-2,000 metres)

1. Switching to L.W. (turn knobs clockwise), set trimmers C3 and C4 as in No. 1 above.

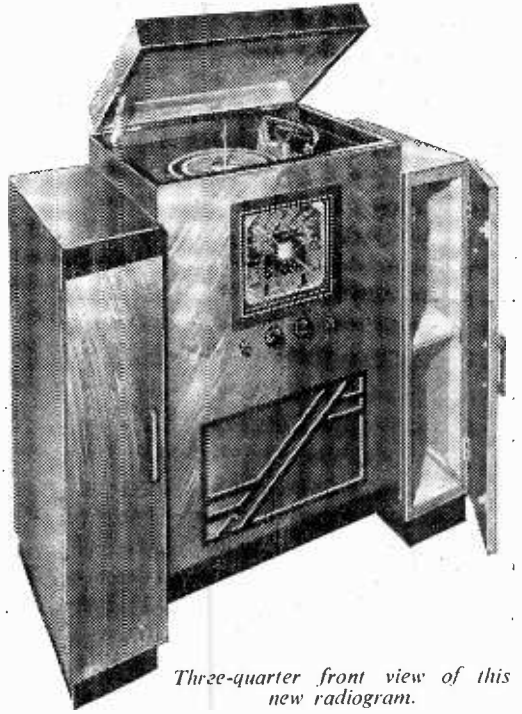
2. Set pointer at 69 deg. and tune in the Light programme (1,500 metres), by adjusting core of L3 (L.W. oscillator).

3. Adjust core of L4 (L.W. aerial) for maximum.

4. Tune in any station around 120 deg. and tune C4 (aerial trimmer) for maximum.

Short Waves (15-50 metres)

Without a signal-generator, little can be done to align the S.W. coils accurately, and it is advisable not to alter the position of the cores. The oscillator is designed to work at a frequency 465 kc/s above that of the signal being received. Both C5 and C6 (oscillator and aerial trimmers) should be half-opened. A signal may be tuned in around 160 deg. and C6 adjusted for maximum. (The leads from the coil-pack to the frequency-changer should be as short as possible, in order to obtain best results on S.W.)



Three-quarter front view of this new radiogram.

Using a Signal Generator

Where a signal generator is used, the tracking points and frequencies are as follows :

L.W.	29 deg.	1,800 metres	166.7 kc/s
L.W.	140 ,,	1,000 ,,	300 kc/s .
M.W.	37 ,,	450 ,,	666.7 kc/s
M.W.	138 ,,	250 ,,	1,200 kc/s
S.W.	32 ,,	45 ,,	6.667 m/c
S.W.	149 ,,	20 ,,	15 m/c
Trawler-band	32 ,,	210 ,,	1,429 kc/s
Trawler-band	143 ,,	110 ,,	2,727.3 kc/s (approx.)

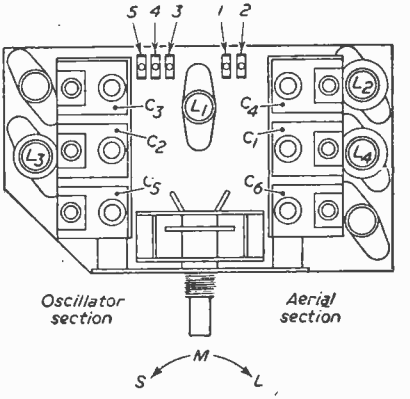


Fig. 4.—Details of the coil trimmers.

When the specified Glass Dial Assembly is used, all the stations should come into line, once the preceding instructions have been properly carried out. If they do not do so, within reasonable limits, it may be because the wrong type of tuning-condenser is used. This should be the usual type of .0005 μF. twin-gang, maximum capacity (vanes closed) when spindle turned fully clockwise.

Gramophone

When the tuning has been satisfactorily carried out, a wide range of stations should be heard at very good quality. Obviously the better and higher the aerial the wider the range of the receiver, but good results on a reasonable selection of stations will be obtained even with a short length of wire attached to the aerial socket. To reproduce records all that is necessary is to plug in the mains lead from the gramophone motor, plug two leads from the pick-up into the pick-up sockets and place a suitable record on the turntable. The motor has an adjustable head and switch for the type of record being played and the switch and pick-up head should be set correctly. Pressing the start button will set the motor in action and the pick-up will automatically be lowered and the radio/gram switch should be turned to gram when the signals will be heard. The volume control has about the same variation as on a good local station signal and it should be possible to turn the control to full on any record without overloading or distortion. It should be noted that no damage can occur to the delicate pick-up head by inadvertently pressing the start button if the receiver is not switched on, as the on/off switch also controls the gramophone motor, and if the set is switched off the motor also is off.

An Accumulator Maintenance Panel

A USEFUL ACCESSORY FOR THE SERVICE ENGINEER OR EXPERIMENTER

By W. Nimmons

FOR those who charge their own accumulators, either from a rotary converter, an A.C. rectifier, or from a windmill or by any other means, an accumulator maintenance panel is a great help. It not only shows what current is being supplied to the accumulator or accumulators, but serves another very useful function: it enables the state of charge to be read right through the charging process, and, what is perhaps more important, when the charge is finished.

Since incomplete or haphazard charging is a fruitful source of accumulator failure, any trouble taken at the actual charging will repay itself many times over in the shape of healthier cells.

The only true gauge of the state of charge is a voltage reading, taken with proper precautions to ensure that the cell is delivering current at a rate at least as great as that which it normally supplies. If a voltmeter is flicked across its terminals, and the reading is 2.6 volts, this is by no means an indication that the charge is complete. The voltmeter may be only drawing a few milliamps of current, whereas, if the reading is to be a true one, it should draw at least one ampere and still give a reading of 2.6 volts before we can say the charge is complete.

Neglect of this simple but all-important fact is responsible for many accumulator failures. I do not minimise hydrometer readings; but some types of cell do not permit of the insertion of a hydrometer, and so we must rely on voltmeter readings.

The Circuit

The panel described is made up of an ammeter and a voltmeter, together with a rheostat for regulating the current and two other resistors whose purpose will be revealed in due course. In the meantime consider Fig. 1. The input terminals are connected to the ammeter through a rheostat; this can be about 10 ohms for ordinary purposes, with a low-voltage input. Low voltage means anything from about 4 volts for charging a single cell, to around 18 volts for charging a 12 volt accumulator. The negative goes direct from the input to the output, while the positive goes via the rheostat and ammeter, as shown.

The voltmeter circuit, which is independent of the ammeter circuit, is, unlike the latter, used only intermittently. While the ammeter is in circuit continuously, the voltmeter is used to take readings of the various cells; for this reason it should be supplied with two long leads, long enough to reach the farthest cell.

A reading is first taken with the switch open, when the reading will be around 3 volts for a fully-charged cell. When the switch is closed, thus bringing the resistor into circuit in parallel with the meter, the voltage should read around 2.5 or 2.6.

This resistor determines the current drawn from the cell while the reading is being taken, and may be anything from 1 or 2 ohms for a normal wireless cell to about a quarter of an ohm for a large car battery. It is obvious that with a back E.M.F. of 2.5 volts a current of 2.5 amps will be drawn from the cell with a resistance of 1 ohm; a current of 1.25 amps with a resistance of 2 ohms; and a current of 10 amps with a resistance of ¼ ohm. These currents are necessary to gauge whether the cell is fully charged, according to type. Thus, if the voltage is only 2.2 while delivering current the cell is not fully charged.

Constructional Details

So much for the theoretical side. To get down to practical details, the panel is designed around ex-W.D. instruments, the purpose of which is not known. These are excellent moving-coil instruments sold by many dealers at the ridiculously low price of 3s. 6d., possibly because of their peculiar scale. This is shown in Fig. 3. However, if these are not procurable any ordinary ammeter and voltmeter may be used, though the cost in this case will be greater.

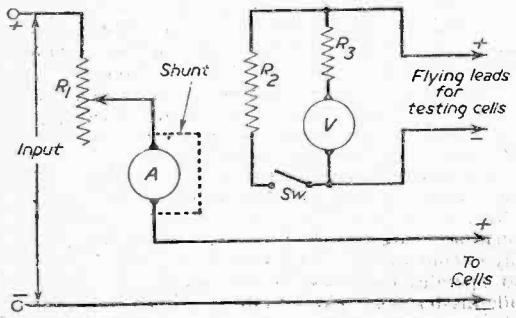


Fig. 1.—Theoretical circuit of the panel.

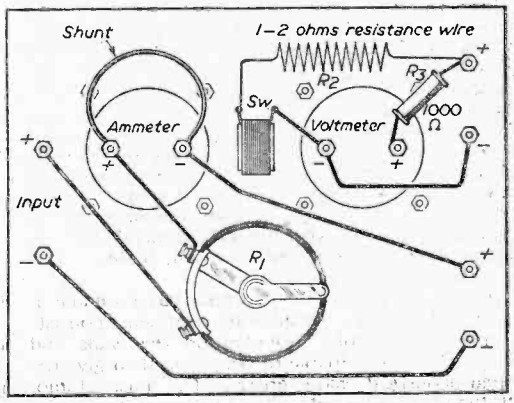


Fig. 2.—Wiring of the panel.

If instruments of this type are procurable, the reader is warned against connecting them up to an accumulator (even a 2-volt cell) without having the resistors in circuit, either in parallel or in series. If this is done the needle will be driven up hard against the end-stop and possibly bent, or the mechanism damaged.

To read amps a very low resistance is wired in parallel with the meter terminals. This is as low as .01 ohm, and since it is difficult to get a piece of resistance wire of ordinary gauge short enough a piece of No. 22 copper wire about 3in. long should be used. This can be shortened if necessary.

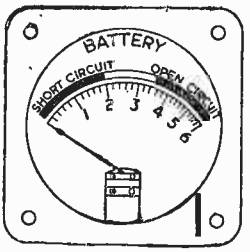


Fig. 3.—Showing the appearance of the scale after the new scale and figures have been written in Indian ink; in the original scale the shaded portions are coloured red.

The original scale can be left untouched, but superimposed with the markings, in amps, as shown in Fig. 3. The actual amperages marked will depend upon the current which will flow, but 2, 4 and 6 are requisite for all practical purposes. These can be marked in Indian ink.

To get the bridging wire (in parallel with the meter terminals) to the right length, connect a 24-watt, 6-volt headlamp bulb in series with the meter across a 6-volt accumulator. Since the current is 4 amps, adjust the length of the bridging wire until the needle points to this figure, *taking care to disconnect the meter from the battery* before removing the bridging wire to shorten. If the bridging wire is removed with the meter still connected it will lead to the destruction of the meter.

Before leaving the " amps " side of the panel, it is necessary to point out that the rheostat should be wound with heavy wire, otherwise it will overheat.

Turning to the " volts " side, R2 in Fig. 1 is 1 or 2 ohms in the case of wireless batteries, or ½ ohm in the case of a car battery; while R3 is (for this particular meter) 1,000 ohms. The 1K ohm resistor can be a 1-watt type since the current is small, but R2 will dissipate momentarily a maximum of 25 watts and can conveniently be made of Nichrome or resistance wire coiled in a close spiral; it should be so placed that it is well away from the other components, and particularly from the panel and the case, for it may get very hot during the time it is in use, and for this reason the meter leads should be applied only momentarily to the cell—just enough to obtain a reading. It can be made of No. 22 Eureka resistance wire, which has a resistance of 1.1 ohms per yard.

R3 is approximately 1,000 ohms. With this in series with the meter, connect up to a 2-volt accumulator which has been used a little after being charged, so that its voltage is approximately 2. Mark on the scale of the meter this point and call it 2 volts, which will be about one-third of the way along the scale, and mark similarly with a 4-volt and 6-volt accumulator. The meter should, of course, be taken out of its case to do this, being careful not to disturb the needle, which is very delicate.

This completes the work which has to be done on the panel, which should be about 8in. × 6in., and can be assembled in a case 3in. deep. The case can be placed convenient to where the charging is taking place.

As mentioned previously, an ordinary ammeter (reading 0—6) can be used, and a voltmeter with a similar scale. In this case the only extra components will be R2, the switch (a toggle switch is very convenient) and the rheostat. The ammeter is, of course, kept in circuit continuously, its small resistance being no barrier to the current.

BBC Swansea Studios

ON Thursday, May 1st, the BBC returned to the pre-war studio premises at 32, Alexandra Road, which were reduced to a mere shell by enemy action early in the war. These premises, after restoration by the Swansea Corporation, have been completed by the BBC to designs prepared by Mr. Cyril A. Hughes, L.R.I.B.A., who has worked in close co-operation with the BBC's specialist staff on the arrangement of the studios and their acoustical treatments and finishings.

The accommodation now provided is more suited to modern requirements than it was originally, and includes a large music studio with associated narrator's studio, a general purpose studio and a talks studio, plus an echo room for use with any of these, as required. There are also the usual control cubicles, together with a central control room, battery room and switch room.

The music studio on the first floor has a volume of 39,000 cubic feet. Acoustical treatment consists mainly of resonators, mounted on the walls and ceiling, which are capable of being tuned to give the desired acoustical characteristic. The music studio, with the narrator's studio, its control cubicle and the echo room, form Studio No. 1 suite and is fitted with sound equipment of the latest BBC design.

The general purpose studio, also on the first floor, has a volume of approximately 6,000 cubic feet. Its acoustic response can be varied by means of special screens used in combination with the treated wall surfaces. Provision has been made to enable the circuits of this studio to be controlled, together with the music and narrator's studios, by a single operator in the control cubicle of Studio No. 1 suite.

The talks studio, situated on the second floor, has a volume of about 3,500 cubic feet. It has been treated with wood panelling and provided with mirrors to create a quiet, domestic atmosphere.

The central control room forms a focal point for the outputs of the studios and outside broadcasts, from where they are fed into the main network of the BBC programme distribution system.

All amplifier equipments in the premises are supplied with power from rectifier units connected to the main A.C. system of the building. A 50-volt " floating " battery has been installed to operate the relay circuits of the studio equipment. This battery also operates the clock system comprising a high-grade master clock which controls a number of slave dials.

Two New Ferromagnetic Materials

A DUTCH DEVELOPMENT OF INTEREST TO ELECTRICAL ENGINEERS

By "Technicus"

THE development of ferromagnetic materials with low losses at high frequencies has assumed increasingly greater importance with the rapid growth of electrical motors. A great deal of money has been spent on the subject by electrical equipment manufacturers and the steady improvement over the years points to a measure of success in their research work. Two main sources of losses in magnet materials are eddy currents and hysteresis effects, and it is the aim of those who formulate such materials to cut such losses to the minimum. It can be shown that losses in a core are reduced by the use of thin laminated material, but to produce the desired thinness means costly rolling, which has made the powder core more economical. But the latter offers certain technical disadvantages in that it is difficult to ensure uniformity in a powder core, which leads to permeability losses.

Type	Apparent density	Initial permeability	Curie temp., deg. C.	Resist. D.C., megohms	Dielectric constant at low freq.
IIIA	4.93	1750	130	1.8	10^5 (approx.)
IIID	4.78	806	235	1.0	
IVA	4.90	650	140	less than 4.10^4	10^3 (approx.)
IVC	4.17	90	385		
IVE	4.04	17	585		

"Ferroxcube"

The well-known Dutch electrical organisation, Philips, of Eindhoven, have worked on the problem of high permeability, low-loss core material for some years. They have now announced two such materials, which appear to mark a big step forward. "Ferroxcube" is what the mineralogist calls a cubic ferrite, that is to say, iron oxide (Fe_3O_4) into which has been introduced a metal such as cobalt, nickel, copper, magnesium, cadmium or zinc.

These metals enter the crystal structure of the iron oxide and form a particular crystal symmetry. It is the arrangement of the metal atoms within the crystal that results which gives the ferrites their interesting ferromagnetic properties.

The fact that the ferrites can be formed with various divalent metals, as mentioned above, means that they can be made to various properties. The data given in the above table illustrates the properties of some of the varieties of "Ferroxcubes."

It seemed inevitable that the investigations on "Ferroxcube" should lead to better ferromagnetic materials at the Eindhoven research laboratories, and success rewarded the work there. The magnetically soft ferrites are well adapted to high-frequency inductances and transformers, but there is still left a wide field unsatisfied, as, for example, that for permanent magnets.

"Ferroxdure"

The answer to this is provided by "Ferroxdure," which is magnetically hard enough to make "permanent" magnets. As with "Ferroxcube" material, so with "Ferroxdure"; it represents a class of oxides rather than one in particular. But of unusual interest is the fact that "Ferroxdure" contains no nickel or cobalt, which are both expensive and in short supply at present. It is a ceramic oxide, that is to say, it has high heat resistance, and is represented by the empirical formula $BaFe_{12}O_{19}$. One might describe it as an iron oxide into the crystal lattice of which has been inserted barium oxide, to give a hexagonal crystal symmetry.

Among the properties of this new magnet material are high coercive force and low saturation magnetisation. In combination these two properties mean that the material resists demagnetisation, while its high resistivity suggests its value for high frequency work. The high value of coercive force and the comparatively low value of permeability enable magnets to be constructed of "Ferroxdure" with strong alternating poles at small distances from one another in a single bar.

The development of the above two materials illustrates the value of good research being skilfully applied to practical ends. The Philips organisation with its large manufacturing resources in a comparatively small country, like Holland, also serves to show how initiative and imagination can go a long way to making up for lack of indigenous supplies of coal, metals and oil, which seem to be the tripod upon which industrial importance rests.

Components have, of course, already appeared on the market containing these new materials, and the main item at present available for the home-constructor is the television line output transformer utilising Ferroxcube.

The Radio Show

THE radio industry opens its national shop-window at Earls Court on August 26th, and the shutters will be pulled down on September 5th. Needless to say, as in previous years, I shall be delighted to meet readers who call at our stand, the number of which at the moment of going to press is unknown. Although this issue is dated August, it is actually published during the month of July, so it is in next month's issue that you may expect my comments on the exhibition.

As the years go by I like more and more the dissociation of the National Radio Show from Olympia. It was a mistake in the first place ever to have used such an ugly portmanteau word as "Radiolympia." It tied an exhibition to a particular building. This was very nice for the owners of Olympia, but it placed them in a very strong position with the industry. The National Radio Show is a more euphonious and representative title. You can see that national conditions have not improved since the last show. On the other hand, television has shot ahead by leaps and bounds and Wenvoe, the latest of the BBC television transmitters, will be in operation before the show is over. I expect, therefore, that television will provide the dominant note at this year's show.

Reith on Broadcasting

THE White Paper on broadcasting, as expected, provided Lord Reith with an opportunity for a sesquipedalion attack on some of its provisions in the House of Lords. Some of his remarks were like the idle wind which we regardeth not ! One would have imagined from Lord Reith's comments that he was still in control of the BBC. Many of the things he criticised could have been put right when he was Director General. Now he is outside the BBC his criticism is that they were not done ! He dislikes the suggestion for sponsored TV programmes, and, in fact, sponsored programmes altogether. He asked: "What grounds are there for jeopardising this heritage and tradition of British broadcasting? Why sell it down the river?" Very fortunately for listeners much of the heritage he left behind has been jettisoned down the river, not being worthy of sale. Does Lord Reith wish the BBC to be run on the same iconoclastic lines as when he was D.G., and which gave rise to such severe criticism during his period of office? He is still riding his same old hobby-horse, but, fortunately, his views carry very little weight to-day. A daily newspaper published a letter where those views were labelled as rubbish and tripe. It must not be forgotten that France, Belgium, Australia, New Zealand, Canada and America, as well as several other nations, have sponsored broadcasting and television programmes running parallel with State programmes. I preserve an open mind on the subject of sponsored programmes, but had I been in favour of them I should have been most unimpressed by Reith's comments and his obscure references to Gresham's law. He had the effrontery to refer to certain districts in England, totalling practically a third of the country, where good reception of BBC programmes is almost impossible. Brighton, only 55 miles from London, is a good example. Those were the conditions when Reith was D.G., when he adopted the attitude that it did not matter what the public thought, but what the BBC thought. What did he do about it?

In any case, Reith at one time was in favour of sponsored programmes and we actually had them in this country. The proprietors of this journal actually paid for programme time and put on a programme with just a bald announcement that "This programme comes to you by courtesy of George Newnes Ltd." No wonder sponsored programmes in this country failed. The attitude of Reith is that publicity is an unclean thing and should not be allowed to spoliate the programmes nor spawn into the ether invitations to buy somebody's pills, potions or nostrums. There was a meanness about Reith's attitude towards sponsored programmes even when we had them. His whole attitude and outlook can best be judged by those mournful, miserable, narrow-minded Sunday programmes which forced listeners to tune into the sponsored programmes from Luxemburg and Normandy. We do not wish to return to those days, and we should do if anyone takes the advice of the ex-Director General of the BBC.

In any case, sponsored programmes in this country have only received official blessing. There is no indication that we shall have them for some years to come. As Lord Reith had already had his say before the Beveridge Committee, it was a mistake to permit him in the House of Lords to have a further say on the matter, when others holding contrary views were denied the same opportunity.

Sir William Haley

I AM sorry that Sir William Haley has left the BBC, although in his new sphere as editor of *The Times* I am sure he will do well. His period at the BBC has been a difficult one, and my impression is that he is glad to be out of it. Mind you, I cannot suggest that editing a morning newspaper will be any less strenuous, but even there he will find the hand of restriction on policy. The great tragedy with the BBC is that it was allowed to go on so long behind its artificial façade of efficiency when it was well known by knowledgeable people that it was a most inefficient and over-staffed organisation. It was, as it still is, a series of water-tight cells with little co-operation between each and practically no co-ordination. In very truth its right hand does not know what the left is doing. It is practically impossible now ever to get it right, although improvements have taken place.

The British Radio Components Exhibition

A REVIEW BY THE MARQUIS OF DONEGALL

THIS highly interesting Exhibition fitted neatly into the Ballroom and Balcony of Grosvenor House. We may regard it as an aperitif to the Northern Radio Show which later took place in Manchester's City Hall.

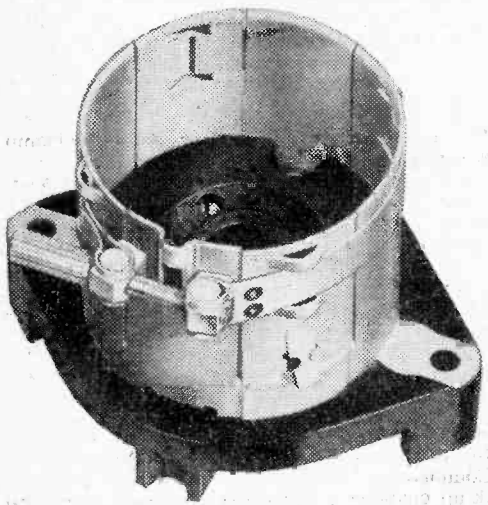
This was the ninth private Exhibition and covered the fields of Radio, Television, Electronic and Telecommunication industries. It was organised by the Radio and Electronic Component Manufacturers' Federation.

During the past few years this annual show has been growing in importance owing to the ever-widening application of electronics to modern industry and each year it has attracted more and more visitors. I think that the organisers are right in preserving the atmosphere of privacy and comfort rather than merging its interests with those of other industries in the impersonal background of a larger exhibition hall.

Since the first post-war show in 1946 the attendance of visitors has doubled, and evidence that the whole show was a "multum in parvo" is demonstrated by the fact that the catalogue was considerably thicker than that of the subsequent Northern Radio Show.

This time there were again over a hundred exhibitors—108 Stands, in fact—bringing new evidence of successful research by British component manufacturers to enable them to design and produce components which are increasingly reliable under extremes of atmospheric conditions, technically more efficient and—many of them—smaller in size.

In spite of the defence programme, manufacturers, it appears, can still meet demands of components for every need, at home and abroad, including domestic radio and television. Shortages, however, are experienced from time to time, and it may be found also that supplies of certain new items are confined to Government use in the future.



One of the new Ediswan Clix valveholders shown at the exhibition

Carriers Gratis

Before I start to pick out a few highlights that struck me, let me say that Messrs. Multicore deserve a mention for providing us all, free of charge, with carton brief-cases in which to collect such pamphlets as we amassed during our visit to the Exhibition.

On a preliminary look round, Mullard's non-metallic permanent magnet using no scarce, strategic or expensive material, struck me as of great importance for focusing units in television receivers. It is ceramic in structure.

Rectangular cathode-ray tubes for television sets are now in production. They save some inches in the back-to-front measurement of the set and were shown by Standard Telephones.

On Tannoy's stand I picked out what is claimed to be the first tube microphone developed in Great Britain—head and stand are blended into a slim tube which does not mask the user from the audience.

In microphones exported to the United States the vibrating part—the ribbon—is made of Duralumin one-ten-thousandth of an inch thick and was shown by Reslosound.

A. H. Hunt showed a condenser approximately one-sixteenth of an inch in diameter made of paper, one-third of a thousandth-of-an-inch thick with a metal coating of a millionth of a millimeter thick—the thickness of the metal being only measurable by resistance values or light.

P.T.F.E. !

I was interested to learn that "P.T.F.E." stands for the longest word in the Exhibition and for some distance outside it I should think. P. I. Callender's had Polytetrafluoroethylene winding wire with which coils can be wound for continuous operation at temperatures ranging from 75 centrigrade to over 250 centrigrade. The insulating film of "P.T.F.E." is usually one-thousandth of an inch thick.

Also at Callender's Cables a length of over 3½ miles of enamelled wire weighing an ounce—thickness approximately of a thousandth of an inch—which is used for hearing aids.

The British Moulded Plastics showed a new and complicated plastic moulding — automatic gramophone record-changer moulded in one piece, including inserts for the moving parts. Also a complete set of parts for automatic pick-up. On the photographic side, Telegraph Condenser showed a new light-weight electronic condenser (nine ounces) which considerably reduces the weight of photo-flash equipment.

Crystal diodes now beginning to be used in place of valves of the ordinary type to save space were shown for the first time by Edison Swan and

aluminium-sheathed cables specially developed for the reserve aerial feeders in the BBC Television stations at Kirk o' Shotts, Holme Moss and Sutton Coldfield, were on the Telephone Construction and Maintenance stand.

In the field of capacitors there were tubular capacitors measuring only one-sixteenth of an inch by seven-sixteenths of an inch, produced by A. H. Hunt (Capacitors), Ltd., under the name "Moldseal." New silvered mica capacitors, known as "Cataeons," were introduced by London Electrical Manufacturing Co., Ltd. These have a new moulded finish, and Telegraph Condenser Co., Ltd., showed a range of new high-temperature electronics which will work at 85 degrees centigrade without voltage derating.

During the past year the British Electric Resistance Company has developed a new protective coating for wire-wound resistors which will withstand temperatures of up to 400 degrees centigrade ; it does not require the high-firing temperatures of vitreous enamel. We saw examples of Berco resistors with this coating and the firm also exhibited a new range of power rheostats ; the "Bercostat" available up to a hundred watts dissipation.

Now to switches, plugs and sockets, and a new range of rotary switches with ceramic insulation shown by A.B. Metal Products, who also featured the "Minibank" switch, still the smallest multipole type in the world. A. F. Bulgin, Ltd., known for thousands of products, displayed a new range of microswitches. These included miniature types and models for high operational pressure. Their ordinary switches have been improved as to moisture resistance and peak handling capacity.

A miniature thermo-delay switch for the protection of TV and electronic circuits, together with new types of plugs and circuits and sockets, including a shrouded three-pin mains input type and a double-screened co-axial connector were on the Belling and Lee stand.

Gramophone Accessories

Latest in the field of recording, producing equipment, was the new three-speed record changer, playing 7in., 10in. and 12in. records, mixed. Birmingham Sound Reproducers were responsible for this.

Garrard's were present with modifications and improvements on their three-speed units and Erwin Scharf showed a wide range of new pick-ups, including a magnetic turn-over type with automatic weight adjustment.

On our second tour round the Exhibition, we noticed permanent magnet speakers with totally enclosed magnets specially designed for TV receivers (Acoustic Products, Ltd.) ; Trio-sol, resin-cored solder output is now doubled (Du Bois, Ltd.) ; a new public address pressure-type loud-speaker unit and vibration equipment for industrial research (Goodman Industries).

"Tailor-made" steel cabinets, using pre-fabricated parts which can be packed flat for export and assembled on arrival (Hallam, Sleigh and Cheston) ; quartz crystal units mounted on various types of valve bases and a quartz crystal activity test (Salford Electrical).

Efforts towards the provision of television aerials for the North American market and other markets overseas are made by Antiference with their range of Antex "X"-shaped aerials. They had a demonstration of the effect of mis-matching of the aerial feeder cable, and Belling and Lee are another firm having arrangements for supplying TV aerials overseas, or for making agreements to supply technical information to enable such aerials to be manufactured locally.

English Electric showed transformers and chokes incorporating their "C"-type cores. These cores are wound from continuous strips of cold-rolled, grained oriented steel, for which superior magnetisation characteristics to those of hot-rolled laminations are claimed.

The Ministry of Supply was very prominent in the R.E.C.M.F. exhibition. Their display illustrated the growing demand in the Services for electronic equiment of ever-higher standards of reliability, combined with increasing miniaturisation and ability to withstand greater temperature ranges and severe operating conditions.

From the Atomic Energy Research Establishment, we saw the following : (1) a high-value resistor meter, demonstrated measuring resistors in the range 10 to the 7th—10 to the 14th ohms, with 1-4 volts across them.

(2) Quartz fibres for use in "personal" gamma-ray protection equipment.

(3) A portable quartz fibre electro-static voltmeter, demonstrating how quartz fibre technique developed at Harwell for radiation detection can be adapted to more normal electrical measurement.

(4) A small mechanical process timer, designed for use with the existing nuclear scaling units, which gives 60 scale settings in discreet steps, the time interval per step being determined by the speed of input drives.

The Services

From the Royal Aircraft Establishment : a series of radio-frequency cables illustrating the results of a two-year ageing test of various forms of P.V.C. sheaths and braiding wires. The test demonstrated that the use of non-contaminated P.V.C. is justified and that tinned-copper and silver-plated braiding wires offer little advantage over those of plain copper.

The Signals Research and Development Establishment and the Telecommunications Research Establishment, also showed numerous items, including vitreous glaze dialectric capacitors, as an improvement on paper capacitors ; a sensitive relay with one change-over contact operating on a power of one milliamp and a miniature relay, designed to provide two change-over contacts, the primary use of which is for sender-receiver switches in portable radio equipment. It requires a power of 150 milliwatts ; an oxide film resistor comprising a thin film of mixed oxides of tin and antimony, deposited by spraying solutions of their chlorides on to a heated glass surface.

Finally, in a very wide range of loud-speakers and microphones, Vitavox Type B.52, a little hand microphone which fits snugly into a small stand when required, is an extremely neat job. Life, I also noticed, is becoming more and more complicated for the citizen who likes to get the best reproduction from his gramophone records. I find myself quite busy enough with the three interchangeable heads on my "Connoisseur" pick-up. But Goldring now have a pick-up enabling you, having selected a record, to juggle between no fewer than five interchangeable heads !

Surplus High-vacuum Rectifiers

DATA OF SOME EX-SERVICE VALVES

By E. G. Bulley

VALVES that fall into this category are available upon the surplus market and are of both the full-wave and half-wave types. Many of them are useful to the radio experimenter and in many cases are most suitable for the transmitting amateur.

Those that are used for the power supplies in receiving equipments have been omitted, as they are considered to be sufficiently covered by manufacturers' data sheets. This article, therefore, is intended to deal solely with the types that are uncommon to the average amateur.

Before proceeding, therefore, it is necessary to generalise on rectifiers as a whole, and to mention that valves designed for rectifier service are based on voltage and current requirements of the load. This is appreciated by remembering that gas-filled rectifiers are suitable for high current loads, whereas the high vacuum types are mainly used wherever high voltages are desired. It is, therefore, essential to bear in mind when planning to use a particular rectifier, that a decision must be made as to the output voltage that will be required by the load, not forgetting, of course, the average current that the load will take. Furthermore, the peak inverse voltage rating has an important bearing upon the output to load.

Comparisons

Comparing the mercury vapour and high vacuum rectifier, one will note that the former has more or less a constant voltage drop, whereas the latter has an internal voltage drop which is proportional to the D.C. load current being taken. This does, therefore, emphasise the fact that if the load current varies, then likewise the voltage drop varies, and the valve will not provide good voltage regulation.

Many manufacturers have, however, overcome this disadvantage by designing such vacuum rectifiers with closely-spaced electrodes.

Types Available

The general aspect of rectifiers having now been discussed, it is necesssary to concentrate upon the types of vacuum rectifiers that are available at present. Many of these employ thoriated-tungsten or oxide-coated filaments, although some do use the conventional pure tungsten emitter. However, in the case of the two former types of emitter, one must remember that they must be operated within plus or minus 5 per cent. of their rated filament voltage. Failure to do so will destroy the emissive properties of the filament. This, however, is not so important in the pure tungsten types, with the exception, of course, that any increase in filament voltage will reduce the life of the valve in question.

Many high vacuum rectifiers that are for disposal were originally designed for use as pulse damping diodes, but these can also be used for power rectification. However, for the interest of the reader, the essential ratings of such valves are given in the accompanying table, and at the same time their commercial equivalents are given where known.

The valves listed can be used in the conventional half- or full-wave circuit, but one can, by connecting two or more vacuum rectifiers in parallel, obtain a larger output current and, furthermore, by this method of connection the internal resistances of the rectifiers enables a somewhat larger voltage output to be obtained.

Relationship figures or ratios have been determined for the use of high-vacuum rectifiers in the conventional type of power supplies, although manufacturers do supply curves from which suitable power supplies can be designed.

A further point is that it is not generally the case for manufacturers to quote both the R.M.S. voltage to the rectifier anode(s) as well as the maximum peak inverse voltage. The reason being that the latter can more or less be determined from the relationship figures.

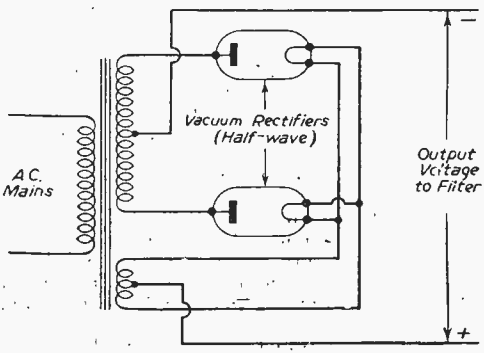
It is, however, as well to mention that on no account should the values laid down for any valve be exceeded.

Referring to the Table, the peak inverse rating of the RK21 is 3,500 volts, this being a half-wave rectifier. Now the voltage relationship between this figure and that of the R.M.S. voltage is approximately 1.4 when used in a half-wave power supply, and likewise 2.8 if two such valves are used in a full-wave single-phase circuit.

The single-phase full-wave power supply is perhaps the most common circuit to the radio amateur, so consideration will be given to this circuit, and the basic circuit is shown in Fig. 1.

Returning to the RK21, the R.M.S. voltage is equal to 3,500 divided by 2.8, which equals 1,250 volts.

It can, therefore, be appreciated that should this R.M.S. voltage be increased to, for example, 1,500 volts, then the peak inverse voltage rating would likewise be increased to a value of $2.8 \times 1,500 = 4,200$ volts. This value is far in excess of what the rectifier will stand.



Basic full-wave single-phase circuit

Furthermore, the relationship between the peak inverse voltage rating and the D.C. output voltage to the filter can be evaluated by multiplying the peak inverse voltage by 0.318. This, of course, assumes zero valve drop and no filter load. To clarify this point and referring to the RK21 data again, the D.C. output to the load would be 3,500 × .318 = 1,113 volts (approx.).

Current Relationship

These relationship figures do enable the amateur to arrive at figures which, although approximate, show the amateur what can be expected of any such surplus rectifier. Another relationship figure which is important is that of the current taken by the load, and in this case it is assumed that a choke input filter is used.

The total D.C. load current when such a filter is used is determined by dividing the average anode current by 0.5, the average anode current being equal to the maximum peak anode current divided by 2. It should be remembered, of course, that these figures apply to the full-wave circuit.

AMERICAN Common equivalent	Surplus No.	Ef	If (amp.)	Max. R.M.S.	Max. p.i.v.	Max. peak anode current	Rectification	Filament
217C	217C	10	3.25	—	7.5kV.	0.6 amp.	H.W.	D.H.
217A	217A	10	3.25	—	3.5kV.	0.6 amp.	H.W.	D.H.
RK21	RK21	2.5	4.0	1,250v.	3.5kV.	0.6 amp.	H.W.	I.H.
836	836	2.5	5.0	—	5kV.	1.0 amp.	H.W.	I.H.
1616	VT266	2.5	5.0	—	5.5kV.	0.8 amp.	H.W.	D.H. oxide coated
BRITISH								
V1907	CV1111	4	1.1	5,000v.	12.5kV.	0.35 amp.	H.W.	D.H.
U17	CV1113	4	1.0	2.5 kV.	6.5 kV.	0.2 amp.	H.W.	D.H.
—	CV1120	2	1.5	5kV.	140.kV.	0.1 amp.	H.W.	I.H.
—	CV1133	4	1.35	2.5kV.	6.5kV.	0.4 amp.	H.W.	I.H.
—	CV1134	4	.65	6kV.	17kV.	0.06 amp.	H.W.	I.H.
FW4-500	CV1264	4	3.2	500v.	1,200v.	0.75 amp.	F.W.	D.H.
U15	CV1265	6	2.0	1,500v.	—	0.25 amp.	H.W.	D.H. oxide coated
—	NU13A	6	2.0	2kV.	5kV.	1.5 amp.	H.W.	D.H. oxide coated

F.W. — Full-wave. I.H. — Indirectly heated.

The determination of the various ratings have now been discussed, and it is hoped that it will prove useful to the amateur.

In conclusion, it is necessary to emphasise the point that when dealing with surplus valves it is essential to ensure that they are operated within, and not at, their maximum ratings.

Sound Recording Exhibition

THE 1952 Exhibition of sound recording/reproduction and audio engineering equipment, organised by the British Sound Recording Association, was opened on Saturday, May 17th, by Mr. John Snagge, of the BBC, at the Waldorf Hotel, London.

Twenty-three exhibitors displayed and demonstrated the latest British apparatus in the audio field ranging from pick-ups to complex magnetic tape recorders. Recent developments in lightweight battery-operated portable tape recorders were illustrated by the new E.M.I. Model L/2 unit, which measures only 14in. by 7in. by 8in. and weighs 14½lb. including internal batteries. Standard 5in. spools containing 600ft. of tape are employed. Other units entirely independent of electric mains are the Wirek (Electronics), Ltd., "Reporter" and "Personal" models. The former is operated by a double-spring gramophone motor and the latter is driven by a miniature electric motor supplied by a bank of U2 dry cells.

The new H. J. Leak "Vari-Slope" pre-amplifier was shown and demonstrated. This advance consists of variable-slope low-pass filters (essentially twin-T resistor-capacitor networks) operating on negative voltage feedback principles. No inductors are used at all.

A remarkable new disc recorder, designed by Decca Radio Company engineers, was shown for the first time. This machine has many refinements, including automatic groove spacing for dubbing, variable-pitch cutting, moving-coil cutting-head, hot stylus attachment, suction device for swarf removal, pre-set scroll speeds, automatic eccentric groove mechanism, three speeds. It costs over £1,000.

Additional space was devoted this year to the Amateur Exhibits' Competition Stand. The Cecil Watts Trophy was won by Mr. Cecil L. Appleby, of London, by his all-portable magnetic tape recorder. The committee or runner-up award was won by Mr. C. G. H. Chalker, of Weymouth, with his disc recorder.

The winners' names were announced and the awards presented by the president at the annual dinner held at the Waldorf on Saturday evening.

During the two days of the exhibition continuous demonstrations in the ballroom of pick-ups, amplifiers and loudspeakers, of all types, from simple and inexpensive units to the large Lowther-Hegemann corner loudspeaker, were attended by large audiences. In separate rooms the M.S.S. Recording Company demonstrated their new tape recorder and Vitavox, their Klipschorn loudspeaker.

On the Friday evening, May 16th, a lively discussion between musicians, represented by Miss Anna Instone and Mr. Julian Herbage, of the BBC, and technicians, represented by Mr. Peter Walker (Acoustical Mfg. Co.) and Mr. D. Thomson (Decca Record Co.), debated what is a high-quality recording from their particular standpoints.

TRANSMITTING TOPICS

Variable Frequency Oscillators—3

CONSIDERATIONS IN TRANSMITTER DESIGN By O. J. Russell, B.Sc. (G3BHJ)

(*Concluded from page* 301 *July issue*)

WITH a total tank capacity of 1,000 pF. for a 3.5 Mc/s V.F.O., difficulty may be experienced in obtaining oscillation, and a somewhat lower total capacity plus tapping down might be most effective.

The once popular Franklin oscillator of Fig. 8 is included for completness. It is an example of loose coupling, for the coupling condensers to the tuned circuit should be as small as possible—a few pF. However, despite the possibility of such loose coupling the Franklin is not so attractive as might at first appear. In effect it is a form of amplified feedback. At high frequencies the inevitable phase shifts and low gain of the R.C. amplifiers introduce effects which reduce the advantages. This can be combated by using peaking chokes in the amplifiers, which introduce complication in design and possibility of oscillations and unwanted effects due to the chokes.

However, the circuit of Fig. 9 is another attempt to obtain loose coupling. Under the name of the Clapp circuit it has recently enjoyed high popularity. Correctly designed, the effective tuning capacity is relatively small. However, the tapping down effect due to the large condensers across the grid and cathode of the valve makes any changes due to valve variations have a negligible effect upon the total effective capacity. As the total tuning capacity is low, of the order of say 50 pF. or less, a large inductance is needed. This is a different approach to the use of a small coil with a large tuning capacity, but the desired aim of making valve variations a negligible part of the total capacity is the same. The Clapp circuit is, in fact, similar to the equivalent circuit of a quartz crystal, wherein the series capacity effective loosely couples the crystal to the valve. For this reason, the series tuning capacity of the Clapp should be small. This requires a quite small tuning condenser to cover an amateur band. The merit of the Clapp is only realised if the series tuning capacity is small. Needless to say it is *not* a " series tuned " oscillator circuit. The effective tuning capacity is in parallel with the coil, and consists of the actual tuning capacitors in series with the grid and cathode tapping condensers. Versions which employ large values of tuning condensers are largely destroying the correct functioning of the Clapp oscillator, for then the valve itself is effectively tapped across more of the tuning coil, and this decreases stability. Tapping loosely is, in fact, only half of the story, for the large inductance used has in itself certain advantages. It must be realised that the low C tuned circuit is especially vulnerable to accidental stray capacities. Thus the movement of a screen or metal panel near the coil will produce a much greater frequency variation than with a V.F.O. using a very high C tuned circuit. As a large coil is needed, the problem of making this

(*Continued on page* 357)

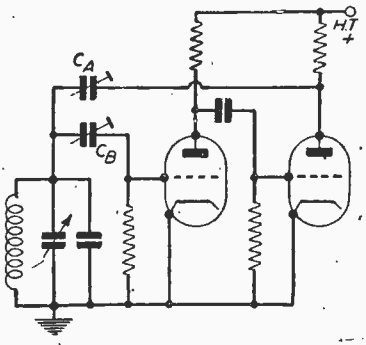


Fig. 8.—The Franklin oscillator. C_A and C_B are 0-15 pF. trimmers.

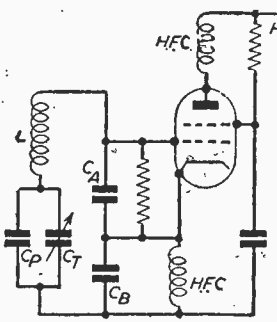


Fig. 9.—Clapp oscillator. Total effective tuning capacity is approximately C_P plus C_T, which may be, say, 35 pF. or less. $C_A = C_B$ which may be 500 pF. to 1,000 pF.

mechanically rigid against vibration is difficult. It is necessary in any V.F.O. to use a stable coil, preferably wound on a ceramic former for rigidity, and to mount it well clear of metal panels. With the Clapp circuit this point is of very great importance. Thus the stability of a V.F.O. does depend both upon electrical and upon mechanical stability. The design of a V.F.O. involves a careful consideration of the mechanical aspect as well as the electrical, and a little extra thought before construction will be well repaid.

Having considered the popular V.F.O. circuits, and certain of the not so obvious points about them, it is necessary to consider how they will be used in

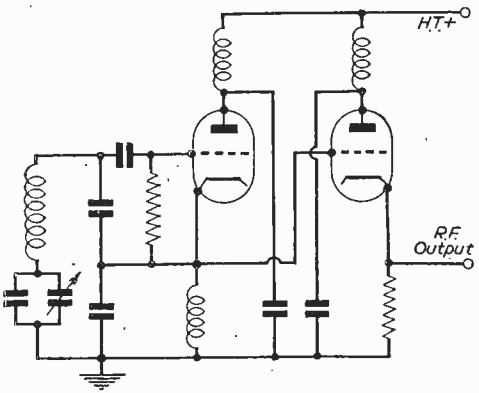


Fig. 10.—Cathode-follower buffer stage, with Clapp V.F.O.

conjunction with the rest of the transmitter. This is where a considerable amount of trouble can be caused. A V.F.O., perfectly stable by itself, may be adversely affected when connected to a transmitter.

As has been mentioned, one of the most potent forms of minor instabilities are those due to loading effects. Any variation in the anode circuit loading may be coupled back into the grid circuit, thus causing a frequency shift. Tuning a doubler stage driven by a V.F.O. can thus react upon the V.F.O. and cause a perceptible shift. Even where the H.T. to the V.F.O. is stabilised this effect can be noticed, because the effective input capacity of the V.F.O. valve can be affected by changes in its anode current, and by changes in the impedance of its anode circuit. Valves of very good shielding and isolation of the anode from the grid are necessary. Thus the 6AG7 has already been mentioned, while the 6K7, 6SJ7 and the 6F6 are also suitable well-shielded types.

As has been noted previously, it is inadvisable to tune the anode circuit of electron-coupled forms of oscillator, and it is usually advisable to employ neutralisation if this is attempted. A simpler method is to dispense with anode tuning, and to employ an H.F. choke as the anode load. This will greatly minimise the variations caused by anode circuit effects, and it should be noted that one advantage of the electron-coupled circuits is that they combine to some extent the functions of both oscillator and buffer stage in one valve through the screening effect of the screen grid.

It is axiomatic, that stability is best ensured by not driving the oscillator hard, and by employing plenty of buffer stages rather than trying to drive direct from the oscillator. Of course, "it can be done," but it is not easy, and it is far easier to obtain good results by using a little less economy in valves and components. For the same reason we have ignored the fact that it is quite feasible to make variable inductance tuned V.F.O.s—either by a continuously variable tap, or by a permeability tuning method. These, however, do not circumvent the basic design requirements laid down, and like other aspects would normally only be tackled by experienced amateurs. The experienced amateur can be relied upon to take short cuts. However, good results can more easily be obtained, certainly by the use of an extra stage or two.

Final Design

The final circuit employed, of course, will depend upon whether the V.F.O. is to be an integral part of the transmitter, or if the V.F.O. is to be a separate unit standing by the receiver, and coupled by co-ax. to the transmitter proper. One popular method employed with the Clapp but equally applicable to the normal tapped coil cathode oscillator, is to use a cathode follower triode stage. The cathode follower stage has the advantage of presenting a negligible load to the oscillator. It has been used in the triode form, as shown in Fig. 10. However, there seems little point in this, for due to the shielding of a tetrode, the normal type of V.F.O. circuit is in effect already an oscillator and buffer stage combined in one valve.

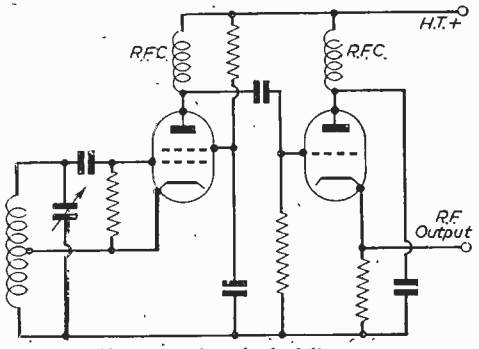


Fig. 11.—V.F.O. and cathode-follower output. The buffering is improved over the arrangement shown in Fig. 10.

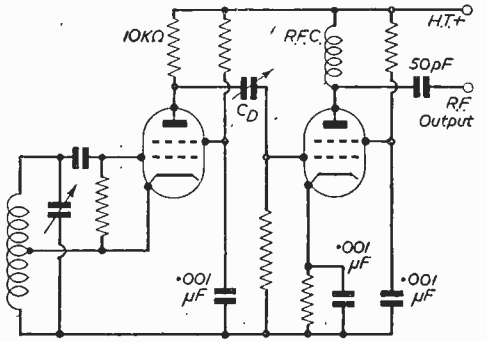


Fig. 12.—Class "A" buffer stage. The amplifier valve has normal bias as in L.F. use. An adjustable (CD 0-50 pF.) drive condenser is used to prevent overloading the amplifier.

The circuit Fig. 10 merely does roughly the same thing with two valves. The circuit of Fig. 11 is proposed, therefore, in which the cathode follower valve is coupled to the anode of the usual type of V.F.O. oscillator. This, in effect, provides two stages of buffering and should give superior isolation. It will also give an increased output, for the cathode follower gives no voltage gain, and the V.F.O. anode R.F. output is considerably higher than the cathode or grid output. A merit of the cathode follower, is that it is admirably suited to work into a co-axial cable.

The arrangements of Fig. 10 and 11 seem so excellent,

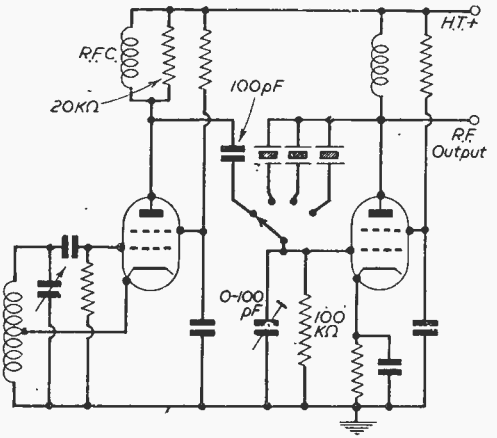


Fig. 13.—Crystal-V.F.O. switching.

that it rather diminishes the appeal of a straightforward amplifier circuit. However, one arrangement of merit is a buffer amplifier operating under Class A conditions following the V.F.O. Provided that the drive from the V.F.O. is not too great, the stage may be operated under true Class A conditions, and will present a negligible load to the V.F.O. It is even proposed that this stage, which may well use a 6V6 or 6L6, should also have an untuned load, and finally feed into a normal amplifier before driving the transmitter proper. If, however, the stage is to have a choke load, then it is clear that it should be of a widely differing value from that used in the oscillator anode, as parasitic oscillations may otherwise be caused. One solution would be to use a resistance anode load of the order of 3,000 ohms, and Fig. 12 indicates the layout of such a "safety-first" unit. In all cases, it is intended that the final output is applied to drive a transmitter proper, and not to be used as a transmitter. Thus, with one or more buffer stages, the oscillator can operate at a low level and, furthermore, the buffer stages themselves need only be very lightly driven so as to prevent interaction upon the oscillator. Preset coupling condensers are useful, so that the stages can be lined up with adequate but not excessive grid drive. A Class A isolating buffer stage in particular, should not be overdriven.

Crystal Circuits

One point will immediately arise, and that is the question of alternative crystal operation. Previously, Pierce circuits which could be adapted to alternative V.F.O. operation have been described. In many cases, of course, the V.F.O. may be coupled into the grid of the crystal oscillator of a previously crystal-controlled transmitter. Alternatively, the V.F.O. may be the initial start of a new transmitter, and crystal facilities may just as well be incorporated in the V.F.O. buffer unit. One way is shown in Fig. 13. A Class A buffer stage follows the V.F.O., and to ensure freedom from parasitics when running on V.F.O., the two anode chokes are of differing inductances, and the V.F.O. anode choke is also damped by a swamping resistance. For crystal use, the V.F.O. is cut off, and the Class A buffer stage becomes a Pierce oscillator. It should be remembered that auxiliary crystal facilities have a special merit. If a multiple crystal holder such as the Brooke's unit is fitted, it can be stocked with crystals marking the band edges and other subdivisions of the band. The V.F.O. then becomes in effect its own check unit, so that the danger of out-of-band operation is greatly reduced when a turn of the switch will give exact crystal marker frequencies. This relieves the operator's mind, and the Post Office alike, for anything tending to reduce improper operation is to be encouraged, especially under present-day conditions.

Power Supply

The power supply for the V.F.O. is, of course, important. It is an advantage if the V.F.O. unit has its own small power pack. It is not a good plan, however, to include this within the V.F.O., as heating should be minimised as far as possible. Furthermore, a voltage-regulated supply for the oscillator proper, and preferably also for the first buffer stage, should be provided. A Class A buffer stage by presenting a steady load, regardless of whether there is drive or not, helps to maintain a steady voltage. Neon stabilisers are almost universely employed for this purpose. Two choices are open to the constructor.

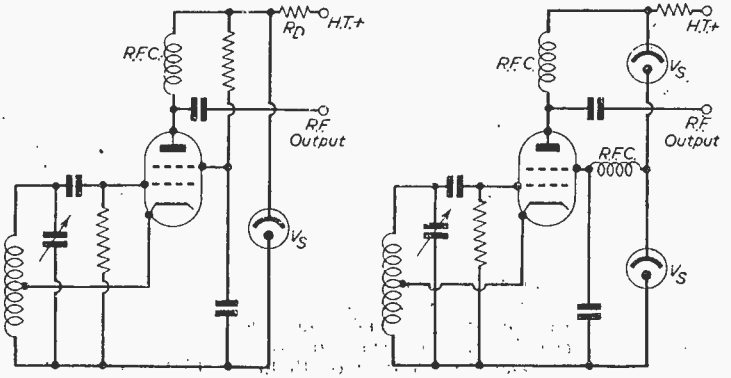


Fig. 14. (left).—H.T. stabilised V.F.O. RD depends on the H.T. supply, voltage and maker's data for the stabiliser (Vs); Fig. 15 (right).—Two stabiliser valves in series stabilise anode and screen simultaneously.

As previously described, a value of screen-dropping resistors can be found which will make overall voltage changes have little effect upon the frequency. If this value is used, it is only necessary to stabilise the overall H.T. supply to the V.F.O. valve. If low-power operation of the oscillator is used, a single 105-volt stabiliser can be used. On the other hand by "brute force" methods, both the screen and anode can be stabilised by using two neon stabilisers and applying 105 volts to the screen and 210 to the anode (Figs. 14 and 15).

Keying

Regardless of the final oscillator set-up, the problem of which stage to key will arise. For break-in and similar work, it is usual to key the oscillator. This may be done by any of the usual methods such as screen, grid block or cathode keying. However, it is a severe test of a V.F.O. to provide chirpless keying at the higher frequencies, and to eliminate any residual chirp it may be desired to key an intermediate stage. In the interests of stability, this should be a stage remote from the V.F.O. However, whether oscillator keying or not is employed, there is one essential thing in the interests of other users of the amateur bands and that is a means of keeping the transmitter from radiating while allowing the V.F.O. to oscillate. Unfortunately, this is not always done, and the characteristic swoops and whistles of V.F.O. transmitters being swung fully radiating over the band is a menace that should be eradicated. In any case, it is much more comfortable to the amateur operator to swing his V.F.O. on to a DX station's frequency if only the V.F.O. is running. However, a switch to disable the main power amplifier stages is easily fitted. If an intermediate stage but not the V.F.O. is keyed, then, of course, a separate switch for the V.F.O. is used anyway, so that with the key up the V.F.O. alone can be switched on. Where the V.F.O. itself is keyed, a switch in a cathode lead to a driver stage will enable the V.F.O. to be set to frequency without radiating a signal on the air. Needless to say, the vicious practice of connecting the cathode leads of all transmitter stages together and keying them all together is not recommended. It is ideal, of course, for producing violent surges in the H.T. supply line, and appears useful in transmitters in which the stages are so unstable that unless all the cathode leads are broken, the stages would radiate violent parasitics. Normal transmitting practice is, as most amateurs are aware, somewhat different.

An Interesting Sound Installation

THE General Electric Co., Ltd., has recently completed an interesting sound equipment installation in Singapore's first international club, The Island Club, which caters mainly for the golfing community. The club was established long before the war but the premises were destroyed by the Japanese, and in view of the changed political outlook after the occupation the Government was anxious that it should fill an important position in the community life of Singapore. It was therefore decided to build an imposing clubhouse which would be worthy of the club's position.

As the sound system could be installed whilst the building was still under construction, it was decided that the loudspeaker layout should be as unobtrusive as possible. The following facilities were required:

(1) Paging throughout the club premises and in the car park.

(2) Music throughout the club premises.

(3) A microphone positioned on the "apron" in front of the clubhouse, to be used by visiting golf professionals to address members, and a further microphone in the ballroom for the dance band and other social activities.

The main control was to be located in the secretary's office, but the ballroom microphone was to have an individual control for use by band members.

Interior

In the ballroom on the first floor a large number of loudspeakers were used to give low level distribution, the basic unit being a high-grade 10in. permanent magnet unit, concealed behind decorative aluminium grilles. There are a total of 18 loudspeakers in this particular location and it was thought best to leave them in their original cabinets as in this fashion they were fairly proof against attacks from vermin. The loudspeakers have been mounted in the ceiling although as a general rule this is nowadays considered unsatisfactory. In this particular installation however there appeared to be no real alternative as there are no solid walls to this part of the building, which meant that the loudspeakers would have had to be mounted on the pillars at the edge of the ballroom. Quite apart from the architects and others concerned with the design of the building, who felt that this arrangement would prove unsightly, it was considered that due to the width of the ballroom it would be difficult to obtain a satisfactory level of reinforcement (for announcements, etc.) in the centre of the floor. In practice, the present arrangement has been found to be very satisfactory and no doubt the fact that when in operation the sides of the ballroom are almost completely open, assists very considerably.

Exterior

The outside canopy was covered by two mono-planar horns located in the front edge of the roof. The car park paging is covered by a single mono-planar horn mounted on top of the secretary's office.

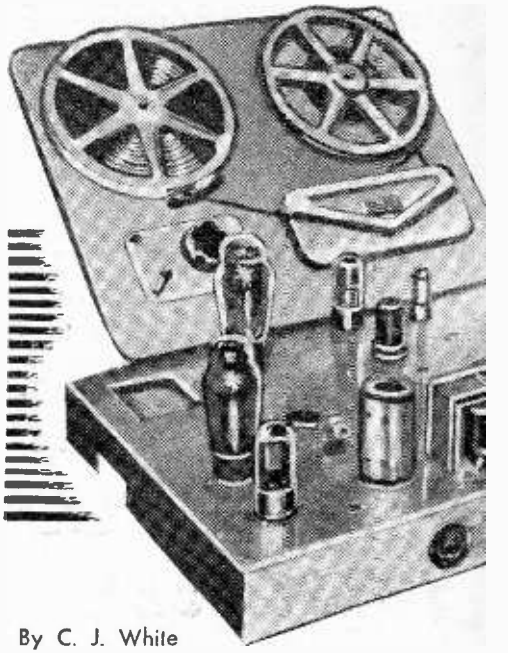
Paging and music reproduction in the downstairs lounge and "19th Hole" is from a high grade 10in. permanent magnet unit mounted in a decorative cabinet and positioned on the bar. In the ladies' and men's dressing rooms, 8in. loudspeakers are used.

The equipment itself comprises a 30-watt amplifier, record changer, switch panel and monitor loudspeaker. Two junction boxes terminate the permanent wiring for the loudspeaker and microphone distribution systems.

The President of the Club is the Rt. Hon. J. Malcolm MacDonald, the Commissioner-General for South East Asia, and the opening ceremony was carried out by the Rt. Hon. Oliver Lyttelton, Secretary of State for the Colonies.

ALTHOUGH the equipment about to be described was designed around a Wright and Weaire Tape Deck, the considerations involved also apply to all tape decks in general.

The requirements were that with the magnetic tape running at 7½in. per second, the output/frequency response should be 60-8,000 C.P.S. ±3 db with a very sharp "cut" above 9 kc/s. The distortion—amplifiers and tape—should be at a very minimum, and the noise—hum and "scratch"—should not be more than is heard when L.P. records are reproduced on high-quality equipment. It should also be convenient to use, having a small, self-contained amplifier for monitoring (about 3 watts output) and a low-voltage output suitable to be fed into any available high-quality amplifier tone-control unit such as the Williamson or Leak. It must also accept any input: from a high-quality low-output microphone to a large voltage, from, say, the detector of a local broadcast receiver, together with a satisfactory and clearly seen "volume" indicator.



By C. J. White

Design as a Whole

There is no doubt that these requirements were stringent, but it has been found possible to satisfy them with reasonable economy of material, and it is thought that, with care, the same results can be achieved by any home constructor. The very first point to be made is that the design must be considered as a whole; for instance, changing the cathode resistor of the EL33 bias output valve R52 (V9) from 270Ω to 200 or 500Ω, i.e., increasing or decreasing the output by a small amount, results in as much as a 6 db depression or lift of the higher middle frequencies, together with a change in distortion and noise. Though substitution of resistances by a different ohmic valve is not usually made, the substitution of valves very often is. Taking

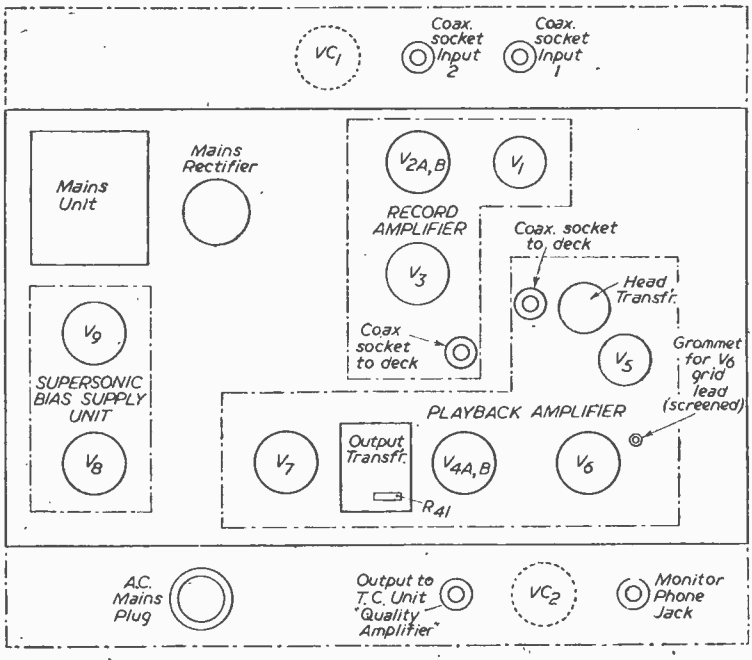
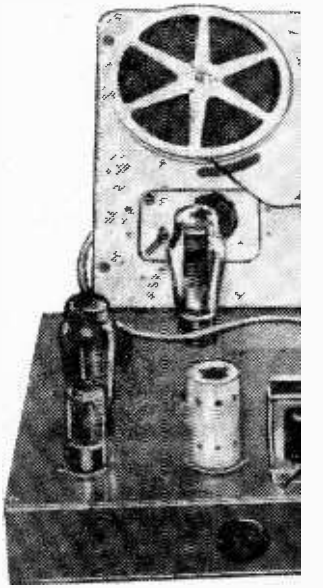
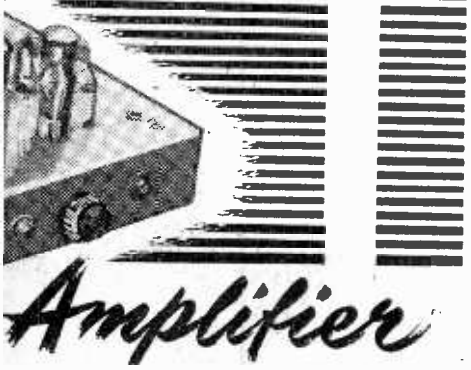


Fig. 1.—Plan view of the amplifier chassis.



The com

Tape Deck Amplifier



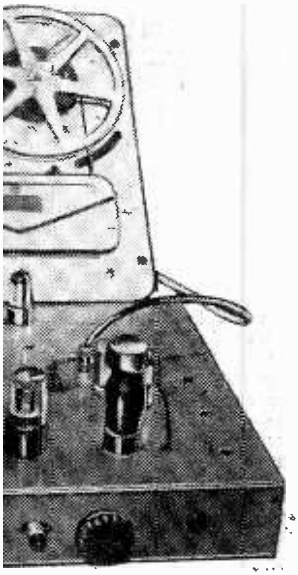
the EL33 (V9) as a case in point, quite often the use of a 6V6 instead would make no difference to the equipment and, as a matter of fact, replacing the 6V6 (V7) of the playback amplifier by an EL33 or vice versa has negligible results, but such is not the case with the bias output valve. The circuit constants are such that only the EL33 can be used in this position unless, of course, equipment is available to correct the equalisation for the change of supersonic bias volts so caused, and to ensure that they are sufficient for minimum distortion plus complete erase. Very great care has been taken with the design of the supersonic bias supply. The waveform is a very close approximation to a pure sine wave combined with reliable starting, constant volts and sufficient output, a combination of requirements impossible to satisfy in a single-stage oscillator.

Tone Controls

To obtain the tremendous bass and treble "lifts" for proper equalisation, negative feedback tone-control circuits were used with the exception of one stage in the recording amplifier. It cannot be too strongly emphasised that the first-class performance of this equipment is due to the application of negative feedback and that circuit constants are critical: any ideas that "it's only a tone-control condenser, a .002 μF will do instead of .001 μF" must be discarded. The 0.002 μF across the EF40 (V5) anode

Frequency/Output Characteristic of Tape Deck Amplifier
Taken with constant volts input to input 1. Ref. Level

1,000	cycles	per	second	—20 db
60	,,	,,	,,	—17 ,,
100	,,	,,	,,	—20 ,,
250	,,	,,	,,	—20 ,,
1,000	,,	,,	,,	—20 ,,
4,500	,,	,,	,,	—20 ,,
7,000	,,	,,	,,	—19 ,,
8,000	,,	,,	,,	—17 ,,
9,000	,,	,,	,,	— 9 ,,
11,500	,,	,,	,,	— 2 ,,



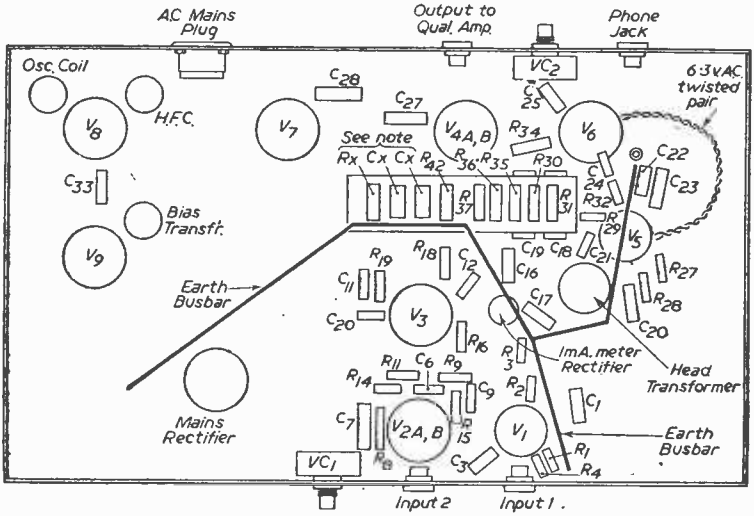


Fig. 2.—Underside view of amplifier—Note: Cx and Rx are part of H.T. supply. Cx=16 μF 450 volts and Rx=2,500Ω 10 watts (wirewound).

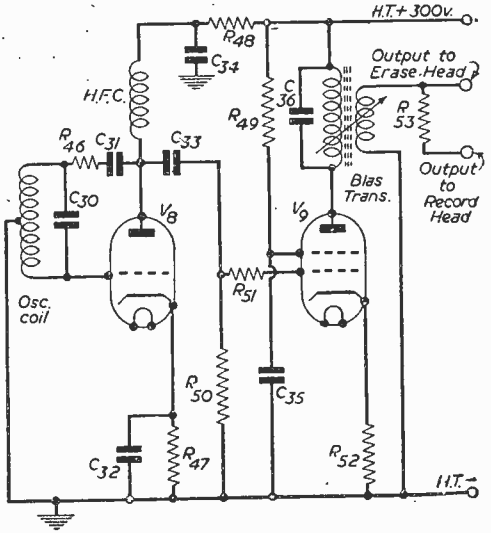
pment.

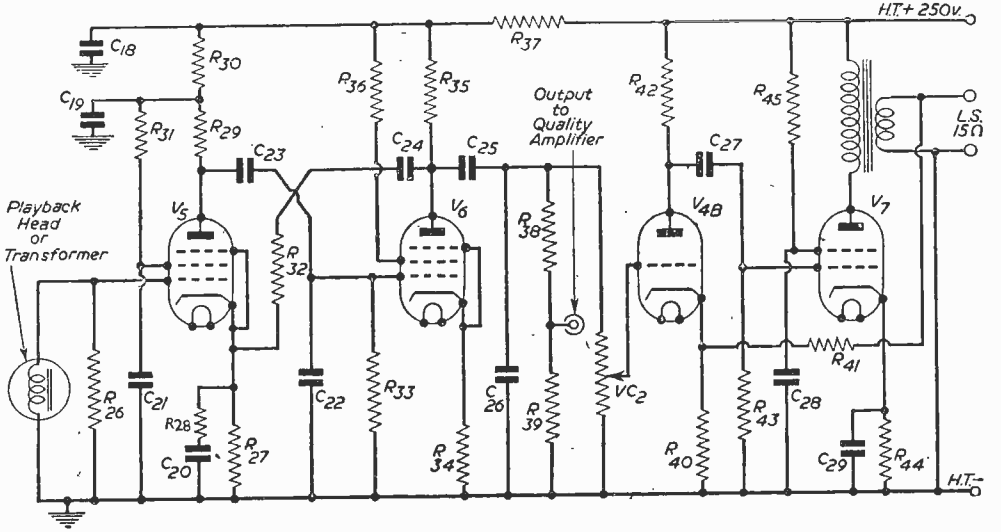
load (C22) is one of these ; the replacement of this condenser by a 0.001 μF or 0.003 μF results in the sharp cut at 9 kc/s moving up and down the frequency characteristic by as much as ± 3 kc/s, with other deleterious effects.

Apart from these strictures construction should be fairly simple. Single-point earthing : it is perhaps best to take all earths to a copper busbar grounded only at V1 valveholder and, if possible, separate filament supplies to the playback and recording amplifiers with separate "humdingers." A "unit" power pack is a convenience ; it is much easier to orientate a complete power pack for minimum hum rather than attempt it with the mains transformer only. Very short leads are essential ; 2in. long is very long on the grid and anode of early stages, and screened leads going through the chassis must have grommets to prevent earthing, and the screening should be earthed to the busbar only.

Economical H.T.

Because playback and record amplifiers are not in use at the same time, an economical H.T. supply can be provided, with the qualification that double-





PLAYBACK AMPLIFIER WITH SUPERSONIC BIAS SUPPLY

R26—1.5MΩ $\frac{1}{2}$W.
R27—2.2KΩ $\frac{1}{2}$W.
R28—270Ω $\frac{1}{2}$W.
R29—220KΩ $\frac{1}{2}$W.
R30—27KΩ $\frac{1}{2}$W.
R31—1.2MΩ $\frac{1}{2}$W.
R32—125KΩ $\frac{1}{2}$W.
R33—1MΩ $\frac{1}{2}$W.
R34—1.5KΩ $\frac{1}{2}$W.
R35—100KΩ $\frac{1}{2}$W.
R36—150KΩ $\frac{1}{2}$W.
R37—50KΩ 1W.
R38—470KΩ $\frac{1}{2}$W.
R39—47KΩ $\frac{1}{2}$W.
R40—1.5KΩ 1W.
R41—10KΩ $\frac{1}{2}$W.
R42—100KΩ 1W.
R43—500KΩ $\frac{1}{2}$W.
R44—570Ω 1W.
R45—4.7KΩ $\frac{1}{2}$W.
R46—1.0KΩ $\frac{1}{2}$W.
R47—4.7KΩ 1W.
R48—25KΩ 1W.
R49—4.7KΩ $\frac{1}{2}$W.
R50—250KΩ $\frac{1}{2}$W.
R51—1.0KΩ $\frac{1}{2}$W.
R52—270Ω 1W.
R53—135Ω $\frac{1}{2}$W.
VC2—500KΩ $\frac{1}{2}$W. (volume control).
Oscillator coil, Bradmatic 1A.
H.F. choke, Bradmatic.
Bias Transformer—Wright & Weaire, type 579.

Valves

V5—EF40. V6—EF37.
V4B—$\frac{1}{2}$6SN7. V7—6V6.
V8—6J5. V9—EL33.

C18—16μF. elect. cond. 350V. wkg.
C19—16μF. elect. cond. 350V. wkg.
C20—0.01μF. paper cond. 250V. wkg.
C21—0.25μF. paper cond. 250V. wkg.
C22—0.002μF. paper cond. 250V. wkg.
C23—0.25μF. paper cond. 350V. wkg.
C24—0.001μF. mica cond. 250V. wkg.
C25—0.25μF. paper cond. 350V. wkg.
C26—300pF. mica cond. 250V. wkg.
C27—0.1μF. paper cond. 350V. wkg.
C28—8.0μF. elect. cond. 350V. wkg.
C29—50.0μF. elect. cond. 25V. wkg.
C30—0.005μF. mica cond. 250V. wkg.
C31—0.001μF. mica cond. 350V. wkg.
C32—0.1μF. paper cond. 250V. wkg.
C33—0.001μF. mica cond. 350V. wkg.
C34—0.1μF. paper cond. 350V. wkg.
C35—0.1μF. paper cond. 350V. wkg.
C36—0.005μF. mica cond. 250V. wkg.

section smoothing (two chokes, three condensers) should be used. An output of 360/370 volts at approximately 75 mA is suitable. This can be provided quite easily by the standard 350-0-350 v. 80 mA transformer. Dropping resistors for the three units were not specified as it is thought that constructors would use any power supply they had on hand. They were 2,500Ω 10 watt wirewound between the H.T. and the playback amplifier; 2,500Ω 5 watt wirewound between the H.T. and the record amplifier, each with a 16 μF electrolytic condenser 450 v.w. on the amplifier side H.T.+ to earth; and 1,500Ω 10 watt wirewound resistor between H.T.+ and the supersonic bias unit with a .25 μF condenser on the unit side H.T.+ to earth.

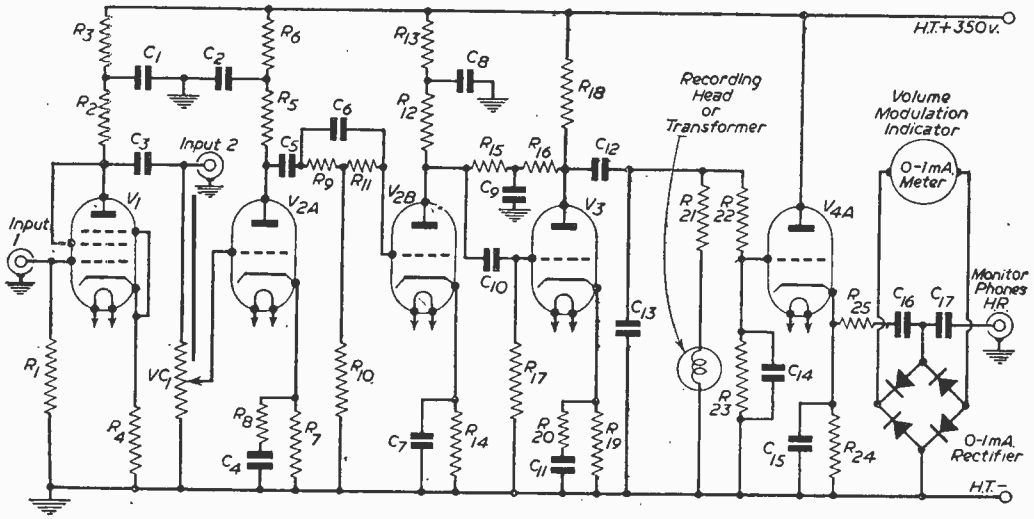
Volume Indicator

The only unit to require much discussion is the volume indicator. The writer favours the use of the "magic eye" in that it avoids loading the circuit and it is an instantaneous peak-reading indicator, thus enabling the operator to avoid both under- and over-modulation of the tape, but unfortunately it is difficult to see at any distance. In the present design a 0—0.1 milliamp meter is used, fed from a cathode follower, which avoids loading the recording head and additionally enables one roughly to shape the frequency characteristic of the indicator to suit the tape. The 3in. meter is very easy to see, and with a little experience, particularly when recording percussion instruments which are often given a good, hard "bash" before the meter pointer has had time to come to rest after the previous one, very easy to use. The constants are such that maximum reading on the milliampmeter corresponds with maximum permissible modulation.

It was found that it is a convenience to be able to monitor the programme material as it goes on to the tape. In order to do this the input to the meter was tapped off via 0.1 μF condenser (this is to correct for excess of low frequencies) and fed to a pair of H.R. 'phones, 2,000/4,000 ohms. This gives a signal loud enough to be heard through much extraneous noise.

The frequency response of the equipment is, as will be seen, very satisfactory, and subjective tests gave results which are described as "superb."

As mentioned in the opening paragraph, these amplifiers may be used with almost any modern Tape Deck, and for those who wish to make up their own the separate components are available from M.O.S., of Tottenham Court Road, who can also supply suitable motors, heads and oscillator coil units.



RECORDING AMPLIFIER WITH VOLUME INDICATOR

R1—1MΩ ½W.
R2—40KΩ ½W.
R3—150KΩ ½W.
R4—1.2KΩ ½W.
R5—120KΩ 1W.
R6—15KΩ 1W.
R7—2.2KΩ ½W.
R8—3.7KΩ ½W.
R9—100KΩ ½W.
R10—22KΩ ½W.
R11—250KΩ ½W.
R12—120KΩ 1W.
R13—15KΩ 1W.
R14—2.3KΩ ½W.
R15—250KΩ ½W.
R16—80KΩ ½W.
R17—500KΩ ½W.
R18—50KΩ 1W.
R19—1.5KΩ 1W.
R20—200Ω ½W.
R21—54KΩ ½W.
R22—600KΩ ½W.
R23—470KΩ ½W.
R24—5.7KΩ 1W.
R25—800Ω ½W.
VC1—500K. ½W (volume control).
Rectifier, 1mA Westinghouse meter rectifier.

Valves
V1—EF40.
V2A, V2B } 6SL7.
V3—6J5.
V4A—½ 6SN7.

C1—16μF. elect. cond. 450V. wkg.
C2—16μF. elect. cond. 450V. wkg.
C3—0.1μF. paper cond. 250V. wkg.
C4—0.01μF. paper cond. 250V. wkg.
C5—0.1μF. paper cond. 350V. wkg.
C6—50pF. mica cond. 250V. wkg.
C7—0.01μF. paper cond. 250V. wkg.
C8—8μF. elect. cond. 450V. wkg.
C9—500pF. mica cond. 350V. wkg.
C10—0.1μF. paper cond. 350V. wkg.
C11—0.01μF. paper cond. 250V. wkg.
C12—0.5μF. paper cond. 350V. wkg.
C13—200pF. mica cond. 250V. wkg.
C14—0.001μF. mica cond. 250V. wkg.
C15—0.01μF. paper cond. 250V. wkg.
C16—4μF. elect. cond. 250V. wkg.
C17—0.1μF. paper cond. 250V. wkg.

Tape Recording

A READER'S EXPERIENCES AND SOME HINTS

WITH regard to the article in the July PRACTICAL WIRELESS, regarding Magnetic Tape Recording.

The first point of choice in tape speeds has, I feel, been overstressed. The speeds of 7½in. per second for normal musical reproduction and 3¾in. per second for dictation quality should be those only to receive the consideration of amateur constructors contemplating constructing such equipment. Adequate quality in playback is easily obtained with the speed of 7½in. per second ; this fact is borne out by the adoption of this speed by most Tape Recording manufacturers as the " standard " speed.

The high quality achieved with using the speed of 15in. per second is at the expense of playing time. As most recording tape is marketed on 7in. reels containing 1,200ft.—the playing time thus obtained is just over 15 minutes. Is this sufficient uninterrupted time in which to record passages of orchestral music of a classical nature? Moreover, the extended frequency response obtained with the speed of 15in. per sec. is a doubtful asset when recording from BBC transmissions. The highest audio frequency broadcast by the BBC does not, I believe, by International agreement, exceed 9 kc/s—and this can be achieved on tape running at 7½in. per second.

Therefore, to provide facilities to record much higher frequencies than those available is pointless. If it is argued that higher frequency response is obtained from gramophone records, then I will agree that adoption of " high fidelity " speeds is justifiable. But is it the amateur's main object to re-record commercial gramophone discs on to tape?

Motors

I cannot see that Mr. Delaney should suggest using separate motors for recording and playing back. It is obvious that (a) the tape travels in the same direction for both functions and (b) for true reproduction both speeds should be identical. Surely then, a single motor is more likely to achieve this than two?

The use of separate amplifiers for the recording and playback processes is to be commended, but for reasons of economy the dual purpose amplifier is often adopted.

Circuit

Construction of a dual purpose amplifier is, on account of the multi-switching, somewhat more complicated than would be the case of separate amplifiers —but the main advantage in choosing a single amplifier is that it will ultimately be simpler to operate. To my mind, the minimum number of control knobs, consistent with good performance, on the front panel should be the constructor's aim. He can have as many " presets " as he likes mounted " behind the scenes," but the whole recorder should be designed so that any member of the family can eventually operate the apparatus—a complicity of knobs on the front panel won't help in this direction !

Erasing

In respect of permanent magnet erasing I agree this should be discarded in favour of high frequency erasing. I recently purchased a reel of tape that had been used with a recorder employing a magnet erase—the noise level apparent on the tape as I purchased it was extremely high and confirmed what has already been written concerning this failing. Fortunately, I found that my high-frequency erasure overcame this trouble quite satisfactorily, and the tape was left clean as new after only one complete run through the heads.

The subject of twin track recording is open to question. We are told the quality enthusiast will choose single track as opposed to double track recording. As tape modulation is effective along the lateral length of the tape, I cannot see the reason for this choosing. It may well be that with half track working, the tape will not handle so much signal volume before saturation and consequent distortion occurs, but despite this fact that only a very weak signal can be superimposed on to the tape, the high-gain pre-amplifier should certainly make up this loss and give adequate loading to the final stages of the playback amplifier.

In respect of my own recorder I took about four weeks to set it up to my satisfaction and can well appreciate the difficulties that can arise with this type of equipment.

I use a Lane type (the original model with the single heavy duty motor) recorder coupled with my home-constructed record/playback amplifier. This amplifier conforms to the usual standard circuitry and modified only to the extent that (bass gain control apart) all frequency compensation is preset and automatically adjusted on either position of the record/playback switch.

As a precaution against possible hum difficulties, the power pack is built on to a separate chassis. The whole assembly, together with a 10in. speaker of very moderate price, is built into a console cabinet. I have incorporated a 500 micro-ampmeter to indicate recording level, and it is my opinion that this is a very essential item in obtaining successful and uniform recordings.

The signal is obtained by a method described in PRACTICAL WIRELESS articles, some three years ago, dealing with disc recording. The signal is taken (from the receiver) from the junction of the coupling condenser and grid resistance to the output valve. The recording signal is fed from this point through a loading resistor of 500 KΩ value which shunts the output stage of the receiver without affecting performance. From the earthy end of this resistor the signal is then fed through co-ax cable and Pye plugs, straight to the volume control of the record/playback amplifier.

Taking everything into account, I think I obtain good results from recording on tape. The hum level is very low and is only just audible on playback when the tape is not modulated. When speech or music commences the hum is inaudible. Bass response does not quite, I admit, equal that obtained with commercial radiograms—but the clarity of tone is way ahead. Incidently, I find that I obtain a varying bass with different makes of tapes.—L. H. MILLER.

Inexpensive Quality

IMPROVING QUALITY OF REPRODUCTION BY MEANS OF A GOOD SPEAKER CABINET

By K. C. Ireland, A.R.I.C.S.

IT is a well-known fact that the normal commercial table radio does not provide the quality of reproduction usually given by a console or radiogram. The reasons are not hard to find: prohibitive purchase tax, shortage of materials and labour have forced manufacturers to reduce the size of the loudspeaker and cabinet to such dimensions that it becomes impossible faithfully to reproduce the low notes. The radio chassis is capable of very fine reproduction but it is prevented by the restricted size of the cabinet and speaker from giving of its best.

This article is the result of the writer's attempts to obtain good quality at low cost, and although the results may not even now be ranked as quality at its finest, they have provided a measure of realism far beyond that obtained from the set as purchased.

The cost was reasonable, approximately 35s., excluding the loudspeaker.

Having purchased a new table model it was appreciated that it must have somewhere to stand. The obsolete set stood on an old table which ill-matched the modern lines of the new instrument. Why not construct a cabinet capable of providing a large baffle area and at the same time provide means of support for the set?

Many amateurs fight shy of cabinet work, but by the use of easily obtainable materials, a few tools, and simple but carefully executed joints a very attractive, substantial and workmanlike cabinet can be made.

The cabinet can be made to accommodate a standard 8in. or 10in. speaker. The writer's speaker was an 8in. model of permanent magnet design taken from a 1932 battery-model set. This was doctored by cutting away the corrugations and substituting a linen surround, and although this modification gave a noticeable improvement in bass response, it was considered that some increase in top would be required on speech.

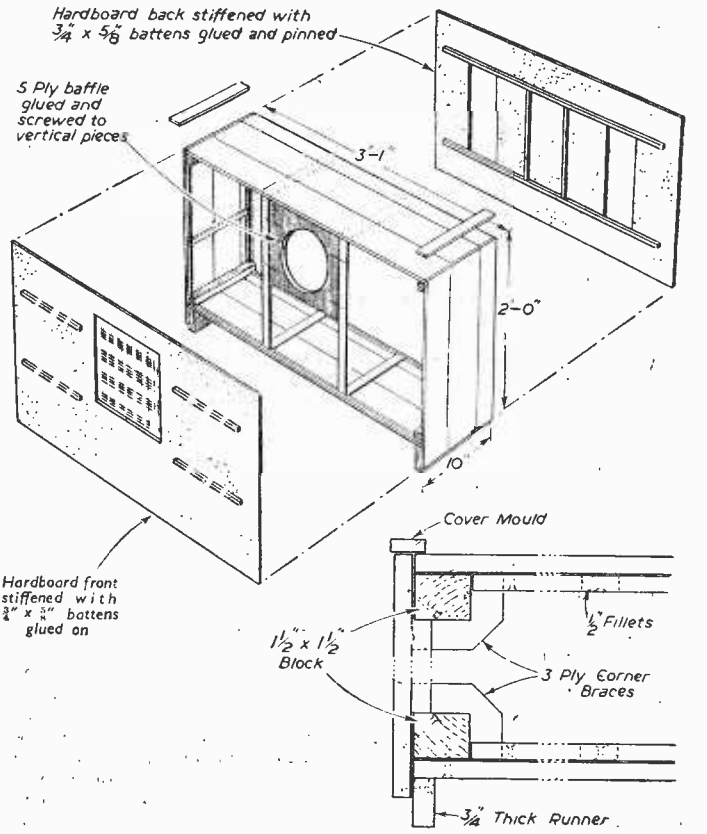
The simple expedient of brushing a thin coat of french polish on to the cone produced the desired effect. By placing the speaker near the top of the cabinet baffle high-note production is improved.

Construction

The sides, top and bottom of the cabinet were made up of ⅞in. tongued-and-grooved boards 4in. wide. Two and a half boards are required for each section.

Cut the boards rather longer than the finished size required. Fix together by fitting the tongues into the grooves and secure by screwing battens 1in. wide to the inside surfaces. When this has been done the boards can be squared across at the ends and sawn to the correct lengths.

The four sections are secured at the corners by 1½in. by 1½in. wood blocks set back approximately ⅜in. from back and front edges; this is done to



Details of the cabinet suggested by Mr. Ireland.

allow the front and back panels to be recessed in. Secure the blocks to the four sectional pieces with 1½in. wood screws driven in from the inside faces of the blocks.

Three-quarter-inch by ¾in. fillets of planed timber are glued and screwed between the blocks to support the back and front panels.

The cabinet is raised from the floor by means of two lengths of ¾in. timber screwed to the sides below the base boards.

To assist rigidity pieces of three-ply timber are glued and secured with panel pins at the back. Set the joints of the framing square before fixing these corner pieces. Now carefully plane the front and rear edges of the cabinet to ensure that they are parallel and the finish smooth and clean.

Two 1½in. by 1in. vertical battens are provided at the front at 12in. centres to provide intermediate supports for the front panel.

This front panel is cut from ¼in. hardboard, which can be obtained from any timber merchant for 10d. per square foot. This is an easily worked material which cuts cleanly with a sharp tenon saw and in addition takes a fine polished finish. The speaker opening can be cut with the tenon and fret saw. Having ensured that the front is tight and well fitting, remove it from the cabinet and glue ¾in. thick battens horizontally at about 6in. centres. These battens will stiffen the board. This is essential to prevent drumming.

The speaker baffle can now be prepared and is cut from a piece of five-ply with fabric stretched and glued across the opening. The small baffle is now glued and pinned between the vertical struts in the cabinet, making sure that the face of the five-ply is flush with the struts. Allow ample time for all glue to set and then proceed to fix the front panel into the cabinet and secure with glue and small panel pins.

The back of the cabinet is made up of a sheet of hardboard in a similar manner to the front and secured to the cabinet with wood screws. In the original model an improvement was noticed in crispness of speech when two vertical slots, each about 12in. high by 4in. wide, were cut in the back panel.

Cover the joints between top and side sections with a small piece of timber glued and pinned in position.

Decorative Finish

The finished cabinet can be stained and polished or painted. The materials used for the cabinet will take either finish well.

The original model was stained and french polished, and this will be described.

All fixing pins showing on the face of the cabinet should be well punched down. Now well rub down the top and sides with medium glasspaper. Do not glasspaper the hardboard.

The next operation consists of filling the grain of the timber; again do not apply the filler to the hardboard. The filling is done by mixing a good wood filler with water to a paste and brushing this mixture into the wood across the grain. Fill all screws and nail holes flush with the surrounding surfaces and similarly treat all defects in the timbers. Allow ample time to dry, when the cabinet will have the appearance of having been whitewashed. Now remove all the surplus wood filler with glasspaper, always rubbing with the grain and never across it. This operation will leave the cabinet in its natural colour.

Stain the whole cabinet, including the hardboard, with a good-quality oil stain. The shade is a matter of choice. By staining the top and sides dark and the front panel a lighter shade an attractive contrast can be obtained.

The cabinet is now ready for polishing. French polishing is an art but successful results can be obtained by using one of the several amateur french polishes now on the market, being guided by the manufacturer's directions. The secrets of a good finish are ample preparation before staining and making certain surfaces are thoroughly dry and hard before applying the successive coats of polish and, of course, taking care that all parts of the article are evenly coated, particularly the corners.

The hardboard has a fine surface which readily takes stain and polish. The wood fibres used in making this material stand out well and give an interesting and expensive-looking finish.

If care is taken during construction to see that all corners are square and all cut edges well smoothed the finished cabinet should look neat and attractive.

The final operation is to screw the speaker to the baffle and connect to the extension speaker sockets on the set. It is possible, of course, to remove the speaker provided in the set cabinet and use this in the cabinet by extending the leads. It will then usually be necessary to "black-out" the speaker fret in the set to prevent the dial lights shining through.

R.I.C. Premiums

THE panel of judges appointed by the Radio Industry Council to award premiums to the authors of articles deserving to be commended by the industry, hopes to make its first awards in respect of articles published between January 1 and June 30, 1952.

This will enable the results to be announced and cheques presented at the National Radio Show, to be held at Earls Court, London, from August 26 to September 6.

Premiums of 25 guineas each, up to an average of six per year, are offered. Authors of published articles or editors publishing them are invited to submit for consideration articles published during the first six months of the year to the Secretary, Radio Industry Council, 59, Russell Square, London, W.C.1. not later than July 7, 1952.

Only non-professional writers contributing to journals available to the public are eligible at present. Full particulars of the competition are available on request.

The judges are:

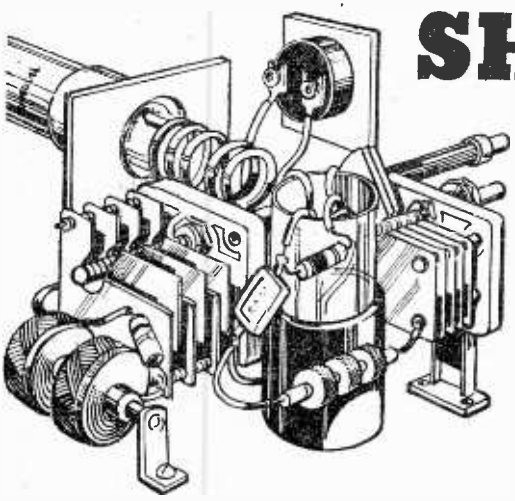
Professor Willis Jackson, D.Sc., D.Phil., M.I.E.E., F.Inst.P., Professor of Electrical Engineering, Imperial College of Science and Technology, University of London.

Mr. P. D. Canning, Chairman of the Technical Directive Board of R.I.C.

Mr. W. M. York, Chairman of the Public Relations Committee, of R.I.C.

Mr. T. E. Goldup, M.I.E.E., a member of the Technical Directive Board.

Vice-Admiral J. W. S. Dorling, C.B., M.I.E.E., Director, R.I.C.



SHORT-WAVE SECTION

PRE-WAR COMPONENTS AND EXPERIMENTAL SHORT-WAVE RECEIVERS

By A. W. Mann

SUCH is the popularity of short-wave reception and receiver construction that in most large towns one finds an amateur supplies stores, as distinct from the present day radio shop. To be successful the amateur supply business must carry a comprehensive stock of new, ex-service and second-hand components.

Taking into account the fact that the amateur fraternity is rapidly increasing this type of business has come to stay, and is worthy of local support.

There is a certain type of amateur experimenter to whom the use of any type of pre-war standard component is a retrograde step. Anything contained in a moulded case, for example, cannot be entertained. Everyone to his taste, of course. The writer, whilst using post-war components where necessary in experimental designs, also uses those of pre-war manufacture. First, because he knows from experience that they are efficient, and also that throughout the country there are readers of this journal who have similar ones to hand.

While I would not advise experimenters to purchase second-hand short-wave coils of the comparatively large diameter types common to the early days of short-wave reception, there are certain types which are equally as suitable for inclusion in experimental short-wave receivers as when made in the factories of this country years ago.

Some of the firms responsible for them are now defunct. Others are engaged in a different branch of the industry.

The purpose of this article is to discuss some of their products which can sometimes be seen in the local amateur supplies shop, second-hand, and in some instances in brand new unused condition, and at bargain prices.

L.F. Coupling Components

Fig. 1 shows in theoretical form the Telsen 1 to 1 RCC coupling unit. This is contained in a brown moulded case. It is extremely light in weight and unique in that decoupling components are built in, thus eliminating several wires. The whole forms a compact hermetically sealed unit.

The low-pass anode feed filter is a safeguard against motor-boating, and if used in conjunction with an H.L. type valve will provide a useful measure of amplification. This unit is intended for use in the first stage of a two-stage L.F. amplifier.

Inter-valve Coupling Unit

At Fig. 2 is the theoretical diagram of the inter-valve coupling unit by Telsen. This has a 10 to 1 ratio, and because of this, as well as on other accounts, is somewhat unusual.

This is a high permeability, filter-fed L.F. transformer, containing a nickel alloy core, and is designed for use with an L.F. pentode. It is claimed that the amplification possible when this unit is used in a single stage L.F. type receiver is equal to two stages of L.F. and with improved reproduction.

Now a point in the design of these units is that spaghetti resistors are used as distinct from present types. In case of breakdown these resistances should be suspect. While I have never experienced this trouble I am aware that such has been the case. A carbon type resistor should be used as a replacement.

When an A.C. H.T. eliminator is used with a headphone type receiver, L.F. choke output should invariably be incorporated. The makers of the above units also produced a tapped pentode output choke. This is of the 25/50 mA type, and by the rearrangement of the three terminal connections ratios of 1 to 1, 1.6 to 1 and 2.5 to 1 are obtainable. This choke is an excellent one in every way.

L.F. Transformers

A useful series of low-frequency transformers were produced during the same period, all of which were enclosed in the familiar light brown bakelite cases. Later the latter gave way to aluminium painted metal cases.

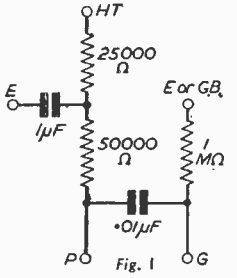


Fig. 1.—Theoretical arrangement of the Telsen RCC coupling unit.

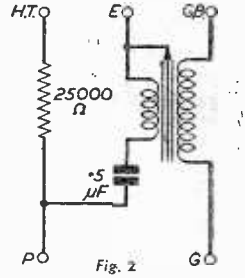


Fig. 2.—The R.C. fed L.F. transformer with 10-1 ratio.

These were distinct from the filter—fed 10 to 1 unit. They included the Ace models 3 to 1 and 5 to 1 ratio respectively. There were several others, including push-pull input, multi-ratio output transformers, etc. I have found that both the moulded cased and metal cased types are most satisfactory when used in short-wave receivers.

H.F. Chokes

Those who wish to cover the trawler and top amateur bands will, of course, use a suitable H.F. choke like the Eddystone 1010, or if an all-wave receiver is contemplated, the highly efficient Osmor QO1, both of which are of the unscreened types. Pre-war screened types included Graham Farish and Telsen respectively. The former is efficient down to 10 metres although 12 metres is quoted as the minimum. The latter is rated as from 10 metres to 100 metres.

The practice of using L.F. inter-valve coupling chokes in the anode circuits of receivers is not very often followed. It may interest those who have Telsen types on hand to know that the 40H type have a normal rating of 3 mA current, with a maximum current of 10 mA.

In the case of the 100H the rating is 2 mA and 6 mA respectively. The 40H, inductance 40-31H at 0-20 mA.

The 100H, inductance 105-100 H at 0-10 mA. The writer described a choke-resistance-coupled three-valve regenerative receiver using 100H L.F. chokes in a pre-war issue of this paper. This receiver provided a really good signal-to-noise ratio, and I am considering building an up-to-date version, using this form of L.F. amplification.

Nickel Alloy L.F. Transformers

Among the components produced by Lissen was the Hypernik range of L.F. transformers. I use these in certain receivers, the ratio being 4 to 1 and the components being intended for use in straight circuits, but can successfully be used as a parallel-fed arrangement. A separate unit in the form of a tone compensator which could be coupled to the transformer base together with a 50 KΩ graded variable resistance was available for use with this model, and proves very effective in correcting high-note losses and the integral filter equally so as a heterodyne whistle suppressor.

While on the subject of parallel feed the writer strongly recommends the little R.I. Parafeed L.F. transformer. This is also a nickel-alloy type with a primary inductance of 80H. Primary D.C. resistance 1,100Ω, the secondary D.C. resistance being 2,800Ω. The ratio is 3 to 1 but by auto-connection is 4 to 1.

Coils

The local amateur shop usually carries a good stock of short-wave coils and switched coil packs. If you favour the former a complete set should be obtained while available. In the case of T.R.F. receivers being the choice, two complete sets will be required. In the case of superhets it should be remembered that some modification may be necessary with regard to the oscillator coil winding. Rather than remove turns from a standard commercial plug-in coil, the writer would prefer to wind special ones.

This, by the way, is one of several reasons why some experimenters prefer a switched coil pack. When second-hand coils are purchased, one or more complete sets are required, especially in the case of types which are no longer manufactured.

So far as the new hand is concerned, it is a matter of buying that which he can afford, rather than what he fancies or would prefer. This brings to mind that one sometimes comes across various types of dual-range short-wave and all-wave tuning units of pre-war manufacture. These naturally are not as efficient as present-day products. At the same time, however, there are two which, while rather greater in physical dimensions than modern types, are of good design. and if the second-hand price is reasonable are suitable for experimental purposes. These are the Lissen Triple range, and Four-range coils respectively.

Tuning Condensers

While it is permissible to use components such as have been outlined and as are to be found in the second-hand market, the same does not apply to tuning condensers and valves.

Tuning coils may, for example, be home wound, but to tune them short-wave tuning condensers of modern design and manufacture should be used.

The valves used should be new ones or alternatively ex-service types of which there are many at present available from reputable advertisers.

The data given in this article, together with various suggestions, is intended especially for the younger generation who are becoming interested in short-wave experimenting, together with others who for financial reasons, must perforce build up a useful stock of components the hard way or forgo the pleasure to be derived from experimental work altogether.

Book Received

"Textbook on Sound," by J. W. Winstanley, M.Sc., A.Inst.P. 239 pp. 153 illus. Published by Longmans, Green and Co., price 12s. 6d.

AS its title implies, this is a textbook for students, and is not for the beginner. Primarily it embraces that material likely to be met with by those preparing for such examinations as Advanced or scholarship levels and it contains a fair amount of maths. There are eleven chapters: The Nature of Sound; Wave Motion; The Velocity of Sound; Reflection, Refraction, Interference and Diffraction of Sound; Measurement of Frequency; The Vibration of Strings, Rods and Solid Bodies; Free and Forced Vibrations, Resonance; The Acoustics of Building; Intensity of Sound; Analysis, Recording and Reproduction of Sound; and The Combinations of Simple Harmonic Motions. This will give some idea of the scope of the book, which is further illustrated by 4 photographic plates.

"Presenting Technical Information"

Mr. John Scott-Taggart points out that he omitted a line in his article appearing on page 305 of our July issue. From the seventh line of the left-hand column, the paragraph should read:

"The letter m should be used for milli- (e.g., mA for milliampere) meaning thousandths and μ for micro- (e.g., μA for microampere), meaning millionths."

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).

Peculiar Faults

SIR,—A set came to me recently which was not working properly. It was a straight three-valver and the symptoms were: a total lack of reaction from about 400 metres to the top of the dial, and also on the long waves. The set behaved normally from 400 metres to the bottom of the dial.

The first thing I noticed was that some previous serviceman had endeavoured to "cure" it by various expedients. He had reduced the resistor supplying the detector valve from around 30,000 ohms to 5,000 ohms in an endeavour to get more H.T. to the valve, and had also substituted an L.F. valve for the proper detector valve. Still no reaction.

I thought at first it was a fault in the coil, but on going over the trimmers of the gang condenser there was a tell-tale crackling; and then I discovered the cause of the fault. The mica separating the trimmer was very thin, and had actually worn into a hole at the point of greatest pressure. This resulted in total lack of signals on the upper part of the dial. It is, however, a nice little problem why this did not affect the lower part of the dial. The only explanation I can think of is that the fractured mica represented a high-resistance joint, the resistance increasing with frequency. But why the sharp cut-off at 400 metres?—WM. NIMMONS (Belfast).

TR/9

SIR,—I have read the correspondence on the TR/9 conversion with much interest. I converted this receiver as described, and as batteries took up rather a lot of space, as well as being costly, I decided to try and build a mains version. I have done so with considerable success, using a 6K7 as R.F., 6J7 det., and a 6K7 as an output pentode for 'phones. The results are great. I am using a D.C. power pack as I have only D.C. mains. Also, with reference to windings 3, 4 on the coils; I reversed the connections to these as they did not seem to be in phase and results were vastly improved.—F. SAMMON (Londonderry).

A Fault Finder

SIR,—I wish to draw the attention of readers to two errors in the article "A Fault Finder," by J. S. Kendall (April issue) and an error in the article, "Ten Thousand Cycles Down," by R. D. Paterson (May issue).

Mr. Kendall shows the circuit of a multivibrator and calls it a "flip-flop." Now the multivibrator is a relaxation oscillator, while the flip-flop, although its circuit may be somewhat similar, is not an oscillator. The multivibrator is characterised by its two A.C. couplings (i.e., two R.C. networks), and the flip-flop by its one A.C. and one D.C. couplings (i.e., one R.C. coupling and one D.C. resistive coupling).

Mr. Kendall also tells us that the frequency of oscillation of a free running multivibrator is approximately:

$$f = \frac{10^6}{R_1C_1 + R_2C_2}$$ c/s where R is in ohms and C in microfarads.

If the following assumptions are made a good approximation to the correct value of f can be found.

(i) $R_1 >> C_2$ the anode impedance of valve 2.
(ii) $R_2 >> C_1$,, ,, ,, ,, ,, 1.
(iii) $R_2 << R_{A1}$ the anode load resistor of valve 1.
(iv) $R_1 << R_{A2}$,, ,, ,, ,, ,, 2.

With these assumptions made, f is given by:

$$f = \frac{10^6}{R_1C_1\log_e\left(\frac{E-V02}{Vc1}\right) + R_2C_2\log_e\left(\frac{E-V01}{Vc2}\right)}\ c/s$$

where E is the H.T. voltage,

V01 and V02 are the anode voltages of valves 1 and 2, respectively, with the coupling condensers removed, and Vc1 and Vc2 are the numerical values of the cut-off potentials for valves 1 and 2, respectively, with E volts H.T. applied.

This result is borne out in practice within the limits of experimental error but Mr. Kendall's result gives values of f which may be as much as 150 to 200 per cent. too high.—G. W. FLETCHER (Manchester).

[I would first like to point out to Mr. G. W. Fletcher, that I have not in my article on page 177 of PRACTICAL WIRELESS, *April, 1952, called a multivibrator a flip-flop! Line 13 reads, "This amplification of noise continues until both the valves are overloaded, when they settle down to oscillate in a flip-flop manner." This means that anode current flows in each valve alternately, whilst the other valve is cut off. The flip-flop on the other hand is a circuit that is stable until it receives a pulse, then changes its state; it is used in keying relay circuits, counting circuits and even to supersede the multivibrator in frequency dividing circuits. They have the advantage that as they have to be driven they can be made to divide very accurately, whereas on the other hand the multivibrator is very susceptible to a change in H.T. or heater voltage. For instance, if the H.T. voltage is doubled the frequency is very nearly halved. As there is such a very large variation with a change in H.T. the formula given by both Mr. R. D. Paterson and myself is as good an approximation formula as there is. It is also quoted by many of the highest authorities on the multivibrator, including Dr. H. J. Reich, Professor of Electrical Engineering at the University of Illinois and Dr. F. E. Terman, who holds the same position at Stanford University. The formula is only an approximation one and this should be clearly understood. The one*

given by Mr. G. W. Fletcher is accurate, providing that the precise characteristics of the valves are known, and also the working voltages. As the H.T. voltage changes the cut-off voltage changes, so does the voltage gain of the valve, these are two linear changes but the decay time of the voltage in the grid circuit is exponential and follows Helmholtz's equation for the decay of voltage in a circuit consisting of a resistance and condenser in parallel; it is: time equals CR Log_e V/V1, where C is in farads, time in seconds, R in ohms, Log_e the natural log to the base e, and V the original voltage, whilst V1 is the desired voltage—in this case it is the cut-off of the valve. The approximation formula is actually the sum of the time constants of the two grid circuits, that is the value of time required for the voltage to fall full value to 36.8 *per cent. of the original voltage. It will readily be seen that the approximation formula is only correct when cut-off is* 36.8 *per cent. of the voltage applied to the grid circuit. The maximum voltage fed to the grid circuit is the difference between the voltage at the anode with zero bias and full H.T. line volts, so that the fall in voltage required is E-Vo/Vc and by applying Helmholtz's equation the time constant for one half of the circuit will be RC Log_e (E-Vo/Vc). It will be seen then that the formula given by Mr. G. W. Fletcher is perfectly correct. As to the values of resistance being too high there are times at low voltages when the approximation formula gives them too low!*—(J. S. KENDALL).]

Tape or Wire?

SIR,—I would be pleased for space in your columns to reply to Mr. V. Morley's letter in your June issue, with regard to indifferent quality on his wire recorder.

The quality achieved using wire for the purpose of recording does not reach that using magnetic tape, even though the heads in the former case are easier to construct by the amateur. If Mr. Morley wishes for better quality, I certainly advise him to try and change to a magnetic tape recorder. Incidentally, the mechanism for a tape machine is simpler to construct, as there is no need to worry about "laying" as in the case of a wire machine. In either case, the mechanical stability must be of a high order. Mr. Morley states that "his mechanical arrangement for winding and laying the wire is by no means perfection." I would suggest that he looks into this matter first, and, to his very best ability, obtain, as near perfection as possible, constant speed and torque on his wire, or tape; there must definitely be no "wow" or "flutter" in the recording medium. "Wow" is a term used to designate momentary variation in speed that takes place at a rate of less than about 8 cycles per second, and "flutter," those variations that take place at a faster rate.

From Mr. Morley's remarks it would *appear* that he is recording at too high a level. If the oscillator will not erase the signals on the wire, it seems to point to high recording level, though, as I have not too much experience on wire recording, I cannot be too sure on this point. Try recording at a level where it is possible to erase the signals by means of the oscillator. Permanent magnet erasing I certainly do not recommend, as this gives a higher noise level.

The third point that arises, is the manufacture of the head. It is extremely difficult for an amateur to make a satisfactory head, unless he has all the facilities for making it and the means of testing after completion. The most suitable laminations for construction of the head is Permalloy—any old transformer lamination is definitely not suitable. In this case after the core has been worked (cut to shape) the laminations must be hydrogen annealed before use, and even after that the completed head must be treated very gently. If Mr. Morley wishes, still, to construct his own head the best method would be to obtain some Permalloy and cut sufficient laminations to shape and then send them to a firm that would be prepared to anneal the lot. Not being in the U.K. I cannot give any more information on this point. I think it would be simpler to buy the heads complete from some reputable manufacturer, who will supply all necessary information about fitting the head, together with the equalising circuit necessary. The erasing head is not so critical and, if necessary, this could easily be constructed. Shield all the heads well with Mu-metal.

The last item in the chain is the amplifier. One cannot use just any old amplifier for magnetic tape or wire recording and playback. Because of the nature of the recording medium, the constant current frequency response characteristic rises at approximately 6 db. per octave. This means that some sort of equaliser (depending on the construction of the head, too) must be used. Simple, single-stage or multi-stage equalisers are used, but normally, for amateur work anyhow, the single stage is usually adequate. I have not the space to go into the whys and wherefores of these but, as I said before, the head manufacturers will usually supply information on this point. The equaliser can be used either on recording, playback or on both, care being taken that when recording, overloading does not occur.

I hope that the above remarks will assist Mr. Morley in obtaining better quality on his equipment. It must be remembered, in all cases of high-quality equipment, that all the different pieces of apparatus, when coupled together to make one unit for a specific purpose, must be chosen so that there is a match, and that each contributes its portion without introducing extra distortion or losses. "The strength of a chain, etc.," you know.—R. KRUMMLCK (N. Rhodesia).

Amateur Transmitters

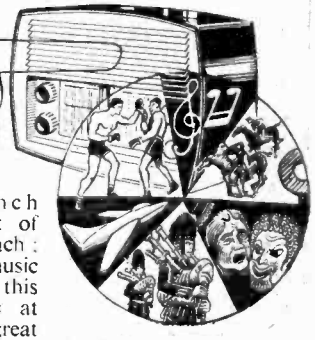
SIR,—I do not write as a spoil-sport, but in the hope that you might find room in your columns to say a few words concerning the standards of amateur transmitting in the L.F. amateur bands.

Before the war one could always rely upon hearing an interesting technical discussion in progress on these bands, but of recent times this is the exception rather than the rule. Surely there is far too much flippant, domestic drivel going on nowadays, radiated by self-styled comedians. In many cases the quality of the transmission is atrocious, and seems to remain so. The one aim seems to be to put out some sort of signal—the true aim of the amateur, i.e., "the further improvement of radio," seems to be sadly forgotten nowadays.

Also there is much unnecessary repetition of phrases—a common fault with the lower grade of amateur.

I have switched off so often in irritation that I feel, at last, that I must write to you, hoping you may consider the matter worthy of a little publicity.—R. LOCKWOOD (Leicester).

Programme Pointers



By MAURICE REEVE

IN a month which did not seem to contain anything of especially outstanding merit, G. K. Chesterton's second play of the only two he ever wrote, "The Judgment of Dr. Johnson," came home an easy winner. Unlike some critics of the daily and weekly press, with whom it wasn't too popular, I thought it was an exceedingly noble, high-minded and mature piece of work, and very good radio to boot. Based on the personality and sayings of the great eighteenth-century Englishman—together with the popular reformer John Wilkes—it is, in spite of its many fine qualities, easy to see why it has never gained a foothold behind the footlights. It lacks high romanticism or stirring adventure, and it is too much on a level, as though the author hadn't been able to cast Boswell's immortal "life" out of his thoughts—this in spite of the interesting theme of the couple over from the rebelling American Colonies acting as agents on their behalf and who expound their views on revolutionary freedom to the Doctor's horror. But it contains some beautiful Chestertonian writing—and can one get much better English than that?—and is a well-constructed piece.

Cecil Trouncer seemed the very re-incarnation of Dr. Johnson and the England of his day, and Howieson Culff as John Wilkes, Cyril Conway as Edmund Burke, Lawrence Payne and Mary Wimbush as the American couple and James McKechnie as Boswell were the most important contributors—together with the adaptor and producer, Frederick Bradnum—to this delightful and worth-while programme.

"A Wind on the Heath," in Peggy Wells's adaptation of Ronald Adam's play, seemed a rather laborious attempt to describe the tenants of an old-fashioned house on Hampstead Heath, with a part that provided Gladys Young with the chance of bringing off something of a *tour-de-force* as Mrs. Pirbright, who goes through the whole gamut of femininity in the course of the play, and who, as a very old lady, tells the story of her life in this quite ordinary suburban house. Miss Young was much less successful as the very elderly Mrs. Pirbright than she was in the various other stages of that lady's career.

Curtain Up

Jack Hulbert, in Felix Felton's adaptation of Somerset Maugham's play, provided a pleasant and amusing interlude in the "Curtain Up" series. I wouldn't rank Jack Straw among Mr. Maugham's many notable contributions to English drama, but anything from his distinguished pen commands respect.

Amongst the many profound and obvious dissimilarities between English and French music is one point of common approach: their failure to see music symphonically. In this weakness France is at one with both her great Latin neighbours, none of whom have produced a symphony of any notability with the exception of César Franck's sole example.

Englishmen, so closely akin to Germans in many ways, might, on the other hand, have been expected to turn sympathetically in the direction in which Germany made herself the supreme and omnipotent master. But we can only boast of two first-class examples. I refer, of course, to the two symphonies of Elgar which were both given magnificent performances last month by the BBC symphony, under Sir Malcolm Sargent. Elgar's examples are masterpieces from any and every standpoint although, perhaps, first cousins to Brahms. Redolent of the pageantry of English history, they are made magnificent with gorgeous orchestra, lush melodies and, in fact, all the colours of the Elgarian pallette. Perhaps the high peaks of our ever-growing musical output.

Music

Julius Harrison's Mass in C, postponed by the death of the King, is a work of great dignity and sincerity, with more than one beautiful moment. I hope we hear it again before too long.

The St. George's Day concert followed the usual pattern of such programmes, with Kendal Taylor doing his oft repeated act of self-abnegation in John Ireland's piano concerto. The two seem as inseparable companions as were de Greef and Grieg.

PROFESSOR BOFFIN

"Turn this knob and you'll hear everything except your wife's voice!"

Szigeti

There were two notable musicians performing last month, each in his own line a master. Szigeti is a violinist who would be outstanding in any company and in any age. Not of the virtuoso *qua* virtuoso brand of players—though his technical equipment is of no mean order and is at all times adequate—his playing has a warmth and opulence which is unmatched in the younger generation of violinists. He played, when I heard him, one of the instrument's noblest possessions, the Brahms concerto.

Beethoven's Sonatas

Claudio Arrau, in addition to a considerable number of concerto and recital appearances, is in the throes of doing the whole collection of Beethoven's 32 Sonatas, one, two and three at a time. This is a big achievement and, Arrau being a very fine Beethoven player, a great treat for serious music lovers is under way.

The standard of performance required by the BBC of its artists, in any given field of activity, is so wide that, unless one is in the know, it is impossible to imagine how those standards are determined and measured. This is always being borne in on the careful, as apart from the gregarious, listener, whether to pianists, music hall artists or what you will. And in passing from a master of his art, such as Arrau, to the very sublimation of incompetence as recently, and frequently, exhibited by Nina Milkina, one is, as I say, quite at a loss to contemplate the methods adopted in assessing and evaluating merit.

"Carnival"

Miss Milkina, in a performance of Schumann's "Carnival," failed to display very much pianistic merit. Her technique seemed to me inadequate for a work that Arrau would probably not rank, except in passages, amongst the hardest in the repertory; whilst her imagination utterly failed to impart to one of the most imaginative and original scores which wears its heart on its sleeve in every page, one iota of poetic feeling or original nuance. It also contained a liberal peppering of false notes. It was not a good performance.

The series of Ballet music concerts on Saturdays was very attractive.

Music Magazine

I suggest to the editors of Music Magazine that they substitute Gerald Moore's rather wooden record of a piano adaptation of Schubert's "To Music"—used as their signature tune—for Elizabeth Schumann's lovely recording of the original song.

News from the Clubs

COVENTRY AMATEUR RADIO SOCIETY

A LIVELY and entertaining "Quiz" was staged on May 26th between teams captained by Bert Chater (G2LU) and "Monty."

The D/F Group has now been formed and a practical demonstration arranged in the forthcoming programme. David Harris (G3RF) has the arrangements in hand.

This year's MARS/CARS Contest was won by MARS, and the Society offer their congratulations to MARS on a narrow but well-deserved victory.

Twelve operators from the society took part in the 2-metre Field Day, and a good score was recorded. Thanks are due to Mr. Cook (G6XR) and Mrs. Cook for the facilities given to members during this event. Site was at Keresley, four miles north of Coventry, and 550ft. A.S.L. Operators reported bad weather conditions.

Club nights continue at the Y.W.C.A., Queen's Road, at 7.30 p.m., and the forthcoming programme is as follows:

July 7th.—Open discussion.—Ken Barber (G3HDP) in the chair.

July 21st.—D/F practical demonstration.

August 4th.—No meeting.

August 18th.—144 mc/s. A talk by Ray Bastin.

CLIFTON AMATEUR RADIO SOCIETY (G3GHN)

Hon. Sec.: R. E. Brown (G3GZH), 210, Edward Street, New X, S.E.14.

ACTIVITIES during the first part of the year have consisted of various lectures by well-known companies, such as G.E.C., S.T.C., A.V.O., and the Metropolitan Police on the various equipments manufactured or used by themselves.

Instruction is being given in theory of radio and also morse code.

A construction class is doing quite well and the club's transmitter under the call G3GHN is becoming quite well known on 160 metres.

Club membership at present consists of well over 45 members although average attendance is usually only around the 30 member mark.

Meetings are every Friday night at 7.30 p.m. at 225, New X Road, S.E.14. All welcomed. Canteen is in continuous operation.

SOUTH MANCHESTER RADIO CLUB (G3FVA)

Hon. Sec.: P. Judson, Ladybarn House, Mauldeth Road, Fallowfield, Manchester, 14.

THE club premises are now available to members every Friday evening, alternate weeks being devoted to arranged programmes and operation of club station, construction work, etc.

MIDLAND AMATEUR RADIO SOCIETY

Hon. Sec.: G. W. C. Smith, 84, Woodlands Road, Birminghan, 11.

THIS society is this year celebrating its coming of age and numerous events are being planned.

The annual dinner is to be held on October 25th, and it is anticipated that the Lord Mayor of Birmingham, accompanied by the Lady Mayoress, will be present.

A recent lecture given by a member, Mr. David Hall, on "Cavity Resonators and Other Wave Guides," was well received.

All meetings are held on the *third* Tuesday in the month at the Imperial Hotel, Temple Street, Birmingham, and visitors and prospective members are always welcome.

THE HOUNSLOW AND DISTRICT RADIO SOCIETY

Secretary: J. Clarke, 124, Springwell Road, Heston, Middlesex.

THE first issue of a society bulletin has been published to keep members informed on past and future events. Some useful notes on electrolytic condensers were also included, and it is hoped to give other information on components in this feature.

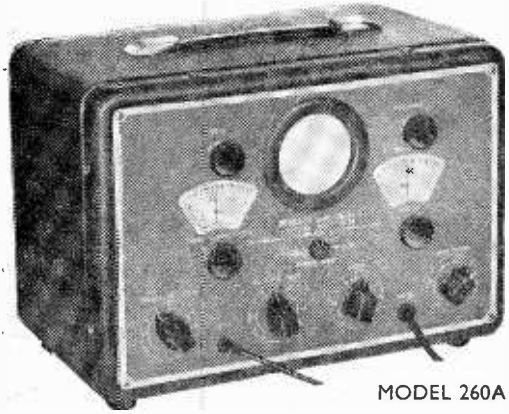
Recently talks have been given by G3AZJ on practical aerials.

Meetings are still held fortnightly at 7.30 p.m. at Grove Road School, Cromwell Road, Hounslow, the first half-hour being devoted to morse practice.

LIVERPOOL & DISTRICT SHORT WAVE CLUB

Hon. Sec.: Arthur D. H. Looney, 81, Alstonfield Road, Knotty Ash, Liverpool, 14.

THE club finished the year with a junk sale, and started their New Year with a very interesting lecture given by G3DOK, whose subject was "Radar Detection." Owing to the magnitude of the subject a further lecture will be given at a later date. The club Tx. has been given a good airing on 160 metres. Morse classes take place every Tuesday evening between 7 and 7.30 p.m. A Club News Sheet (5 and 9) has been started and local events are kept up to date.



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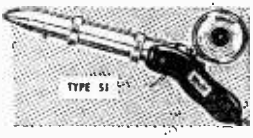

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100 MICROAMPS METER.—2in. Flush Mounting. Widely calibrated scale of 15 divisions marked "Yards," which can be rewritten to suit requirements. These movements are almost unobtainable today, and, being BRAND NEW IN MAKER'S CARTONS, are a "snip" at ONLY 39/6.

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VCR97 C.R. TUBES.—All guaranteed tested full screen for Television use. In maker's crates. ONLY 45/- (carriage paid).

6in. MAGNIFYING LENS FOR VCR97 TUBE.—First grade oil filled. ONLY 25/- (postage 2/-).

TRANSFORMERS.—Manufactured to our specification, and fully guaranteed. Normal Primaries. 425 v.-0-425 v. 200 ma., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a., 0-2-4-6.3 v. 3 a. ONLY 72/6. 425 v.-0-425 v. 200 ma., 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a. ONLY 50/-. 350 v.-0-350 v. 160 ma., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a. ONLY 42/6. 250 v.-0-250 v. 100 ma., 6.3 v. 6 a., 5 v. 3 a., ONLY 32/6. The above are fully shrouded, upright mounting. Universal Mounting 350 v.-0-350v. 80 ma., 0-4-6.3 v. 1½ a., 0-4-5 v. 2 a. ONLY 18/6. Top shrouded, drop through 260 v.-0-260 v. 70 ma., 6.3 v. 3 a., 5 v 2 a., ONLY 16/6. The following are upright mounting. EHT for VCR97 Tube, 2,500 v. 5 ma., 2 v.-0-2 v. 1.1 a., 2 v.-0-2 v. 2a. ONLY 37/6. EHT 5,500 v. 5 ma., 2 v. 1 a., 2 v. 1 a. ONLY 72/6. EHT 7,000 v. 5 ma., 4 v. 1 a. ONLY 82/6.

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Cash with order, please, and print name and address clearly. Amounts given for carriage refer to inland only.

TRADE NOTES

E.M.I. Tape Recorder

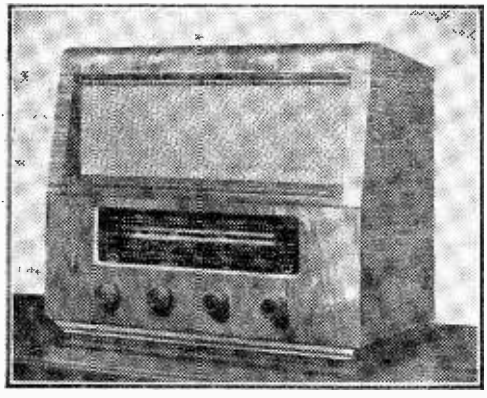
NEWLY released, and shown for the first time at the recent B.S.R.A. Exhibition, the E.M.I. portable tape recorder illustrated on the right is especially suitable for interview work, mobile commentating and similar occasions, and the BBC have acquired a number for such purposes.

Power is supplied by internal dry batteries and the overall dimensions are 14in. by 8in. by 7in., and the weight is only 14½lb. complete. A shoulder strap is fitted and it may easily be slung from the shoulder. There are three versions available, each giving alternative recording times.—**E.M.I., Hayes, Middlesex.**

B.T.H. Pick-up

THE B.T.H. type Minuette magnetic pick-up is now available for early delivery.

The pick-up is a completely restyled and modernised version of the old B.T.H. magnetic pick-up of which over 75,000 were sold. Its magnetic system embodies one of the latest sintered metal alloy magnets making it one of the best moderately-priced pick-ups available to-day.

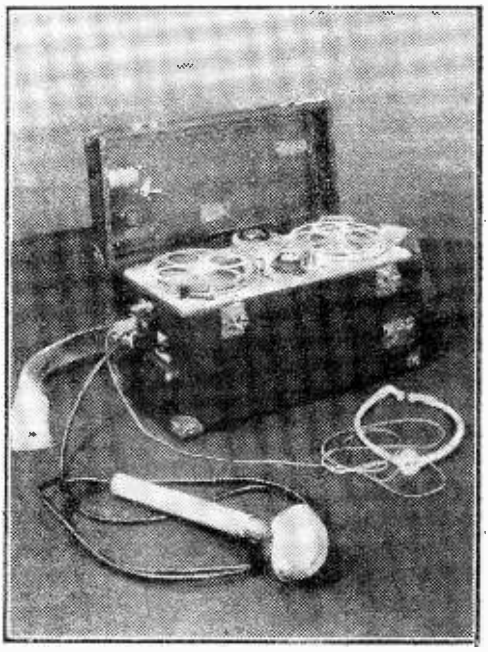


Columbia export model C335X.

It has an excellent frequency characteristic with an output of .7 volts r.m.s. at 1,000 c.p.s. Weight at needle point is 2½ oz.; resistance of the pick-up winding 1,800 ohms; inductance approximately 1½ henries. List price, 35s., plus purchase tax.—**The Edison Swan Electric Company, Ltd., 155, Charing Cross Road, W.C.2.**

New Columbia Export Radio Receivers

SHOWN above is the new Columbia Export Model C335X which has three bandspread short-wave ranges in addition to medium and long waves; Model C334X provides a similar



The new E.M.I. portable tape recorder.

coverage, but has a short-wave logging scale and a separate "Gram" position on the wavechange switch in place of the long-wave band.

Among the many distinguishing features of these new receivers is a three-position switched tone control.

Models C334X and C335X function with full efficiency and reliability under even the most adverse climatic conditions and are designed to operate from A.C. mains, 100-130, 140-160, and 200-250 volts, 40-100 cycles.

They will be distributed overseas by Columbia branches and appointed distributors.—**Columbia Gramophone Co., Ltd., Hayes, Middlesex.**

Ersin Liquid Flux

FOR certain processes where it has hitherto not been convenient to use Ersin Multicore Solder, Multicore Solders, Ltd., announce that Ersin Flux, the non-corrosive extra active rosin base flux, is now available in liquid form.

Specially recommended for dipping purposes or other similar processes, Ersin Liquid Flux is at present supplied to factories only in one-gallon cans.

Samples will gladly be sent without charge upon receipt of a firm's official order.—**Multicore Solders, Ltd., Multicore Works, Maylands Avenue, Hemel Hempstead, Herts.**

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"Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
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I.P.R.E. TECHNICAL PUBLICATIONS: 5,500 Alignment Peaks for Superheterodynes, **5/9**, post free. Data for constructing TV Aerial Strength Meter, **7/6**. Sample copy The Practical Radio Engineer, quarterly publication of the Institute, **2/-**; membership and examination data **1/-**. Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8.

BRITISH SHORT WAVE LEAGUE is devoted to the interests of amateur radio enthusiasts. Publishes 12-page "BSWL Review," monthly (members only). Offers many services and activity departments. World wide membership. Founded 1935. Apply for details to: BRITISH SHORT WAVE LEAGUE, 55, Victoria St., London, S.W.1. (Abbey 2384.)

R.S.G.B. Amateur Radio Call Book, 6,000 British Isles Callsigns, 56 pp., **3/9**; Transmitting Licence, 32 pp., **1/-**; Service Valve Equivalents, 32 pp., **1/3**; Simple Transmitting Equipment, 52 pp., **2/3**; Receivers, 96 pp., **3/9**; Valve Technique, 104 pp., **3/9**; V.H.F. Technique, 96 pp., **3/9**; Television Interference, 40 pp., **2/3**; R.S.G.B. Bulletin, current issue, **1/6**. Five recent issues **2/6**. Prices include postage. RADIO SOCIETY OF GREAT BRITAIN, 28, Little Russell St., London, W.C.1.

RECEIVERS & COMPONENTS

MAKE a Superhet for **£6** or T.R.F. for **£5/5/-**, including valves and cabinet; full instructions **1/6**; midget I.F.T.s, 7/8in. sq., 465 KC, **8/6** pr.; ex-equip. Valveholders, used, but in perfect condition, International or Mazda Octal, **1/9** doz.; 18 S.W.G. Multicore, **2/6** doz. yds.; 1 m/m Sleeving, **1/-** doz. yds.; 2 gr. asst. BA screws and nuts, brand new, **6/-** box: Droppers, .2 amp, 1,000 ohms, tapped, **3/6**; "Radiomaster" T.R.F. Coils, complete with mounting bars and circuit, **5/3** pr.; Tub. Cond., new, .1 mfd, 350v, **2/9** doz., .1 mfd, 500v, **4/-** doz.; Electrolytics, guaranteed, aluminium cans, std. size, 8 mfd, 500v, **1/9** ea., **18/-** doz.; 2 mfd, 350v, **1/-** ea., **10/-** doz.; 200 mfd, 12v, **8d.** ea., 6/6 doz. Min. post and packing 1/-. Latest list 3d. SUSSEX ELECTRONICS LTD., Princes Street, Brighton.

SENSATIONAL price slashing! Coils, Potms,, Transformers, **6d.**; Resistors, Condensers, **2d.** Post extra. S.A.E. list. ANNAKIN, 25, Ashfield Place, Otley, Yorks.

AL. PANELS, 16 gauge, 16in. x 12in., 12in. x 9in., 12in. x 6in., 15in. x 11in., 11in. x 9in., 13in. x 10in., 10in. x 9in. Send S.A.E. WILTON RADIO, 30, Giants Grave Rd., Neath.

HOME CONSTRUCTORS, short wave radio, television. Send for free list. Components. Valves, Kits, Speakers, etc. THE RADIO EQUIPMENT COMPANY (P.W. Dept.), Castor Rd., Brixham, Devon.

EX-R.A.F. Conversion Kits—new; containing 8lb. knobs, dials, rotary selectors. B.A. screws, etc., **5/-**. WILLETTS, 9, Middlefield Rd., Hoddesdon, Herts.

VALVEHOLDERS, 2d.; 3 pos. Key Switches, **1/6**; M/R Midget O/P Trans, **2/6**; Midget Parts. Lists 4d. CARTER'S, 578, Washwood Heath Road, Birmingham, 8.

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RATES: 5/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 6d. extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton St., Strand, London, W.C.2.

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"VIEWMASTER" Valves, as specified, all guaranteed brand new and boxed, comprising 5 EF50, 1 KT61, 1 6P25, 1 EBC33, 1 EB91, 2 6K25, 1 6P28, set of 12 **£6/2/6** (postage and insurance 2/-); PL38, PZ30, **18/6**; EY51, **14/6**; 6P25, 10C1, 6C9, ECH42, X78, ECH21, ECH35, **13/6**; DK32, 10P13, 10LD11, 10F9, 6F15, EC91, **12/6**; 50L6GT, ECL80, UL41, UF41, UBC41, DF33, DL35, DAC32, DL33, **10/6**; AZ31, 5Z4G, UY41, U404, UU9, **10/-**; 6V6GT, KT61, **9/6**; 1S5, 1R5, 1T4, 3V4, **8/9**; EF91, 6AM6, 6F12, Z77, EB91, **8/6**; EF39, EF8, EF50, KT2, **7/-**; 6K7G, HVR2A, **6/3**; 9D2, **4/6**. Postage and packing 4d. per valve extra. C.W.O. READERS RADIO, 24, Colberg Place, Stamford Hill, London, N.16.

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WALNUT Radiogram Cabinets of distinction, stamp details. R. SHAW, 69, Fairlop Rd., E.11.

ROTARY CONVERTER, by EDC. Input 220v D.C., Output 110v A.C., 18.2 amp, 50c.; perfect order. £25. Motor Alternator, Input 220v D.C. Output 180v 17 amp. 480/520 c., £7/10/-. PIMBLE, 12, Liverpool Rd., Newcastle, Staffs.

One coil, 4 circuits. Simple receivers from a crystal set to a 3 valver. Full circuits enclosed.

T.R.I. Coil. 5/- P.P. 6d.

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