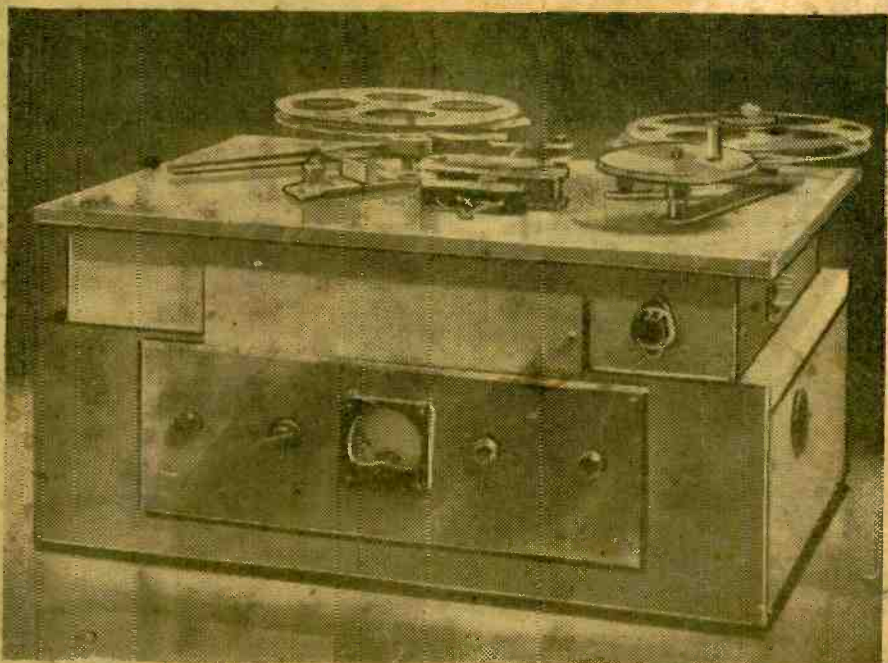
9^D

Vol. 26 No. 530
SEPT.-OCT., 1950

EDITOR:
F. J. CAMM

PRACTICAL WIRELESS



MAGNETIC RECORDING

CHIEF CONTENTS

All-wave Tuners
Two-band Aerial
Negative Feed-back
Versatile Valve Voltmeter
Short-wave Notes
Wavetraps

Practical Wireless

18th YEAR OF ISSUE

EVERY MONTH
VOL. XXVI. No. 530 SEPT.-OCT., 1950

Editor F. J. CAMM

Training Service Engineers

THE radio industry is at last making an effort to ensure that only qualified service engineers handle the servicing of receivers. A first move is the census of servicing personnel on the staffs of radio and television dealers throughout the television areas, which is being undertaken by The British Radio Equipment Manufacturers Association. The object is not only to assess the need for technicians and seeing that the necessary training facilities are provided, but also to check up on those already operating as service engineers. It cannot be denied that large numbers of unqualified people are posing as service engineers, making exorbitant charges for repairs inefficiently carried out, and in some cases making charges for work not carried out or for replacements which have not been made. This is not a satisfactory state of affairs. The industry was far too lax in the early days in providing trade facilities for unqualified people and the charlatans, being interested only in the sales of receivers and regarding servicing as a necessary evil. So it has gone on for nearly 30 years —and would continue on these lines but for the rapidly expanding television industry. A much higher degree of skill is required for servicing television receivers than for ordinary sound receivers.

No one should be allowed to call himself a service engineer and to handle expensive apparatus unless he has a certain standard of education, a comprehensive electrical knowledge, practical experience and integrity. The servicing of receivers has become the happy hunting ground of the quack, and a means of getting rich quick for those who are not too particular in their business methods.

Television receivers are expensive and the same methods cannot be allowed with them.

There will be an increasing need for qualified radio engineers within the next five years, and the census will determine, to some extent, the number, so that training facilities can be provided accordingly. Why does not the radio industry collectively provide a sum of money for the foundation of a radio and technical college through which all technical personnel must pass before they can obtain a job in the industry or with a dealer? By this means the industry would be assured of an adequate supply of men of the right type and with the right experience.

The industry has made vast sums of money out of radio and it should plough a little back to make sure that the public gets a square deal.

The universities should give more attention to it, as they are doing in America. An American university, for example, in May of this year, confirmed the first Bachelor of Science degree in radio engineering that has ever been granted by any university or college. The Audio Engineering Branch of this university has undoubtedly raised the standards of radio servicing and radio engineering in America, and has given it a professional classification. It is high time that it was recognised academically in this country.

Some firms in this country train their own service personnel, but the training is restricted to the servicing of receivers of their own manufacture. They are sometimes unskilled men without theoretical knowledge and are lost when confronted with another manufacturer's receiver. If each firm in the radio trade donated about £500 for the foundation of the college suggested they would be providing for present and future needs a pool of technicians from which could be drawn personnel for all sections of radio, not only servicing.

The Radio Industry Council is taking a preliminary step to facilitate training. Jointly with the Ministry of Education, it is organising a course at the Regent Street Polytechnic for full-time and part-time teachers of radio and television servicing in technical colleges, 64 of which run courses at present. These lectures have been arranged to increase teachers' background knowledge of the industry and are given by members of the industry. Visits are to be made to factories and works' schools.—F. J. C.

PUBLISHER'S ANNOUNCEMENT

OWING to the withdrawal of overtime working which has been imposed by a section of the Printing Industry in London and lateness in publication caused thereby, we have been reluctantly compelled, in order to make up lost time, to produce this issue as a combined September-October issue. As a consequence our Radio Show Report cannot be included until the next issue.

We express our regrets to readers that no other course was open to us. Whilst the dispute continues delays in publishing may be unavoidable.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended 31st May, 1950.

Region	Number
London Postal	2,309,000
Home Counties	1,628,000
Midland	1,716,000
North Eastern	1,879,000
North Western	1,591,000
South Western	1,051,000
Welsh and Border Counties	724,000
Total England and Wales	10,898,000
Scotland	1,117,000
Northern Ireland	204,000
Grand Total	12,219,000

Motorists are reminded that it is necessary for them to take out a separate £1 sound broadcast receiving licence for a wireless-set fitted in a motor-car.

Midland Home Service Transmitters

FROM Sunday, June 25th, the power of the Midland Home Service transmission on 276 metres (1,088 kc/s) from Droitwich was increased from 60 kilowatts to 150 kilowatts, the maximum permitted by the Copenhagen Wavelength Plan. The power of the Norwich transmitter, which broadcasts this programme on the same wavelength, was also increased.

The increased power from Droitwich has been achieved by modifying a high-power long-wave transmitter to work on medium waves. This transmitter, which was built in 1934 to replace the original Daventry "5XX" transmitter, broadcast the Light Programme on 1,500 metres until the Copenhagen Plan came into force on March 15th this year.

The increase in power gives clearer reception of the Midland Home Service, especially for those listeners who live at some distance from the transmitting stations.

The Midland Home Service is still to be found at the same point on the tuning dial.

Death of Mr. N. Gunn

IT is with deep regret that Mullard Electronic Products, Ltd., announce the sudden death, on July 7th, of Mr. N. Gunn, director and secretary of the Company and of its Associated Companies.

Mr. Gunn joined the Mullard Radio Valve Co. as assistant to the managing director in September, 1924.

He had, however, been connected with the Mullard Co. since 1920, when he conducted the legal work involved in the incorporation of the Company. Mr. Gunn was secretary to the Mullard Co. for 26 years, besides being its legal adviser. During that time he was one of the "stalwarts" of the concern and did much to keep its name in the forefront.

Safety Aerial

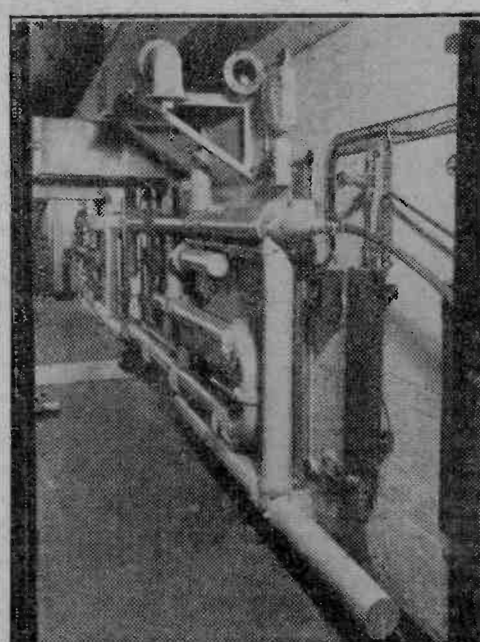
WHEN his bedroom caught fire and he was trapped, Dr. Michael Beasley, of Cudworth, Yorks, was able to swing to safety on his thin wireless aerial, according to a report from a news agency.

Sales Competition

E. K. COLE, LTD., are offering a two-day trip to Southend with all expenses paid to the Ekco dealer's salesman in Scotland who can produce the best paper on "How I Would Maintain Radio Sales After the Coming of Television."

The purpose of this competition is to stimulate thought and emphasise the importance to the dealer of intelligent pre-planning to maintain radio-receiver turnover when interest in television will be at its height.

The competition closes on September 1st, and results will be announced within a month of the closing date.



The vestigial sideband filter, constructed of lengths of concentric feeder, which is connected between the output of the vision transmitter and the feeder to the aerial at Sutton Coldfield. The filter is of the constant-resistance type and comprises a high-pass and low-pass section.

Suppression Campaign

A FIRM at Colchester has launched a campaign to try and drive home the need for suppressors on cars. A service van with a placard appealing for public co-operation in reducing interference toured the car parks and sea-front at Clacton-on-Sea, and motorists were approached to have suppressors fitted on the spot at 1s. 6d., fitting free. It is stated that as a result of the drive, 10 per cent. had the fitting without persuasion, 20 per cent. had the fitting after some explanation, 5 per cent. said they would arrange for their own garages to carry out the work, and the remaining 65 per cent. were "rather suspicious" and refused. On the opening day of the campaign, 96 vehicles were fitted.

Plessey Transmitter-Receivers

THE Plessey Company, Limited, Ilford, Essex, announce that they have received a contract to supply to the London Metropolitan Police a quantity of Plessey Transmitter - Receivers, Type P.TR.7, for use on motor-cycles, and the associated control station installation. This equipment will play a valuable part in helping Scotland Yard to combat crime, and in aiding the police in their task of controlling traffic.

Frequency modulated, crystal controlled, and operating on a spot frequency within the 68.0-100.0 Mc/s. band, this transmitter-receiver has been specially designed for motor-cycle installation. Neat and unobtrusive, the equipment is contained within two waterproof cases mounted on either side of the rear wheel; even weight distribution and the retention of a low centre of gravity have both been achieved. A selective calling system enables any one, or all, of ninety units, each of one or more vehicles, to be called from a central control station.

An important factor for motor-cycle operation is the low power consumption, which is claimed to be a mere 18 watts on "standby" conditions.

Degrees in Audio Engineering

THE University of Hollywood, California, has recently conferred the first Bachelor of Science degree in audio engineering ever to be granted by any university or college. It is claimed that the College of Audio Engineering of the University has raised the standards of audio engineering, now placing it in a professional class. Audio engineering is now recognised academically as an engineering profession.

Talking Traffic Light

A NORMAL three-aspect traffic-light in Syracuse, N.Y., has been fitted with a loudspeaker and a tape recorder. The latter carries injunctions to pedestrians to "Look right," etc., and operates each time the light changes. It is in the form of an experiment carried out by the G.E.C., the local police and the Chamber of Commerce.

Radio and Television Electricity Load

SIR VINCENT DE FERRANTI, M.C., M.I.E.E., in his presidential address to the second British Electrical Power Convention at Harrogate recently, pointed out that with an electric system all sorts of unexpected and considerable loads appeared.

"As an example of this," continued Sir Vincent, "is radio and television, which have not only made a supply of electricity an absolute necessity in every home, as indicated by the rapid increase in the number of consumers connected during the boom years of that industry, but have brought a connected load of 1,200,000 kw. to the supply system."

A wrist-watch radio for the reception of normal programmes is now a practical proposition. The above picture, taken in U.S.A., shows a production receiver in use by a car-driver.

Multicore Works Manager

MR. R. C. FORD, who was until recently with the Blackburn and General Aircraft Company at Feltham, Middlesex, has now joined Multicore Solders, Limited, as Assistant Works Manager, at their Slough factory.

Stereoscopic Television

AN industrial television system, developed by the Radio Corporation of America, which can be given a third dimension was revealed recently by Dr. V. K. Zworykin in an address before the Boston Section of the Institute of Radio Engineers.

By the application of special techniques, the system's usefulness can be extended to provide this type of reception in specialised applications with only a minimum of additional equipment.

Ekco Car Radio for N.Y. Show

THREE of the Daimler Cars being exhibited at the New York Motor Show are fitted with Ekco all-wave car radio.

The CR119 model (a special version of the popular model CR61) installed gives a choice of instantaneous station selection or free tuning and incorporates seven short-wave ranges with band-spread tuning on the 19, 25 and 31 metre bands.

CRYSTAL FILTERS

The Use of the Piezo Crystal in Improving Selectivity

By H. SASSON

OF all the current methods of improving receiver selectivity, that of incorporating a selective crystal filter in the I.F. amplifier section remains the most popular—and not without reason. Although it costs more to install than other devices, it is nevertheless relatively inexpensive, easy to connect up, and reliably efficient in operation.

The Quartz Crystal

The " heart " of such a filter is the quartz crystal resonator around which the circuit is built up. This crystal consists of a thin slice from a quartz crystal sandwiched between two electrodes, which support it mechanically. These two electrodes make up the holder, which is the cause of certain effects discussed further on.

The action of a quartz crystal resonator can be best understood by considering its equivalent in terms of conventional capacitance, inductance and resistance. It will be seen from Fig. 1 that the crystal can be represented by a series-tuned resonant circuit composed of C_1 and L ; R is the unavoidable series resistance of the parts that make up the crystal, and is the factor that limits the Q of a crystal to about 10,000 ; and C_2 is the capacitance between the two electrodes, with the crystal proper acting as a dielectric.

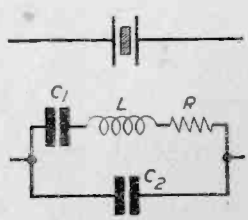


Fig. 1.—The quartz crystal resonator and its equivalent circuit.

Now as the crystal will only pass one frequency, if it be connected in place of a conventional intervalve coupling condenser in an amplifier, a selective coupling device will result. The only frequency passed on to the grid of the following valve will be the frequency at which the crystal resonates.

In actual practice such an arrangement is not satisfactory, as all crystals have an inherent and unavoidable capacity across them. This capacity is that of the holder mentioned above, and, unless suitably neutralised it will, to some extent, pass on to the next valve frequencies rejected by the crystal, hence defeating the whole object of the inclusion of a selective filter.

The Crystal Phasing Condenser

There are several theoretical methods of neutralising the holder capacity, only one of which is found in practice to have any merits. Thus, owing to its versatility, the phasing condenser method is the one invariably used.

In Fig. 2, the input transformer secondary is balanced with respect to ground by earthing either (a) the centre-tap on the coil or else (b) the junction between the two condensers C_1 and C_2 across the coil. The latter method is more reliable in practice, as one cannot be sure of an exact electrical centre-tap on a large coil such as the I.F. transformer secondary.

The crystal phasing condenser Cp has a maximum capacity somewhat higher than that across the holder, and when it is set to balance it exactly, the whole arrangement will act as a series resonant circuit of exceptionally high Q passing only signals of the desired frequency (see Fig. 3 " a "). If the phasing condenser is then varied slightly from the point of exact balance, a very interesting effect is noticed—full use of which is made in practice.

As soon as the bridge becomes unbalanced, the response curve loses its symmetry and takes the form of Fig. 3 (b) . This is because, as C_2 in Fig. 1 is not balanced, a parallel resonant circuit is formed which rejects the frequency corresponding to the pt. 2 in Fig. 3. (b) .

In the case of the circuit depicted in Fig. 2 (b),

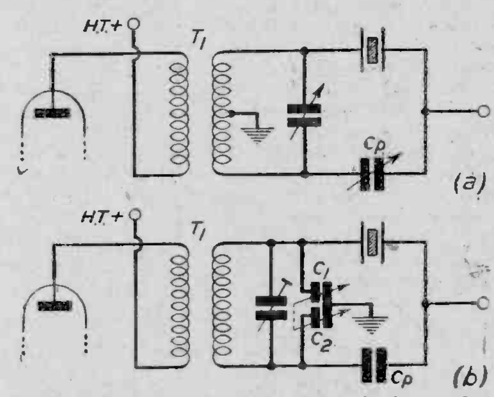


Fig. 2.—Showing the position of the phasing condenser Cp in the bridge. In (a) the centre-tap on the coil is earthed, and in (b) the rotor of the " opposed stator " condenser C_1 C_2.

another way of obtaining this effect is to leave the phasing condenser untouched but to vary the setting of C_1 C_2, which, it will be noticed is not a normal two-gang variable condenser but one in which the two stators are mounted " back to back," i.e., an opposed-stator condenser. In such a condenser, as the capacity of one section increases, that of the other decreases ; hence the total capacity across the whole condenser remains unchanged, and no detuning effects take place. As the junction between the two sections is earthed, the result is that the voltages applied to the crystal and the phasing condenser will no longer be the same in amplitude, and the response curve will again assume the form of Fig. 3 (b).

The frequency of the point Z of zero response can be varied by altering the setting of the phasing condenser (or alternatively, in the case of Fig. 2b, the setting of C_1 C_2), which varies the parallels resonant frequency, and can be moved over to the other side of the resonant peak at will. Thus, by its ability to shift the parallel resonant frequency over a considerable range, the phasing condenser allows a wide rejection control. This effect is made use of in clearing up adjacent channel interference, simply by zero-beating the point Z with the unwanted signal.

Nevertheless, a perfect cancellation at the pt. Z when it is very near the point of maximum response is impossible. Thus the action of the phasing condenser is insufficient within about 100 cycles on either side of the peak. Also there will not be a point of zero response if there is any unbalance of power factor, i.e., such as might occur if the phasing condenser or any other component had high losses and was of a poor quality. Excessive response at Z can sometimes be traced to insufficient screening between the input and output circuit of the filter.

Selectivity

The sharpness of the peak in the response curve at the resonant frequency of the crystal is dependent on the circuit conditions immediately before and after the crystal proper as well as on the properties of the particular type of crystal used in the filter.

If the input coil is detuned from resonance its impedance drops and the curve becomes sharper; similarly, if it is brought into resonance, its impedance rises and the curve broadens.

The same applies to the output impedance, whether it be a tuned resonant circuit or a resistance. In the latter case increasing its value will correspond to the bringing into resonance of a tuned circuit, and decreasing it will be equivalent to detuning the circuit. The higher the resistance (or impedance) the larger will be the voltage developed across it, but, unfortunately, at the same time the selectivity deteriorates. The optimum value of the resistance or impedance, as the case may be, has thus often to be lower than the input resistance of the next valve in the I.F. amplifier, so it is sometimes useful to have a step-up ratio in the output transformer of the filter. To go with this stepping-up in the output circuit a step-down ratio in the input to the filter is sometimes used, provided it is intended to use a Y-cut or similar cut crystal of low impedance in the filter. With an X-cut crystal, which has a high impedance, no stepping down is necessary.

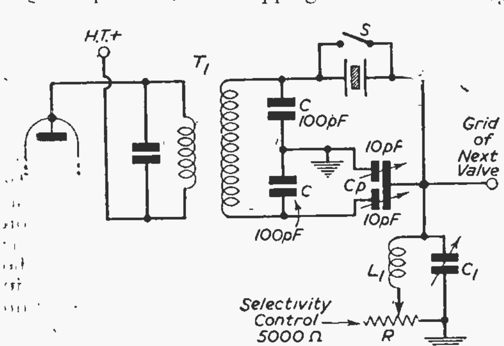


Fig. 4.—(a) A practical crystal gate circuit.

This latter type of crystal is, incidentally, the best kind to use in a crystal filter of the band-pass type.

A Crystal-Gate Filter

This is shown in Fig. 4, where the input transformer T1 has a low-impedance secondary winding. C, C are two identical condensers of about 100 pF. each. The opposed stator condenser Cp has a maximum capacity of about 10 pF. per section. The switch S, to render the filter inoperative, must have Polystyrene, Frequentite or similar insulation. An ordinary toggle switch will not do. R1 is the selectivity control, and is of about 5,000 ohms maximum resistance. The whole unit can be conveniently installed in two I.F. transformer cans (Fig. 4, "b"). The first can contain the input transformer and the second the phasing condenser

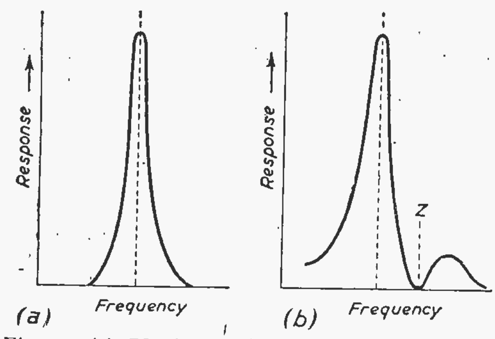


Fig. 3.—(a) Phasing condenser balancing out exactly capacity of crystal holder. (b) Response curve obtained when phasing condenser does not exactly balance the capacity of the crystal holder.

and the output tuned circuit, together with the selectivity control. This type of circuit is one of the most popular crystal-gate circuits, and is given here as it embodies many of the ideas discussed above. It is suitable for both C.W. and telephony selective reception.

Band-pass Crystal Filters

To obtain a practically flat-topped response curve (Fig. 5) instead of a sharp single peak, one might think all one would have to do is to connect

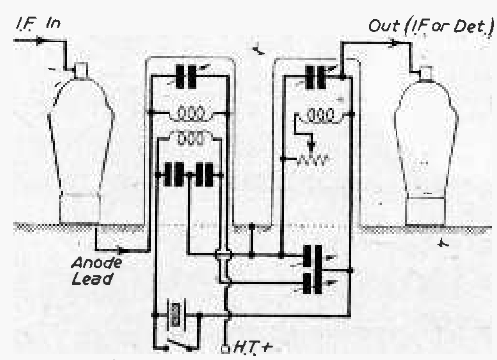


Fig. 4.—(b) One way of laying out the above circuit on a chassis.

two crystals of slightly differing frequencies in parallel in place of one. Unfortunately, such an arrangement would not work, because in the region between the peaks the voltages would not be additive, as their phases would be equal but opposite. Thus one would have a deep trough instead of a flat-topped peak!

This difficulty is overcome by placing one of the crystals in the opposite arm of the bridge, as its input, received from the lower end of the input coil, would then be in opposite phase to the voltage applied to the other crystal. Response would then be high between the peaks where the phases are additive, but very low outside this region, where the phases are in opposition.

With a band-pass circuit containing one crystal in each arm, one might think that there is no longer any need or possibility of inclusion of a phasing condenser, as the crystal capacities would serve to balance each other. This is not exactly correct, as the capacities of the two crystals may not be identical, and a phasing condenser may be required.

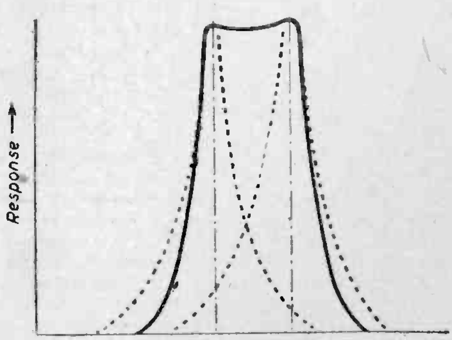


Fig. 5.—The response curve obtained by combining the response curves of two crystals in opposite phase —a band pass characteristic.

As the difference in capacities may be only a micro-microfarad, the adjustment of a phasing condenser would be difficult. It is usual then to connect across one crystal a condenser of capacity 2 to 4 pF. and across the other a phasing condenser of maximum capacity about 10 pF.

If the capacity of the phasing condenser is increased, a zero point occurs on the high-frequency side of the crystal frequency, but one must not forget the effect this change in capacity has on the crystal in the other arm. In this latter case the theoretical balancing capacity has been reduced because of the increase in capacity of the phasing condenser in the opposite arm. This relative decrease in capacity gives rise to a zero point on the low-frequency side of the twin peaks, making the whole response curve symmetrical. The combined effect of the two zero points gives a very great improvement in adjacent channel selectivity over the single-crystal filter described above, in which a zero point on one side can only be made to occur simultaneously with a rise in response on the other side, which might bring in interference from other signals (Fig. 7).

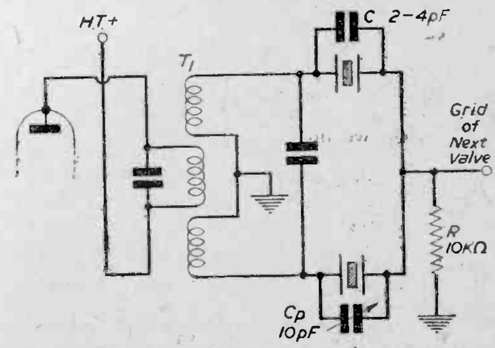


Fig. 6.—A band pass filter for C.W. Cp phasing condenser 10 pF. C, balancing condenser 2-4 pF. T_1, input transformer—secondary composed of two normal secondaries in series. R, 10,000 Ω.

The narrow but flat-topped response curve of a crystal band-pass filter enables the receiver to hold a signal whose frequency is not perfectly steady, due either to an unstable carrier in the transmitter or to a drifting H.F. oscillator in the receiver itself, without any adjacent channel interference. It also enables the receiver to give more intelligible speech, i.e., higher fidelity on telephony than is possible with a single-crystal filter.

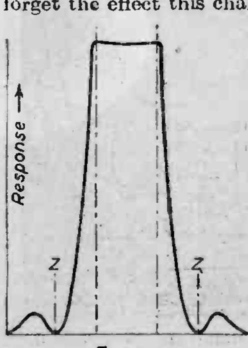


Fig. 7.—The effect obtained in a band-pass filter when the phasing condenser does not balance the capacity of the crystals in their holders. 2 Zero points are obtained. Compare with Figs. 3 (b) and 5.

Filter for C.W.

For an I.F. of 465 kc/s. a difference of 500 cycles between the resonant frequencies of the crystals is adequate. In such a case the ideal crystal frequencies are 464.75 kc/s. and 465.25 kc/s. As the two peaks are very close to each other, the crystals can operate at high selectivity, and one need not take into consideration the dip in the middle of the flat top of the response curve.

British Sound Recording

A Review of the B.S.R.A. Exhibition in London

By THE MARQUIS OF DONEGALL

ASTOUNDED! Amazed! I could use all the other expletives more familiar to Wardour Street than to scientific research. The basis of this article was the all too brief exhibition given at the Waldorf Hotel, London, a short time ago.

The progress made in getting these British gadgets on to the market since April, 1949, *is* amazing. It supports the ex-cathedra dictum I have been making for years: "We *are* slow, we British, but, by gad, when we do it, we beat the world to a frazzle!"

How comforting it is to be right, occasionally.

You may well ask me why I pick April, 1949. It so happens that, at that time, I was in America and was dickering between an American wire-recorder—costing more dollars than I could afford, let alone duty—and something similar on my return to Britain.

There was nothing comparable at that time on the British market at anything like my Chicago price. I bought the Chicago machine. Even to-day the prices are not equal, but the quality of the British product is well worth the extra—most of which goes to Cripps.

Should I be specific? The machine I brought from Chicago is a Knight—Allied Radio of Chicago. It has its own built-in radio and phonograph for recording off the air or from records, on to wire. Microphone recording, of course. Cost, retail, 200 dollars, at four dollars to the pound sterling, £50.

Perhaps the most convenient way of reviewing the whole subject in a very short space is to take the recent exhibition as a basis and go round the stands as they were there arranged.

On this basis the first recorder that we come to is on the stand of Messrs. Simon Sound Service, Ltd. This includes a complete twin-channel transportable disc-recording system for professional use. The equipment includes a four-channel electronic mixer unit and a compact vibrator converter enabling the whole system to be operated by a 12-volt battery. Other of Simon's exhibits include portable tape and wire-recorders for semi-professional or home use. The wire-recorder does a continuous hour.

The M.S.S. Recording Co., showed a very wide range of recording apparatus. These go through studio portable equipment, portable radio equipment, portable recording equipment of a different type, special speech-therapy recording equipment and other types of studio recording equipment. As far as the studio recording equipment, which I considered the most interesting, is concerned, it consists of two turn-table recording units with high-quality reproducing heads, amplifier and loud-speaker units, individual faders for microphone and reproducing heads. The overall response can be set flat, plus or minus, 2 db from 30 c.p.s. to 10,000 c.p.s., but controls enable any reasonable characteristic to be obtained. The output of this is 30 watts.

We should, I think, at this point mention the British Sound Recording Association, founded in 1936, under whose auspices the exhibition was held. At their stand they were able to show through the courtesy of Wirek Electronics one of the most modern examples of magnetic tape records for studio and other high-quality work.

The Wirek, Model B.2, is a particularly neat little wire recorder. It is an improvement on the Webster Chicago, in that it is fitted up for reproduction of phonograph disc on to wire, for recording telephone conversations, as well as stop and start mechanism for the purpose of transciption by a secretary.

We now come to the Wright and Weaire exhibits of British Ferrograph tape-recording apparatus. I had already seen one of these tape-recorders demonstrated on a recent visit to Belfast and was considerably impressed with its performance. The built-in speaker of this model A tape-deck machine is regarded only as a monitor and it, therefore, for maximum efficiency, requires the use of an efficient external loudspeaker. On the Stereophonic sound instrument there is incorporated a Wearite-type C deck. On this provision is made for the simultaneous recording and simultaneous playing back of two side-by-side tracks on the tape. The demonstration I saw consisted of a "live" orchestral recording in which each tape track was fed from its own microphone and amplifier—the microphone being strategically placed during recording. The subsequent play back was via two loudspeakers each fed from its own tape track.

This was to me an interesting experiment and demonstrated enormous possibilities of binaural recording in recreating the original sound.

The Marquis (centre) at one of the stands at the Exhibition

In demonstrating what they call their Wearite type B deck, an incoming radio signal was switched either direct to a loudspeaker or fed to the loudspeaker immediately after recording, identical amplifiers being used in both cases. By this means a quick comparison could be made between the actual and the recorded signal. It would have taken a keener ear than mine to detect the difference between the two.

I have already mentioned the Wirek Model B.2, wire recorder. As everybody knows Wirek is the Magnetic Recording Division of Boosey and Hawkes, Ltd. They also showed two tape-recorders, one for serious studio use and the other a personal recorder, weighing only 15lbs. It has a miniature lapel microphone and tape speed designed for 15in. per second or an alternative speed of 7½in. per second as required. It is designed for play back on studio gear.

The Dictaphone Co., showed their "Timemaster" dictating and transcribing machine. These employ a plastic memo-belt. It is really a portable dictating machine taking up hardly any room on the desk. It is also equipped for telephone recording. The memo-belt is a flexible plastic recording medium, cylindrical in shape and combining constant groove speed which can be conveniently filed or mailed. But I have already described this in detail in a former article.

Their time-speaking clock is designed to enable messages to be time-coded. A synchronous master-clock causes pre-recorded time announcements to be reproduced at arranged intervals and these announcements are recorded by the message-recording time-master machines provided that the message is not at that instant being recorded. These time announcements were recorded on 35 mm. film, the time checks being given every half-minute.

The sound-mirror magnetic tape recorder shown by Thermionic Products is a very nice looking table model, weighing about 36lbs. It incorporates an 8in. loudspeaker and a high-fidelity non-directional microphone, for which provision for storing is provided inside the cabinet. The makers also provide this model in what I call suit-case form.

Certainly one of the nicest-looking instruments in the Exhibition was the G.E.C. Magnetic-Tape-Recorder. I understand that it can be easily stripped of its cabinet and incorporated into industrial installations. Also it is the only instrument with the "tape-spool" and "take-up" on the same spindle. This tape-recorder stands on the floor and is from all points-of-view a handsome piece of furniture. It records from external sources such as a radio receiver, telephone line, a standard 15 ohm high-fidelity moving-coil microphone or, presumably, a phonograph.

So far we have dealt only with complete recording units whether for the amateur, priced at somewhere around £50 to £80, or what I didn't deal with: the mobile recording vans, such as Leevers Rich Mobile Sound Recording unit; the Associated British Pathé recording van, the mobile Broadcast unit of Radio-Luxembourg and the B.B.C. eight-channel mobile recording unit. Then there was the sad case of the E.M.I. mobile recording unit which was destroyed in a blitz-fire and was replaced in 1940. This unit is fitted with both tape and disc-recording with modern equipment. It can even be operated where no power is available from the mains. These recording vans were on view in Tavistock Street on the second day.

Unfortunately, my train from Sheffield was five hours late and I didn't get the opportunity of seeing them. But I am not actually contemplating ordering one at the moment.

Then we come to the case of Mr. Leak, or should I say Mr. Harold Joseph Leak, who had quite a bit of press in late 1949 and thoroughly deserved it.

But to refresh your memories, Mr. Leak is the Managing Director of H. J. Leak and Company. Apparently he read of an Exhibition to be held in New York by the Audio Engineering Society and wrote asking them if they would like a British exhibit. They said that they would like it very much. With commendable speed, the Bank of England allowed him his dollars, with the result that orders for this British product were forthcoming.

Mr. Leak puts over his "Point 1" Amplifiers. The trade-mark "Point 1" was originally applied to the first Power Amplifiers having a total distortion as low as point 1 of 1 per cent. Mr. Leak has progressed since that but "Point 1" still remains the trade-mark.

As I write, I have in front of me the report of the National Physical Laboratory about these amplifiers. Having no space to reproduce it you will have to take my word that it is pretty impressive.

In the accessories field, Garrard Engineering were well to the fore. It was the first time that I had seen their record changer, which will automatically play a batch of records, mixed 12in. and 10in.

The only two machines that I have seen before which will perform this conjuring trick are the American Cape Hart and my own pre-war British Autotrope, which takes 36 discs of mixed sizes *and turns each one over*, if desired.

Decca showed a new modified version of their parallel tracking device, first shown at the B.S.R.A. Exhibition. This instrument cues perfectly to a fraction of an inch of the groove.

In conclusion, we must mention that the B.S.R.A. has produced some gramophone records of considerable interest.

The first is the "History of the Gramophone," in two parts on a 10in. disc. It is an account of 90 years of progress in the art of sound recording.

Secondly, a demonstration record of the high-frequencies. This is a violin unaccompanied on a double-sided 10in. record.

Thirdly, the low-frequencies are demonstrated. This is a bass-viol unaccompanied, also on a 10in. double-sided disc.

Lastly, a test-frequency record. This is designed for testing pick-ups, etc. It has been recorded as a continuous spiral from outside to inside in 1,000 cycle bands from 10,000 cycles to 1,000 cycles, below which the frequencies are recorded at 500, 200, 100 and 50 cycles.

Altogether the exhibition was of great value to all interested in sound reproduction in any form. Its organisation reflects very great credit on those concerned.

On your Wavelength

by THERMION

Suppression Still Voluntary

SO the Postmaster-General, in a reply to a Parliamentary question has stated that he did not propose to take legislative action to make suppressors compulsory in motor-vehicles, in order to help television reception. Are we not hearing just a little too much about the interference caused by motor-cars and other electrical apparatus to television reception? We hear nothing about the interference caused to radio reception by television, and if optical television gets really going, employing about 2½ kV as E.H.T., there will be a scream from the owners of radio receivers which will be heard from Greenland's icy mountains to the shores of Valparaiso. I am reminded of this by a letter from a waspish critic, who writes me in hectoring terms because I dared, a few issues ago, to voice a plea for voluntary suppression. The gravamen of his letter is that he lives next door to a television fan, and the interference which his television causes makes listening quite impossible whilst the TV receiver is in operation. I cannot accept his invitation to go down and hear for myself—I readily accept his word for it, but I should have thought a little neighbourly conversation in a style a little less splenetic than that in which his letter is written might have resulted in something being done. From the tone of this letter I could gather that the neighbour and my correspondent are as the Liddites and the Hittites—always at war with one another; and it may be, that as a result of some previous altercation, the television owner is showing his resentment much as an irate motor-car owner tootles his horn at the driver in front.

However, it should not be thought that my comments hitherto had only television in mind. All interference, whether with television or radio, is an annoyance, and owners of offending apparatus have had plenty of time to fit suppressors voluntarily. It costs little and it preserves friendly relations. Although the P.M.G. does not propose to intervene at the moment, he will be compelled to do so later on if a nation-wide television service is not to be stultified, because interference destroys its entertainment value. Quite often the B.B.C. and the Pallydrome experts are blamed for this interference, the less knowledgable thinking that the weird splotches sometimes resembling a scrambled-egg are part of the picture radiated from A.P.

The Price of Television

OF course, in its early stages television receivers are bound to be somewhat expensive, but we must remember that a large portion of the high costs goes to the Government in the form of purchase tax, an iniquitous incubus for a new industry. As the service develops and demand correspondingly increases, output will go up and prices will come down. It has followed this course in America, where a television receiver costing £100 a couple of years ago can now be purchased for £28, with a 12in. tube, too. The would-be purchaser in America gets a free home trial, pays nothing down, and can decide the period, within reason, over which he will pay for it if he require hire-purchase terms.

Sets with home-movie size screen—about 30in. by 30in.—are coming along in America and so is colour television. Perhaps manufacturers are, therefore, unloading at knockout prices in preparation for these new developments. I have much sympathy with the British manufacturers. I feel that a purchase tax ought not to be imposed on a young and growing industry. Unfortunately, there is no indication that this is restricting sales at the moment.

The Radio Show

WITHIN a few days I shall make my pilgrimage to the Radio Exhibition, this time being held at Birmingham. The next issue of this journal will contain details of the exhibitors and of the exhibits. I cannot say that I am relishing the journey. I am not particularly fond of Birmingham, and to transplant an exhibition so almost extricably associated with Olympia is like transplanting the orchids from Kew Gardens to the Gobi Desert. The journey, however, is a small matter. The show is the thing, and once within its portals I am certain that the Radiolympia atmosphere will be present. I am hoping that attendances will be at least equal to the previous radio show although, as I have mentioned before, the accommodation difficulties of Birmingham may prevent people from making more than a one-day visit. In fact, my trade friends with whom I like to natter on radio and old times tell me this year that their visits will not coincide with mine. For the radio show is the only annual opportunity I have of seeing a lot of people in a short time. However, I shall extract the same pleasure from gazing into radio's large shop window. I understand that the P.W. television receiver will be on show, and those unfortunate readers unable to purchase the issues containing details of its construction will be able to purchase a book containing a reprint of those instructions, including information on adapting it to suit Sutton Coldfield transmission. The receiver is housed in a specially designed console cabinet, for the manufacture of which arrangements have already been made. Incidentally, wireless and television cabinets for constructors provide a problem of the moment. Up to 1939 there were many cabinet-makers providing cabinets for home-constructed receivers; only a few provide them to-day. There is the difficulty of timber shortage and timber control with which to contend.

Two-band Matched Impedance Aerial

A Novel Arrangement of Value to the Amateur Transmitter and Experimenter

By O. J. RUSSELL, B.Sc. (G3BHJ)

THE advantages of a matched impedance feed to a transmitting aerial are well known. Most particularly to be reckoned are the reduction of radiation from the feeder, the reduction of feeder losses and, with proper coupling circuits, a more easy elimination of harmonic radiations, thus reducing television interference. The popular moulded twin feeders now in use are preferably used in a matched impedance condition, as their use in an unmatched condition renders them exceptionally prone to excessive losses in wet weather. Furthermore, although the new twin feeders are available in low-impedance types, the losses of the 300-ohm versions are far less than the lower-impedance types. This is, of course, only to be expected from the greater spacing of the 300-ohm impedance feeders. It is unfortunate, therefore, that most users of the 300-ohm moulded twin lines have been forced to employ them as tuned resonant lines, with all the disadvantages of increased losses resulting from this mode of operation. What is needed is the operation of 300-ohm line in a matched impedance condition, so that the actual length of line is immaterial, and the line losses are as low as possible. This is the ideal mode of operation, but with the exception of such one-band devices as quarter-wave matching stubs and other somewhat cumbersome subterfuges, it has not hitherto been possible. A very recent design published in America now provides a solution of the difficulties, and moreover provides a two-band solution, so that the DX man can erect an aerial for 40 and 20 metres, feed it with any length of 300-ohm line, and remain secure in the knowledge that operation is in a satisfactorily matched impedance condition. In point of fact, if necessary the antenna can be made for any two adjacent bands, such as 10 and 20, 40 and 20, 80 and 40, and so on. All that is needed is a piece of wire and the feeder.

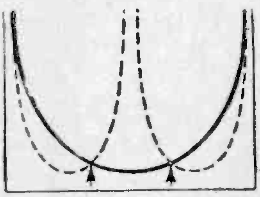
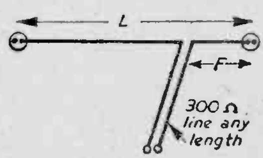


Fig. 1.—Diagrammatic representation of impedance variation along a half-wave wire (full line) and a full wavelength wire (dotted line). Arrows indicate the points where the feed impedance is the same value for both systems

Feed Point

The solution is as simple as that, with the proviso that the feed point is made at the correct distance from the ends of the antenna. For two-band matched impedance operation with 300-ohm line, the correct feed point is not at the centre. As we all know, the centre of a half-wave dipole is in any case a low impedance of the order of 75 ohms, which would not match 300-ohm line. In order to see how a satisfactory two-band match can be made, we must consider a very fortunate coincidence pointed out by WϕWO, who originated this new system. Consider the diagram showing the feed-impedances at various points along a half-wave wire operating first on its fundamental, and then on its second harmonic. On the fundamental there is one standing wave system on the wire, with high voltage at the ends and low voltage at the centre. The high-voltage ends correspond to high-impedance points of the order of 3,000 ohms, while the low-voltage (and high-current) portion in the middle corresponds to a low-impedance point. Operating on the second harmonic, the wire still has high-voltage points at the ends, but also has a high-voltage point in the middle, which is now a high-impedance point—a fact familiar to those who have assayed to feed a full-wave antenna with low-impedance coaxial feeder. The low-impedance points where current is highest are now in the centre of each half of the antenna. Looking at the diagram showing the approximate impedances corresponding to half-wave and full-wave operation, it will be seen that the curves cross at two points where the feed impedances are the same. By a fortunate coincidence, the required feed impedance at these points is almost exactly 300 ohms. In the case of a 40-metre antenna, the feed point for correct operation is actually 22ft. 8in. from one end, and for correct two-band operation it is preferable to have a total top length of 68ft. rather than the usual 66½ft. With a total top length of 68ft., and using 300-ohm line, a satisfactory matched impedance condition is given for both 40- and 20-metre operation, while for combined 10- and 20-metre operation, a 34ft. top with the feeder attached at 11ft. 4in. from one end can be used. If required, similar proportions could be



Top length L, and feedpoint F for the two-band system.

Bands	L	F
160/80	272ft.	90ft. 8in.
80/40	136ft.	45ft. 4in.
40/20	68ft.	22ft. 8in.
20/10	34ft.	11ft. 4in.

adhered to for other wavebands, such as 80 and 40 or 160 and 80. For calculation at any desired centre frequency of operation, the 68 top length represents the optimum figure quoted by WϕWO for operation around 7,130 kc/s and 14,250 kc/s.

For Receivers

It is hoped that the above brief description of the new antenna system may be of interest to transmitters and amateurs alike. The advantages of matched impedance operation for transmission are, of course, well known for transmission, and have been outlined at the beginning of this article. The efficient operation of a receiver is also improved if it is possible to supply it with a suitable impedance feed. Wide variations of impedance do occur with many receiving aerial systems, which can seriously reduce the performance on certain frequencies. With the modern communication receiver designed for a medium impedance input, a system of this sort should prove ideal, while the transmitting amateur has yet another cogent reason for employing the same aerial for reception and transmission. It should be pointed out that, apart from the unwieldly old-fashioned air-spaced twin open wireline, the moulded 300-ohm lines produced by reputable makers have the lowest losses of any types of normally available feeder.

Making All-wave Tuners

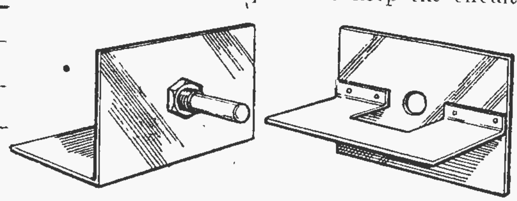
Straight and Superhet Units are Not Difficult to Construct. Details of Design are Given Here

By W. J. DELANEY (G2FMY)

THE construction of modern receivers of almost any type is greatly simplified when an all-wave tuner is employed. As most readers know these tuners consist of two or more coils mounted on a baseplate with a self-contained range switch. For those constructors who find that most interest in radio lies in making their own components, the following details are given—but it must be pointed out that for a really comprehensive superhet covering four or five ranges, the commercially produced article will be found most satisfactory, as the makers are in a better position to match coils and overcome stray capacities than the amateur with his limited apparatus. For the simplest type of circuit, say a straight two or three valver, there will be needed only two tuned circuits the aerial and the intervalve coupling. For a superhet also, two circuits are normally all that are required, the aerial and the oscillator. The great difference between these two types of receiver lies in the fact that in the straight set all circuits are required to work at the same frequency, whereas in the superhet the oscillator coil operates at a different frequency—to set up the beat at the required I.F. Thus, there is much greater risk of instability in the straight receiver.

Chassis

For a superhet, therefore, a simple rectangular chassis as shown in Fig. 1 is all that is needed as a mount for the coils. The switch, preferably of the rotary type—Yaxley or similar, is mounted in the centre of the panel, and the aerial coil(s) on one side and the oscillator coil or coils at the other side. The separation provided by the switch in the centre is all that is required to keep the circuit stable, and all coils may be mounted in the same plane. The required tracking and/or padding condensers may be mounted on the small chassis, which need only be about 3in. or 4in. square. For the same number of coils to be used in a straight receiver, however, screening must be introduced between the coils. This is carried out most easily by using a horizontal plate mounted in the centre of the panel part of the chassis as shown in Fig. 2. The centre of the horizontal portion will have to be cut out to clear the switch, and the aerial coil(s) mounted on the upper side and the intervalve coil(s) on the underside. If more than one H.F. stage is employed three or more screened sections will be called for and the best arrangement then is as shown in Fig. 3. The vertical partitions must be high enough to prevent coupling of the coil fields, and with all of the chassis mentioned the final dimensions will depend upon the type of coils which are used. The popular Wearite "P" coils are easily mounted but have the drawback that they cover one range only and this means that two or three coils have to be used for each circuit. They are very small however, and are all accurately matched and the makers supply details of inductance, etc., for those who wish to construct realiably calibrated equipment. Denco can also supply similar types of coil, both of the air and of the iron-core type. The latter types of coil may be matched by means of the core and offer certain advantages. Dual-range coils may be obtained for medium and long waves, both in the straight and superhet types, but for those who wish to construct their own the following details are given.



Figs. 1 and 2.—Simple chassis for superhet or straight units.

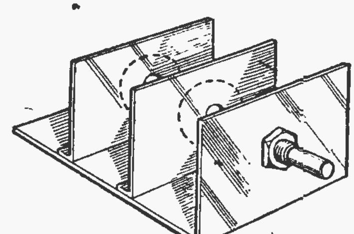


Fig. 3.—Chassis for a multi-coil unit.

Coil Construction

For the coil formers ⅜in. or ½in. diameter paxolin or polystyrene tubing may be used and is obtainable in long lengths which may be cut up as required. Although short-wave coils may be wound solenoid fashion with thick wire, for the medium and long waves pile winding is undoubtedly the simplest for the home constructor. Small cheeks of stout card are pushed into position and cemented in place with Belsol or Denco polystyrene cement. Fig. 4 shows the idea and gives suitable dimensions. Primary and secondary are wound in the two sections, but for a dual-range (medium and long waves) the medium-wave section could be wound in one space and the long-wave section in the other, using tapped coils, or separating primary and secondary by a layer of thin typing paper.

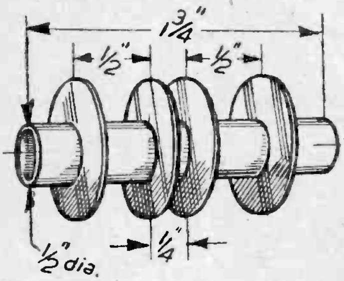


Fig. 4.—Coil former for a dual-range coil unit.

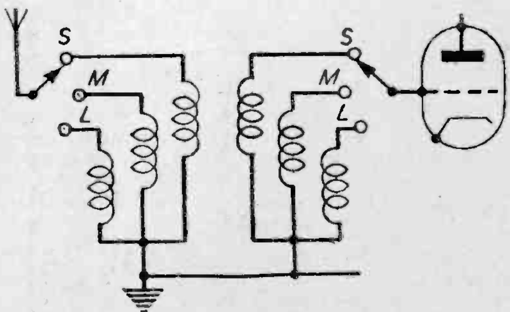


Fig. 6.—How the rotary switches should be wired to the coils.

The gauge of wire is not critical and although enamelled wire takes up less space there is a risk of short-circuited turns due to the enamel becoming cracked. The number of turns will depend upon the ranges required and the tuning condensers employed. Very approximately 70ft. of wire will produce a coil which will tune over the medium waveband with a .0005 μF. condenser. Primaries may be about one-tenth to one-quarter of the secondaries, the larger the winding the poorer the selectivity. In the case of superhet oscillator coils, care must be taken to get the two windings in correct phase, and therefore in the event of the oscillator stage failing to oscillate it may be necessary to reverse the connections to the ends of one of the windings. Oscillators may be checked, of course, in the usual way, by including a milliammeter in the anode circuit and short-circuiting the grid to earth, when the anode current will show a marked change if the valve is oscillating. If the needle remains steady then there are either insufficient turns on the oscillator primary, insufficient voltage on the anode, or the coil is connected the wrong way round. Fig. 5 shows the simple frequency changer stage which just calls for the two coils: input or grid coil which may have a primary winding or be tapped to provide the required degree of input selectivity, and the oscillator coil consisting of a primary and secondary. As similar coils are required for each wave-range, the lead from the input grid, from the oscillator grid condenser and the H.T. feed to the oscillator anode coil (or the oscillator anode) should be taken to the arms of the rotary switch or switches, and the ends of the coils taken to the appropriate points on the outside of the switch so that rotation of the switch will bring in the required coils as shown in simple form in Fig. 6. Here just a primary and secondary of an input coil are shown to illustrate the idea, which can obviously be extended to any desired limits, eight or nine wave-ranges being possible, with switched primaries and secondaries on some ranges and not on others.

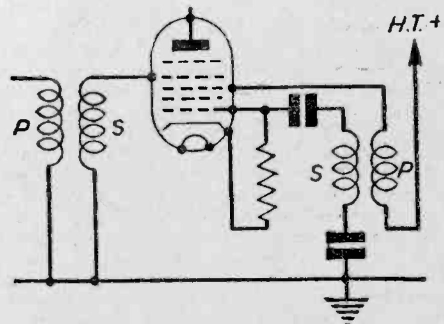


Fig. 5.—Simple frequency-charger stage.

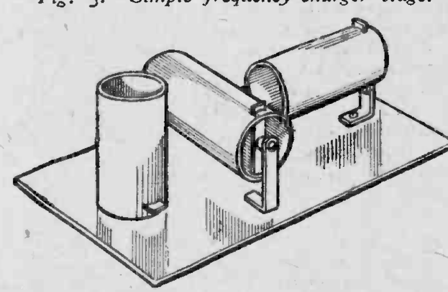


Fig. 7.—Three coils may be mounted as shown here to avoid interaction.

Obviously for these the separate sections are switched by separate banks on the Yaxley type of switch, each being in its own compartment, and wiring thus kept down to a minimum. Finally, it is worth while remembering that for the very simplest type of circuit, such as a one-valve receiver, where only one coil is required for each wave-range, screening need not be adopted, and three coils may be mounted in such a position that they are all at right-angles to each other and the risk of interference thus removed. This may be carried out as shown in Fig. 3, one coil standing upright, one horizontal, and the other horizontal, but at right angles to the other horizontal one. They may be placed fairly close in this condition.

A SIMPLE TRANSMITTER—2

An Effective One-watter for the QRP Enthusiast and Transmitting Beginner By "ELECTRON"

IF external supplies are contemplated, holes must be drilled for the battery leads.

There is rather more work attached to the chassis, no less than five valve-holder fixings to drill. Two of these are for the KT2's and the other three are for the coil formers. If self-supporting horizontal coils are to be used, however, other arrangements will have to be made. Incidentally, for this type of hole the only real method is to use chassis cutters; these cutters go through aluminium very easily.

Having finished the aforementioned large holes the next step is to attend to the mounting of the two tank capacitors. Now these are "live" on both the rotor and stator (i.e., they have H.T. on both sets of plates) and so must obviously be insulated from the chassis. If insulated brackets are not to hand it is a simple enough job to make some up in the shack. Those made for the original model consist of a paxolin strip, drilled to take the fixing nut on the capacitor spindle, and an "L" shaped aluminium bracket. The metal section is bolted by one leg to the paxolin and on the other to the chassis. Use fairly heavy gauge aluminium and paxolin for it is important that the whole mounting is rigid and allows no flexibility. To complete the tank capacitor fittings, two solid spindle couplers and two lengths of ¼in. diameter rod are needed. But don't mount the variables until all the drilling has been finished—it is so very easy to damage them!

All that remains now, as far as the chassis drilling is concerned, are a few lead-through holes and earth tag fixings. However, if internal batteries are to be used, a hole to take a rubber grommet (for the battery leads) should be drilled at the rear of the chassis.

Wiring

It is assumed that the importance of good mechanical and electrical solder joints are noted and that the necessity to keep all wiring as short and direct as possible is in mind. And don't be afraid to use really heavy gauge wire, especially in the grid circuits. Make the wiring as rigid as possible. As a matter of interest practically no extra "leads" were required, in the transmitter described, for components, and even the wire-ends of resistors, etc., have been clipped off short. Connections are all from pin to pin on valve and coil holders, or to earth tags, except those to jacks and battery supplies.

Wire in the valve filament leads first, taking heed that the negative side is also connected to one side of the on/off switch (the other side of the switch goes to an earth tag). Both filament leads are taken through the chassis to an insulated tag strip mounted on the back of the panel.

Then solder in the screen by-pass capacitor and resistors. C1 and R2 are taken direct from the screened-grid pin to an earth tag on the back of the chassis. R3 is connected to one of the pins on the CO stage coil base. The grid lead from V1 is taken through the chassis to the crystal holder, thence via R1 to the key jack.

The anode of V1 is taken to one side of the variable C2, connections from this point being taken to the other side of the CO coil holder and via C3 to the grid of the PA valve holder. From the junction of R3, C1 and L1 C4 is connected and the other end earthed. Also from this point

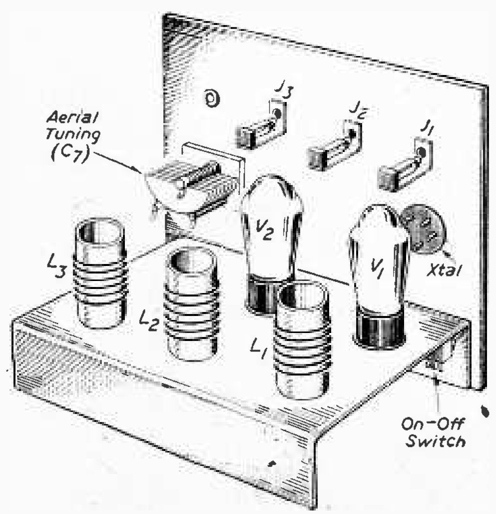


Fig. 6.—Rear view of the set showing coils in position.

a lead is taken through the chassis to one side of J2.

As for the PA stage, first of all connect the grid leak R4 and wire in the lead for the negative bias connection. From the anode pin of the V2 holder take a short lead to one side of C6 and continue it to one pin of the tank coil holder. C5 can then be wired in and a lead taken from the screen-grid

COIL DATA

	1.7 Mc/s	3.5 Mc/s	7 Mc/s	14 Mc/s
L1, L2 ..	45 turns, 22 s.w.g.	40 turns, 16 s.w.g.	16 turns, 16 s.w.g.	8 turns, 16 s.w.g.
L3	40 turns, 22 s.w.g.	35 turns, 16 s.w.g.	13 turns, 16 s.w.g.	7 turns, 16 s.w.g.
Links ..	10 turns	8 turns	5 turns	3 turns

All coils are close wound.

pin to the hot end of C6. Insert the RF choke and take the free end via the chassis to one side of J3. Whilst on the above chassis wiring connect together the two free ends of J2 and J3 and then this joint position is connected to the H.T. positive battery lead. This only leaves the aerial tuner and coupling links to be fixed.

The jacks 2 and 3 must be of the type which gives insulation from the chassis since both sides are "hot." And they should be connected for closed circuit operation, otherwise no H.T. will be applied to the valves when no metering is used.

It is, of course, possible to use auto bias on the PA stage, but a separate battery supply was found to be more satisfactory. For the KT2, with an anode voltage of 120 volts, the grid bias necessary is in the region of 5 volts.

Operation

Provided that care has been taken in the construction, little trouble should be encountered when tuning up the transmitter. If you have a range of crystals covering the fundamental band so much the better; for certain crystals are what might be termed "stubborn" when used in QRP circuits. If one doesn't oscillate, try another. If this does not produce results try introducing a little feedback in the CO stage by inserting a small capacitance between the anode and grid circuits. This is best done by soldering a lead to the anode pin, using thin-gauge wire, and winding the loose end round the grid lead to form a small spiral. This small capacitance does the trick. To tune up the transmitter, first of all set all variable capacitors at minimum. Do not connect up the aerial yet. Then insert the meter in J2, depress the key and slowly increase the capacitance of C2. At one point a sudden drop in anode current will be observed; this means that you have reached resonance and the CO is tuned. Now transfer the meter to J3 and repeat the process by tuning C6 until a dip is shown in the meter. You now have both the CO and the PA at resonance. If you have not adjusted C2 at the best position, the tuning of C6 may cause the CO to stop oscillating, but a slight readjustment of C2 will rectify matters.

The aerial must now be tuned and, with the meter still in J3 position, the variable capacitor C7 is rotated, *after connecting up the aerial*. The effect of putting the aerial on will be to show an increase in the anode current meter, but as C7 is rotated a point will occur where a dip is observed. It is at this point of lowest reading that the aerial is correctly tuned. But it must be emphasised that the dip should not be deep; in fact, it should be just noticeable if the aerial is coupled correctly and is cut to the right length.

Tune slowly when rotating for resonance and fit the controls with as large knobs as practical. If you wish to use a dipole aerial (unlikely for top band but certainly an idea if operation on 14 Mc/s is contemplated) then simply ignore the aerial tuning circuit and connect your feeders direct to the link on L2. Again, if link coupling is not considered favourably, tighter inductive coupling of the aerial to the PA tank can be obtained by arranging the coils L2 and L3 side by side or alternatively end on. The links would, of course, not be used with either of these arrangements.

Come what may, the little transmitter described will bring the joy of knowing that you are a genuine QRP operator. You will not break any DX records but at least you will be getting a great deal of real enjoyment out of the hobby—which is more than some of the big shots seem to do!

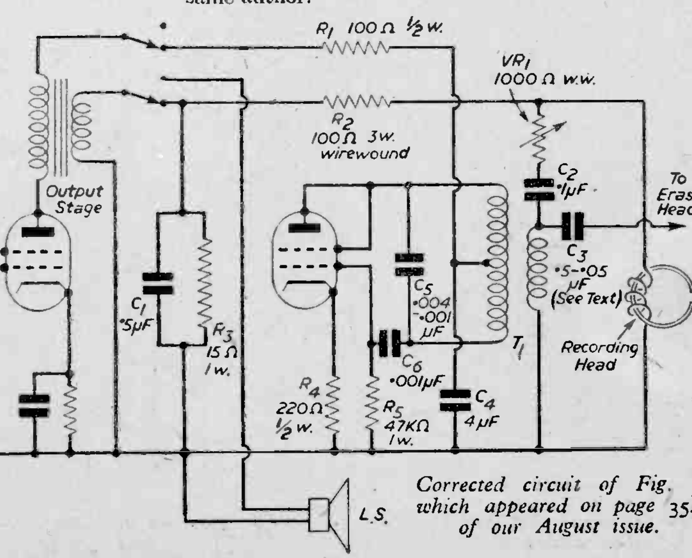
Magnetic Recording —A Correction

IN the August issue details of an oscillator and head circuit were given in connection with the description of the use of magnetic recording heads. Unfortunately the value of one of the components (VR1) was omitted from the diagram and the oscillator grid-leak (R5) was connected on the wrong side of condenser C6.

Grid Leak Connection

To avoid any difficulties a corrected diagram is reproduced on the right. From this it will be seen that the grid leak R5 should be joined direct to the control grid of the second valve in the manner usual to this type of circuit. It will also be noted that the value of the variable resistor VR1 should be 1,000 ohms and that it should be of the wire-wound type.

On pages 396 and 397 further notes on this interesting branch of radio will be found by the same author.



Corrected circuit of Fig. 3 which appeared on page 354 of our August issue.

Negative Feed-back—2

Some More Details of a Modern Circuit Arrangement

By ERIC LOWDON

LET us assume that the Ra is high compared with RL. When RL is reduced the current does not change much, but the output volts fall in proportion to the change in resistance, and therefore the feed-back volts Va must also fall. Thus the effective input volts Vi—Va must be greater than before, since the feed-back is less; this in turn causes the current to increase and therefore the output voltage also increases towards its original value. There is, of course, a conflict between the rising anode volts on the one hand and the accompanying rise in feed-back volts on the other, but the balance between the two effects leaves the anode volts much less reduced than would have been the case without feed-back.

We saw earlier that this is what happens in an amplifier (without feed-back) in which the valve Ra is low compared with RL. Voltage feed-back, then, causes the valve to have a low apparent Ra which makes for constancy of output with change in RL. Further, this low impedance is effectively in parallel with the load, and this is just what is wanted for an output stage where the load is a loudspeaker.

It would seem, then, that negative feed-back can be arranged to make the valve Ra high or low as required. However, there is one very important point with regard to all this that must always be kept in mind—the Ra is high or low only so far as the load is concerned.

That is to say, if we imbue the load with the power of speech and ask it what it thinks of the valve resistance, it will answer high or low according to how it is affected by the circuit; but if we ask the valve what its resistance appears to be, the answer it gives will be the same as that in the valve manual. We will return to this point shortly, when we discuss a circuit where the Ra seems to be both high and low at the same time.

Typical Feed-back Circuits

Most readers will be familiar with the popular feed-back arrangement shown in Fig. 4. The output volts are applied across the potential divider made up of R1 and R2—C1 is usually made large enough to have negligible reactance at the lowest frequency the amplifier is required to handle—and the ratio of R1 to R2 is adjusted to give the desired amount of feed-back across R2. This is voltage feed-back from the anode of V2 to the cathode of V1, but since R2 is also the cathode resistance for V1, current feed-back is introduced into this stage.

The potential dividing chain in this circuit should have an overall resistance of not less than 15 to 20 times the load impedance of V2. Thus if the load impedance Fig. 4a is 3,000 ohms, then the chain will have to be not less than 45,000 ohms; or if the feed-back is taken from the secondary of the output transformer Fig. 4b having an impedance of 15 ohms, then the chain will be not less than 225 ohms. The ratio of the resistors one to the other will, of course, depend on the amount of feed-back required.

Another popular circuit which is used for a variety of purposes, is the cathode follower shown in Fig. 5. But what kind of feed-back is used here? At first glance it looks rather like current feed-back, but let's look again.

If you remember, current feed-back was defined as a circuit in which the feed-back voltage is proportional to the current in the load resistance. In the example given, the feed-back was developed across the cathode resistor, but the output of the circuit was developed across the anode load. In the case of the cathode follower, however, the cathode resistance is also the load resistance, and the output voltage as well as the feed-back voltage is developed across it. This is therefore voltage feed-back and all that was said earlier about this

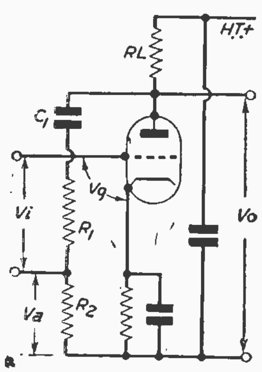


Fig. 3.—This circuit shows voltage feed-back.

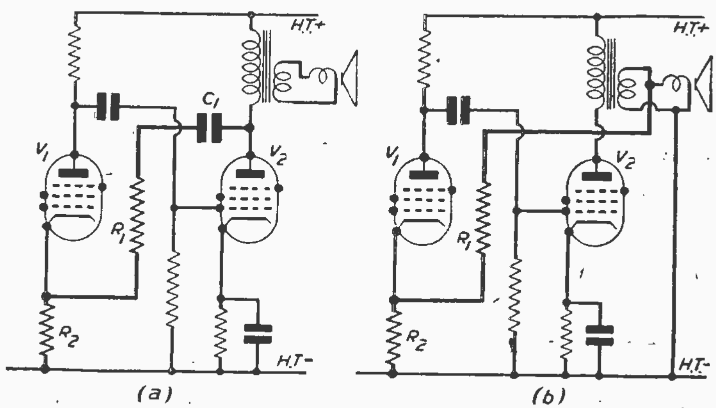


Fig. 4(a) and (b).—Two popular methods of applying feed-back in A.F. amplifiers.

type of circuit also applies here. In fact, one of the most valuable points about the cathode follower is the fact that the apparent Ra can be reduced to a very low value indeed whilst the input impedance to the valve is kept very high, thus giving a very low impedance output for a high impedance input.

Note, also, that unlike the other circuits previously described, the *total* output is fed back to the grid, and this means that the gain of the circuit must always be less than unity. For example, if 2 volts are required between grid and cathode to give an output of 30 volts across the load resistance RL, then obviously a total of 32 volts input will be required, 30 volts to neutralise the 30 volts feed-back and 2 volts to provide the 30 volts output. Thus the output is always less than the input.

Finally, we come to the phase splitting circuit of Fig. 6 and it will be seen that an output is taken from the cathode as well as from the anode. The feed-back voltage is developed across the cathode resistance and depends on the current in the anode load resistance, so this is current feed-back and the apparent Ra of the valve is high—or is it? For the feed-back voltage is also the output voltage from the cathode as in the cathode follower and, therefore, the Ra of the valve is low—or is it?

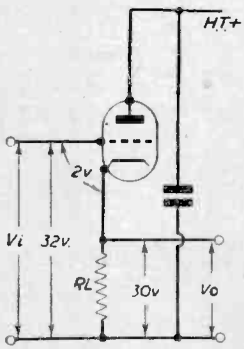


Fig. 5.—A cathode follower circuit.

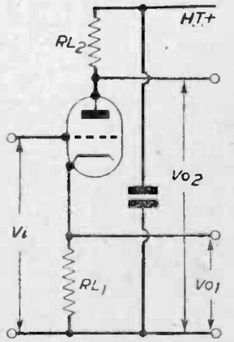


Fig. 6.—A normal phase-splitter circuit.

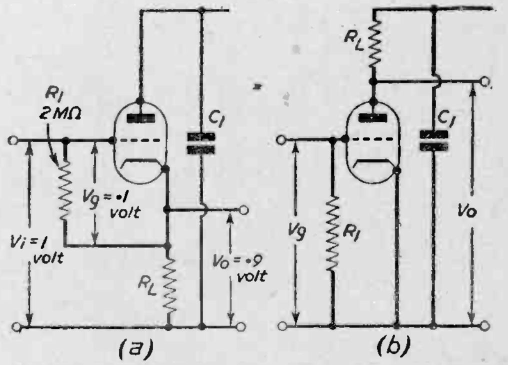


Fig. 7.—(a) A practical cathode—follower circuit, and (b) a simple amplifier, without feedback.

There seems to be something fishy here, for the Ra of the valve cannot be both high and low at the same time. This brings us back to the warning uttered earlier, that the Ra only changes so far as the load is concerned. The cathode load feels that it is being fed by a valve of low Ra and the output impedance from the cathode is therefore low; on the other hand, the anode load is quite certain that the Ra of the valve is high because the voltage output behaves as if such were the case. So this valve has three values of Ra depending on how you look at it, low if you look in at the cathode, high if you look in at the anode and, of course, the one given in the valve manual.

I have endeavoured to show how feed-back apparently altered the Ra of the valve and so changed the effective output impedance of the circuit. In the course of this article the cathode follower was mentioned and it was pointed out that since this circuit is an extreme case of voltage negative feed-back in which the entire output is fed back to the grid, the apparent Ra of the valve and therefore the output impedance of the circuit is reduced to a very low value indeed, *while the input impedance is maintained at a high value.* This circuit is therefore a kind of electronic transformer and can be used for matching the output from a high impedance source into a low impedance load.

It has since occurred to me that the statement italicised above may puzzle many readers, especially when one considers a practical cathode follower circuit such as that shown in Fig. 7a. Here we have R1 and RL, totalling little more than 2MΩ, for RL is normally very small compared with R1, about 25KΩ say, connected directly across the input; in addition the grid-cathode and grid-anode capacities within the valve are effectively in shunt with the input, so that when everything is considered it would seem that the cathode follower has no advantage over conventional non feed-back amplifiers so far as input impedance is concerned. In actual fact, however, the input resistance of the circuit in Fig. 1a will usually be many times greater than the total value of R1 and RL, perhaps 20MΩ or more, while the input capacitance will be very much smaller than the total interelectrode capacitance specified by the valve manufacturer.

Here, then is a mystery, which seems, if anything, to be even more puzzling than the change of Ra under the influence of negative feed-back. By what weird process does a perfectly normal 2MΩ resistance swell to gargantuan proportions, and an apparently stable capacitance shrink to Lilliputian dimensions? The problem is not quite so baffling as it looks, but first let us refresh our memories with a brief discussion on the operation of the cathode follower.

Cathode Follower Action

In a simple amplifier without feed-back (Fig. 1b) the input voltage is applied directly between grid and cathode of the valve, and the output voltage is equal to the gain of the circuit multiplied by the grid-cathode signal voltage Vg. The gain is usually denoted by the letter A, and this as everyone knows is equal to $\mu R_L/R_a + R_L$ where μ is the amplification factor of the valve, Ra the A.C. resistance and R_L the load resistance. Thus, in our simple amplifier the output volts $V_o = A \times V_g$.

(*To be continued*)

Short-wave Notes

Hints and News from an Experimenter's Note-book

By A. W. MANN

THE direct calibration of short-wave receiver tuning dials, now so popular with manufacturers and home constructors, has to some extent put the home construction of heterodyne type wavemeters into the background.

This fact came to mind recently when the winding of a 10-metre plug-in coil was finished, and ready for a trial in the receiver. As a commercial signal generator of good make and known accuracy was to hand, no difficulty was experienced so far as checking the tuning range, and locating the band, were concerned.

When the test was carried out, however, not one 10 metre transmission was to be heard. It was obvious, therefore, that we had struck a period of unsatisfactory receiving conditions. The coil was put aside until a change in receiving conditions would allow further tests to be carried out.

Some days later we were fortunate enough to have another try during a short period in which the band was open, and several Americans were heard. In the meantime, the operator of a "G" 40-metre 'phone station was heard discussing the 10-metre band, and he happened to remark that it had been absolutely dead during the previous week.

Points Worth Noting

This brings me to the point I wish to emphasise. Because an accurately calibrated signal generator was to hand, the 10-metre band was located without difficulty.

Without it, I would have been working at a disadvantage, especially under the existing reception conditions.

The idea of listening on the 40-metre band where 10-metre work is frequently discussed is, in the latter case, to be recommended. It at least gives one a useful guide, before carrying out modification.

Ten Metres Coil Data

Former, 4-pin valve base. Wire 30 gauge copper enamelled. Grid coil, 2 turns spaced ⅛in.

Reaction coil, 3 turns spaced thickness of wire. Distance between complete windings ⅛in.

Six-pin type threaded former.

Grid coil, 2 turns double spaced.

Reaction, 3 turns single spaced.

Primary, 2 turns single spaced.

Distance between complete windings, single space.

Tuning capacity, .0001 μF band spread, 15 pF.

It should be noted that, according to the receiver, the minimum capacity of the tuning condensers, grid circuit losses, etc., slight modification may be necessary. The data given, however, will prove to be a useful starting point. With the average receiver using the recommended tuning capacities no trouble should be experienced.

Wavemeters

Once the 10-metre band has been located, and a few transmissions heard, the band width dial readings should be noted. It is a good idea to follow this by building a heterodyne wavemeter of the battery-operated type and calibrate it throughout the full tuning range of the receiver—including the 10-metre band.

From the calibration data obtained, an accurate set of charts can be drawn on graph paper. If care is exercised the resultant curves will be sufficiently accurate to meet short-wave listener requirements.

Calibration points should be taken on stations of known frequency and accuracy.

Aerials and Wavemeters

A simple heterodyne wavemeter, built in a screening box, is a most useful instrument with which to carry out tests centring around receiving aerials. This applies especially to "directional" tests. For example, the indoor aerial described by the writer in the April issue of this journal showed marked directional properties. The formation of this aerial is actually that of a V beam folded back. Many short-wave listeners are using folded dipoles, but whether folded V beams have been used previously I do not know. As this one has provision for four alternative downlead connections it is, in my opinion, worthy of serious consideration.

No reference was made in the article to the fact that this system was of folded V beam formation, because there was no guarantee that it possessed V beam characteristics.

Extended Tests

In order to ascertain this, a series of tests are being carried out. These will cover a period of one year, or longer if necessary, under changing reception conditions. All bands will be covered.

The test model is suspended east to west. It is found that the centre downlead connection point shows greater gain on U.S.A. 20-metre amateur 'phone signals, and the same applies to 16- and 19-metre broadcast transmissions.

Forty Metres

On this band G signals are usually strong, and the switching over from one tap to another is very effective on individual transmissions, and according to their geographical relation to my location.

A compact, totally screened oscillator with provision for obtaining modulated and unmodulated signals as required, and of the battery-operated type will be built. This will be used in conjunction with the R1116A receiver, and a suitable output meter, with a view to further investigation of directional properties, and the amount of gain obtainable in the comparative sense.

No Surprise

Reading a selection of world-wide radio publications I have noted several references to T.R.F. receivers, which contained an element of surprise as to the results obtainable with this type of receiver under present-day conditions.

Having used this type of receiver among others for many years, I am not surprised. Admitted the superhet standards of sensitivity and selectivity are not obtained.

A soundly designed and carefully constructed O-V-1, or a T.R.F. receiver, is capable of providing very satisfactory results, in the hands of the average operator.

There is one method by means of which the selectivity of a T.R.F. receiver used in conjunction with a doublet aerial may be improved and, in fact, in this respect compare favourably with the superhet.

This takes the form of an adjustable primary winding with a 400 ohms resistor coupled to each end of this primary coil. The whole is made into a compact unit, consisting of a small coil former complete with primary winding, and the two resistors mounted inside the former.

This former should be slightly less in diameter than the inside of the receiver plug-in coil formers, and fitted with rubber pads, so that it is a sliding fit. The twin feeder cable is coupled to the free end of the resistors. The primary winding of the coil in the H.F. stage of the set is not used.

The sliding primary, the turns of which are a matter for experiment, permit an alteration of the amount of inductive coupling so as to obtain optimum results. Operation is admittingly tricky, at first, but offers some advantage from the selectivity point of view.

Portable Receivers

The design and construction of compact, battery-operated short-wave receivers, provides scope for those who care to undertake the necessary experimental work.

The writer has often wondered as to what sort of results would be obtainable, using a suitable receiver together with a long wire aerial on the top of the Cleveland Hills. Some day I hope to carry out a series of tests, providing that a compact receiver can be designed and built. That is, one which is really portable in the true sense. I do not doubt but that the time spent in construction will prove to be fully justified and well worth the effort.

Learning Morse Code

That some find difficulty in learning the morse code is well known. Radio clubs are doing much to help overcome this difficulty. The lone hand, however, is apt to find the necessary ground work rather difficult, and his progress slow.

I am of the opinion that if a series of punched, and graded tapes were available, those who are experimentally inclined, would soon evolve suitable tape pulling, and speed-regulating mechanism to enable such apparatus to be used with a simple oscillator of the code practice type.

Morse Recorders

It is probable that many of the younger generation have never seen a morse tape recorder. In the very early days of amateur radio, a London electrical firm produced a popular model at a popular price.

Commercial models are still available, but are rather expensive. This idea was revived in pre-war days in the U.S.A., specially to provide for the non-code readers amongst the short-wave listener fraternity. An amateur instrument would perhaps prove very popular in this country.

We may perhaps find the non-code reader catered for in due course, with a modified version of the teleprinter. To hear morse signals on the speaker or headphones, and see them transcribed into plain language would be interesting. What would be the cost of such an instrument, I wonder?

Electricity Load Spreading

DESPITE great efforts to expand electricity generating capacity, the increase in demand during recent years has generally been such as to offset the increased supply of current. The expansion in generating capacity is now beginning to overtake the increase in demand, but there will still be a substantial deficit during the peak periods next winter unless the different classes of consumers take special steps to reduce the load.

In these circumstances, the Electricity Sub-Committee of the National Joint Advisory Council have recommended that, if the risk of extensive dislocation of industry is to be minimised, load spreading arrangements will be necessary next winter. The arrangements recommended by the sub-Committee (which have been approved by the Government) should, however, prove less onerous than those in force last winter.

The Electricity Sub-Committee was first set up following the extensive "load-shedding" in the winter of 1946-7. For the winter of 1947-8 the Sub-Committee recommended that industry should cut its load during the peak hours of the six winter months by $33\frac{1}{3}$ per cent. of the maximum load in the corresponding period of 1946-7. For the winter of 1948-9 this target was reduced to 20 per cent. for the hours of 8 a.m. to 12 noon and 4 p.m. to 5.30 p.m. in the months of December, January and February. During the "fringe months" of October, November and March, Regional Boards for Industry were asked to make their own arrangements. Last winter, broadly similar arrangements were continued, but for the hours of 10 a.m. to 12 noon the target reduction in load was fixed at 10 per cent. instead of 20 per cent., and Regional Boards were given discretion to deal with the afternoon peak after January 15th.

The Sub-Committee consider that during next winter the position as regards the midday peak will be so improved as to warrant confining the peak hours for industry during the morning to the period 8 to 9.30 a.m., although care in the use of electricity will still be necessary up to noon. During the hours 8 to 9.30 a.m. for the months of December, January and February, a reduction in load of at least 10 per cent. will be required of industry. The afternoon peak hours will remain unchanged at 4 to 5.30 p.m., when a similar reduction of at least 10 per cent. will be required during the period December to mid-January.

Regional Boards will have discretion to require a reduction in load of more than 10 per cent. at these times where circumstances make this necessary.

A Versatile Valve Voltmeter

A Useful Unit Made from Spare Parts—By W. WALES

THIS unit which is about to be described fills a long-felt want, and is, indeed, a necessary piece of equipment for the type of work which is being constantly carried out in the workshops. It will prove invaluable to all serious-minded amateurs who undertake to construct new, and improve the performance of existing gear. The main factors to be considered for such a unit are ease of calibration and simple construction. Also, most of the gear should be available from the junk box. Cheapness is also a very important point to be kept in mind, though under present conditions with so much Government surplus available, the whole of the component parts can be bought for less than twenty shillings, if everything has to be bought to construct this unit.

It was decided that the instrument must be of use as a field strength meter as well as fulfilling the normal functions of a valve voltmeter. The circuit in itself follows conventional design, being of the standard slide-back valve type.

Details of mechanical layout are not included here as it is felt that this should be left to the individual constructor who can utilise materials which he has at hand—the positions of the components not being critical. In the writer's case the instrument was constructed on the chassis of a RF26 unit, this being the unit usually associated with the 1355 receiver.

It might be stressed at the outset that this valve voltmeter can be made to measure quite a number of different voltage inputs by the inclusion of multiplier resistances in the grid circuit meter, also a bias battery to provide the necessary opposing voltage. If one feels ambitious this unit can be made to operate from an A.C. power unit, so making the instrument suitable for mains operation, in so doing getting rid of batteries which to some constructors is an advantage, providing, of course, it is intended for use in a fixed position.

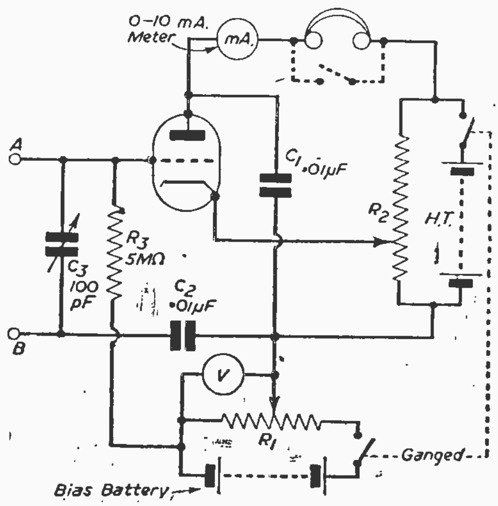
The resistances R1 and R2 should be of about 25 kΩ and should preferably be of the wire-wound variety, this making the voltage changes due to the varying of the position of the slider arm quite linear over the whole scale.

The valve which was originally used by the writer was an IT4 type connected as a triode, but it will be found that nearly any type of valve will be suitable for this particular job, as the operating characteristics are not critical.

When used as a valve voltmeter two probe leads are plugged into the coilholder sockets marked A and B in the diagram, while if it is required for use as a field strength meter all that it is necessary to do is to plug in an appropriate coil as required to tune to the desired frequency. A coil table which is suitable for the 80, 40, 20 and 10 metre bands is included at the end of this article. These ranges, however, can be extended by the use of suitable coils.

If it is desired to use the instrument as a modulation monitor, this can quite easily be brought about by the inclusion of a pair of 'phones in the anode circuit as shown by the dotted lines. When the 'phones are not in use they can be shorted by an ordinary single-pole single-throw switch wired across the telephone sockets, or if available, a self-shorting jack socket can be fitted for the telephones, so that on removal the socket is automatically shorted out, thus connecting the H.T. directly to the meter in the anode circuit.

In use as a valve voltmeter the mode of operation is as follows: R1 is adjusted so that no voltage is shown on the grid circuit voltmeter. Next R2 is varied till the indication on the anode circuit meter is also zero. The probes are then connected to the



Circuit of the Valve Voltmeter

supply which is to be measured. On doing this it will be seen that the anode current meter gives an indication, and all that need be done now is to adjust R1 till this meter goes back to zero again. The voltage which is being measured can now be read direct off the grid circuit voltmeter. It may be pointed out that during the above procedure the variable condenser C3 should be placed in the minimum position, as if R.F. voltages are being measured the condenser C3 will attenuate the voltages to be measured, so giving an inaccurate reading.

COIL TABLE

3 to 6 Mc/s:	18 turns 21 S.W.G. on 1¼in. former.
6 to 12 Mc/s:	12 turns 21 S.W.G. on 1¼in. former.
12 to 24 Mc/s:	8 turns 21 S.W.G. on 1¼in. former.
24 to 35 Mc/s:	5 turns 21 S.W.G. on 1¼in. former.

MAGNETIC R

This Month the Merits of

By F.

IF you wish to make a small and very compact recorder, and have the necessary ability and tools, wire would probably be the most suitable medium. The standard size spool now almost universally adopted is about 2¾in. in diameter and contains sufficient wire, running at the usual speed of 2ft. per second, to give an hour's recording. The wire is stainless steel .004in. diameter (42 S.W.G.). Stainless steel normally is non-magnetic, but due to the special heat treatment given in manufacture, the wire becomes magnetizable and, what is more, gives an infinitely better

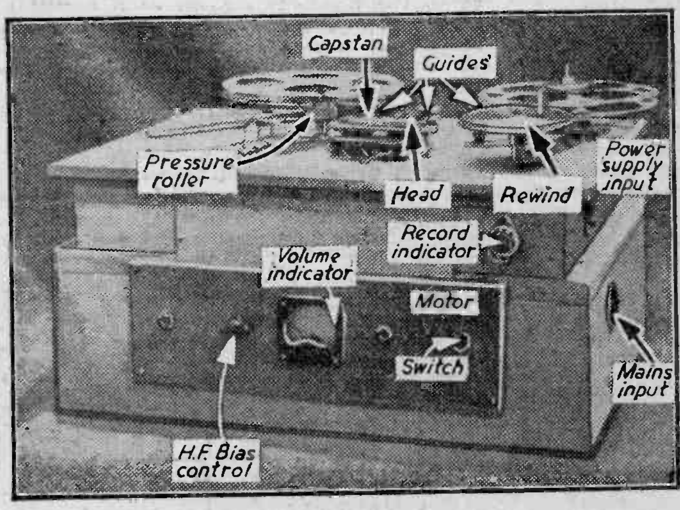


Fig. 1.—A typical home-made tape-recording and play-back unit with self-contained amplifier.

performance than the original carbon steel wire originally used before the war.

It is possible to obtain a high-fidelity wire, which has been passed through an automatic, electronically controlled, annealing process, giving a uniform response and a complete absence of background noise.

Probably the biggest difficulty with wire is making an accurate piling mechanism to spool the wire evenly. Usually a heart-shaped cam, driven through gears connected to one of the spool spindles, operates guides acting on the wire to perform this operation; sometimes the head assembly itself is moved bodily by the cam. If the wire were allowed to pile unevenly considerable variation of wire speed would result, producing a pronounced "wow" on playback.

Some form of braking has to be employed to prevent the wire spilling off the spools; if this happens, a tangle will ensue, usually ending with a break in the wire. A join is easy to make, however, by taking both free ends together and tying a knot, afterwards cutting off the superfluous ends. Large diameter guide pulleys, where employed, should be used, because if the wire is pulled over a small guide it will take on the appearance of a coiled spring, and if a break occurs it is almost impossible to tie a knot with it. The usual standard speed for reasonably good quality reproduction is 2ft. per second.

Tape used in modern recorders is .25in. wide, about .002in. thick, with a magnetic coating .0005in. The dull side of the tape is the coated side, the coating consisting of a very finely powdered iron oxide in a suitable binder. Plastic is the usual base used for the tape although one manufacturer uses a specially selected paper for the purpose.

The tape is marketed on spools similar to those used for 8mm. cine films, and can be obtained in three different lengths—600ft., 1,200ft. and 3,250ft. on 5in., 7in. and 11in. spools.

Double Time

By using recording and playback heads slightly under half the width of the tape, it is possible to record two programmes on the same tape, either at one and the same time, using two heads, or with one head, by setting the head, say, on the

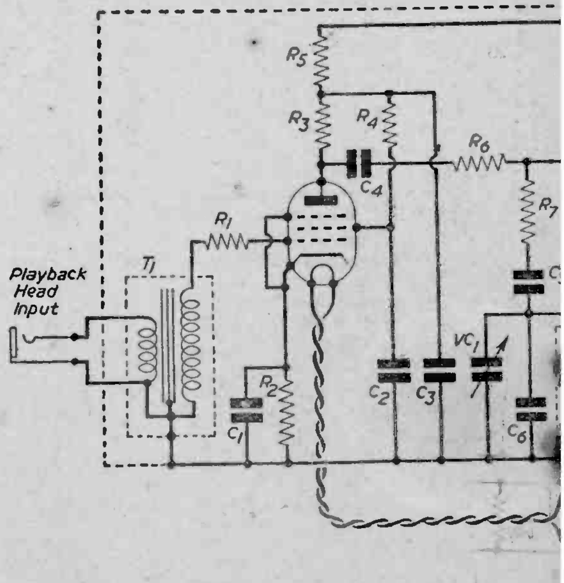


Fig. 2.—Theoretical circuit of a pre-amplifier for use ... recorders. A list of components will be found on

ECORDING—2

e and Tape are Discussed

BLAKE

lower half of the tape, recording the whole reel, and then, turning the recorded reel over and placing on the "feed" side again, carry on recording on the unrecorded half width left. Using this latter method double the recording time is available.

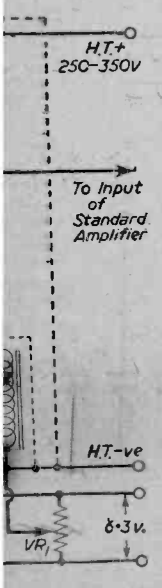
Tape speeds should be arranged to conform with the standards as set by the various manufacturers, to avoid complications should you wish to exchange recordings with friends possessing commercial recorders.

The most popular speed used is 7½in. per second giving a playing time of half an hour per 1,200ft. reel, using a single full width track. Recordings on tape at this speed are comparable with results obtained with wire running at 2ft. per second.

Recently, an improved tape has been made available with a higher coercivity, giving an improved top response, the uncompensated response curve of which is shown in Fig. 4. Tone compensation of some sort is needed at all tape and wire speeds. At 7½in. per second a large amount of bass boost and a sharp lift in top is needed as will be seen from the specimen curve shown.

When recording (see previous article) we endeavour to get a constant recording current at all frequencies by feeding the recording head through a resistor. Although we can do a little bass and top boosting when recording, it is not possible to get the amount required on the wire or tape without overloading, so most of the compensation is done in the playback amplifier. You may ask, "Why does the curve follow this particular shape?"

As far as the low frequencies are concerned, consider as an analogy the humble bicycle "dynamo" (this is usually an alternator not a dynamo, by the way); when you are pushing the bicycle at a slow speed you produce a low-frequency alternating current with a low output. When you increase your speed the frequency of the generator increases, giving a greater output. The magnetic force has not changed in strength at all, but the magnetic lines of force present in the magnet have been cut by the armature at a higher speed. The recorded wire or tape represents the permanent magnet, whilst the playback head will represent the armature.



th tape, or wire
the right.

LIST OF COMPONENTS

R1—1 kΩ, ½ watt.
R2—3.9 kΩ, ½ watt.
R3—200 kΩ, ½ watt.
R4—820 kΩ, ½ watt.
R5—15 kΩ, 1 watt.
R6—100 kΩ, ½ watt.
R7—20 kΩ, ½ watt.
C1—50 μF. 12 v. Electrolytic.
C2—2 μF. 500 v. paper.
C3—8 μF. 500 v. Electrolytic.
C4—.1 μF. 500 v. tubular.
C5—.01 μF. mica.
C6—.0005 μF. mica.
VC1—.005 μF. bakelite dielectric.
VR1—50 ohms wire wound.
T1—Screened input transformer, Screened Top lift inductor — Messrs. Sowter Transformer, 1B, Head Street, Colchester, Essex.
V1—EF37, EF36, or ex.-Govt. VR56.

Fig. 3.—An underside view of the "Ekovox" tape-handling mechanism.

Another Factor

The increase in output as the frequency gets higher and higher goes on more or less in a straight line till we get near the top of the curve. Now, another factor influences the response. As the frequency increases, it will be obvious that the length of each individual "recorded magnet" will get shorter and shorter and, as a short magnet tends to demagnetize itself, the shorter magnets associated with the higher frequencies will exhibit less and less magnetic force. As the frequency rises further top losses will be caused by the cancellation of flux in the head due to the neighbouring magnets touching the head polepieces, but not at the gap itself, and too large a gap width will "defocus" the high frequencies still further. There are many more conditions which will spoil good response, but we have neither time nor space to go into fuller details

—in any case I do not want to frighten you too much!

A suitable playback amplifier is shown in Fig. 2, which can be used with the head described in the previous issue; here both bass and top boost are provided, the top boost being controllable in frequency by means of the variable condenser VC1, which, with its associated padding condenser C6, will shift the peaking frequency from 5-7 kc/s. If a higher frequency boost is needed the padding condenser should be left out; if a lower top boost is required, C6 could be .001 μF., when the range would be 4-5 kc/s.

Note that the input transformer should be screened to reduce hum pick-up, and it is advisable completely to enclose the pre-amp. if possible in a steel case to keep out all extraneous fields. The output should be fed to a normal amplifier by a short, screened lead of low capacity.

The power supplies for the pre-amp. could possibly be obtained from the main amplifier. Note that the heater should only be earthed via the "hum-ding" potentiometer VR1, which should be adjusted for minimum hum.

Hum

The unit should not be placed too near the power transformer or motor, otherwise reproduction will be marred by hum pick-up; in this connection, too, the low impedance leads to the head should be either twisted together or run in screened flex; the "earthed" lead should be taken direct to the earthed side of the input transformer, and not allowed to earth at any other point. If screened flex is used the metallic braiding must be kept clear of chassis or screening except at the earthing point itself.

The table gives a guide to the frequency ranges obtainable with normal "Grade B" tape at the various standard speeds. As the tape handling mechanism I use is driven by an induction type gramophone motor with not much power to spare, I found that 7½in. per second was the best all-round choice of speed. In the first recorder mechanism, to smooth out all motor ripple, the 12in. turntable was left *in situ* and the centre spindle extended to take the brass capstan.

The usual practice in commercial machines is to use a high-speed capstan coupled to a heavy rubber-rimmed flywheel, which is driven by a small induction motor, the spindle of which presses against the rubberised rim as in modern gramophone motor practice. Unless all parts are made with great precision the results will be very disappointing.

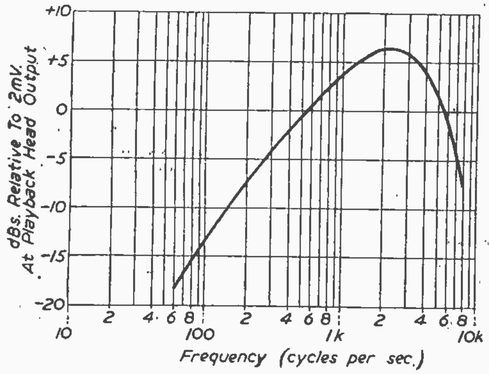


Fig. 4.—Response curve (uncompensated) of the G.E.C. Grade A tape.

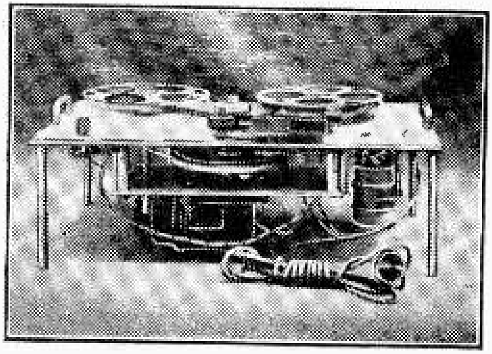


Fig. 5.—Another view of the "Ekovox" tape-handling mechanism developed by the author.

Next month I hope to give details of a tape recorder mechanism, using an ordinary gramophone motor as a drive. I consider this scheme to be the simplest for the amateur to construct.

STANDARD TAPE SPEEDS.

Tape Speed Inches per Second	Frequency Range c.p.s.	Uses
3¾	200-3,000	Speech only
7½	100-5,000	Speech and music
15	50-10,000	High quality music and speech
30	30-15,000	Highest fidelity reproduction, studio use

Smaller Photoelectric Control Units

A PHOTOCELL, of particular value for use in conjunction with extremely small and compact lens systems, has recently been introduced by the Communications and Industrial Valve Department of Mullard Electronic Products, Limited. This new photocell, type 58CV, which is 13/16in. long and has a diameter of no more than ⅝in., is specially designed for an end-on aspect of illumination.

In spite of its size, the 58CV cell has a sensitivity of better than 15μA per lumen. Other characteristics are as follows: Maximum anode voltage 100 v.; maximum cathode current, 3 mA.; dark current at an anode voltage of 100 v. 0.05 μA.

Further technical details of these new photocells can be obtained from:—The Communications and Industrial Valve Department, Mullard Electronic Products, Limited, Century House, Shaftesbury Avenue, London, W.C.2.

Designing Your Own Receiver—2

Advice and Guidance for the Beginner

By STANLEY BRASIER

IT will be seen from last month's details that 250 volts at the anode of the 6V6, 130+18+12=160, must be added making a total of 410 volts needed at the rectifier output.

The rating for the H.T. secondary winding will therefore be 410 volts at 65 milliamps. In practice the nearest transformer rating to this would be 425—0—425 at about 80 milliamps and should be quite suitable. If the excess voltage is undesirable it is an easy matter to include a resistor (calculable by ohms law) of sufficient wattage in series with the L.S. field coil. The addition of another smoothing condenser would then probably provide increased smoothing efficiency.

P.M. Speaker

If it were decided to use a permanent magnet loudspeaker—where no field coil would be available—an ordinary smoothing choke would be necessary. In this case, however, the resistance of a suitable component would probably be only about 500 ohms, showing a saving in voltage drop of $\frac{65\times1500}{1000}=97.5$v. Our transformer secondary winding would then be rated at only 312.5 volts at 65 mA., and shows how the use of a particular loudspeaker affects voltage conditions.

Rectifier

The rectifying valve may now be decided upon and for the higher voltage it will be seen that the type 5U4 taking 3 amps heater current would be suitable. While it would also be suitable for the lower voltage, advantage could be taken in this case of a valve with a lower rating such as the 5Y4 needing only 2 amps heater current.

Since full-wave rectification is being employed, it will be noted that the transformer secondary must provide the necessary H.T. voltage on both sides of the centre tap so that the full voltage is applied to both anodes of the rectifying valve. Thus, each anode combines to give full-wave rectification at the required voltage and current.

H.T. Supply

There now remains the H.T. supply to the various valve electrodes, and these are calculated by again resorting to Ohms Law. It is proposed to work out one of these as a specimen calculation, which should suffice to show the method of procedure. Taking the voltage at X, Fig. 1 as approximately 275, it will be appreciated that a voltage-dropping resistor will be required to feed the screening grid of the 6K7 which needs 125 volts. This figure subtracted from 275 leaves 150 volts to be dropped. The electrode takes 2.5 milliamps, therefore $R=\frac{E}{I}$, therefore dropping resistor $=\frac{150}{2.5}\times1000$ (because I is in milliamps) $=57{,}000$ ohms approximately. Taking the nearest practical value, this will be 50,000 ohms. Note that when working out the value of the bias resistors for the 6V6 and 6K7 the screen current must be added to that of the anode.

In the case of the detector valve, 6J7, the electrode voltages are governed by other factors to which Ohms Law cannot be applied, and ultimate voltages will be much lower than those recommended. It is because the anode resistor has to be large enough in value to develop a sufficient *signal voltage* across it. This is the prime consideration, but in so doing it also drops very considerably the D.C. voltage at the anode. And because screen voltage must generally be lower than anode voltage, this is also lower than need otherwise be the case. With a high-impedance valve such as the 6J7, it is usual to provide an anode resistor of ½ megohm to 1 megohm and a screen-dropping resistor of 1 to 2 megohms.

Ohms Law enables us to calculate all the provisional values of components whose quantities have been omitted in the complete diagram of Fig. 1, and constructors who may have valves on hand which are applicable can apply values to suit. Mention is made of "provisional" values for—as will be seen later—theoretical valuation of components does not always apply in practice.

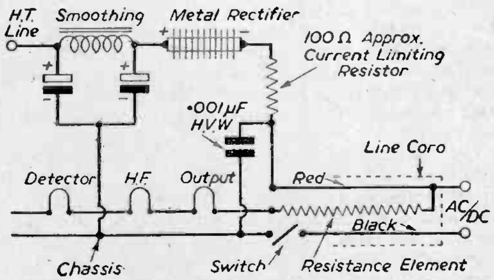


Fig. 2.—Circuit showing method of including a line-cord.

The advantage of supplying power by means of a transformer from A.C. mains is that the rectified output voltage may be raised to any amount in order to allow for subsequent necessary voltage dropping. There are occasions, however, when it is necessary or convenient to operate a receiver from either A.C. or D.C. mains. Although the system is usually less expensive, it is not possible with normal circuits to obtain a voltage in excess of 250 at the output of the rectifier, assuming the use of 230-volt mains. But by choosing a smoothing choke of reasonably low resistance, it is possible to provide for a voltage of something around the 200-volt mark, which provides quite good results.

A.C./D.C. Considerations

If this method is decided upon, quite a different technique is necessary, for although voltage is rationed, so to speak, current is there in plenty and is only limited by the specification of the half-wave rectifier usually employed. So that assuming this component will provide the desired current, that is all we need worry about, and the procedure for the calculations of electrode voltages will be the same as in A.C. practice, bearing in mind the initial reduced voltage. The heaters of valves used in an A.C./D.C. receiver are joined in series and connected across the mains via a resistor which is used for the purpose of dropping the mains voltage to that of the combined heater voltage of all valves. This "mains dropper," as it is called commercially, serves no other useful purpose and, in fact, the voltage dropped across it represents watts wasted. Because of this, special valves are made and provided with high-voltage heaters, where possible, in order to reduce the dropping resistor and therefore the dissipated heat to a minimum.

In the interests of economy the valves have a low current rating of 0.2 or 0.3 amps and it is important to note that all valves in the receiver must consume a similar current, unless special arrangements are provided.

Heater ratings for four typical A.C./D.C. valves would be: rectifier and output valves, 25 volts each and H.F. and detector, 6.3 volts each, all valves consuming 0.3 amps. Dial lamps may also be included in the heater chain and is a means of utilising to a useful purpose some of the wasted watts.

Mains Resistance Value

To calculate the value of the dropping resistor it is necessary only to subtract from the mains voltage the added voltage of all heaters and lamps in the chain. The result of this is then divided by the heater current (of one valve) in amps. The resistor must be capable of carrying this current and in practice may take the form of a large wire-wound resistor mounted on the chassis, or a "line-cord" which also forms the connecting cable between the mains and the chassis. If a line-cord is used it is advisable to obtain the three-way type so that the full voltage may be applied to the input of the rectifier. The correct method of connecting such a cord is indicated in Fig. 2. A line-cord has the advantage of even heat distribution—outside the cabinet. On the other hand, the chassis type is easily adjustable to allow for valve changes and different mains voltages. In view of this fact it is often convenient to combine both methods and the advantages of easy adjustment and efficient heat distribution are still available.

Layout

Having decided on the circuit diagram, the next consideration is that of layout, assuming that the various components have been already acquired. If an undrilled ready-made chassis is to be used it remains only to purchase one of sufficient size to accommodate the components. The enthusiastic amateur, however, will probably prefer to make his own, especially if he intends to progress, for the work is interesting, inexpensive and has the great advantage that a chassis may be constructed to any size or shape according to the designer's choice.

The beginner should be warned against the use of duralumin, which, although light, is very strong and difficult to bend. The most useful material is 18 or 16 gauge aluminium—such metal is readily available from advertisers at reasonable prices and may be obtained with a highly-polished surface.

Before cutting the metal it is necessary to return to the subject of layout. Having determined the size and shape of the chassis, procure a sheet of graph paper (readily obtainable at stationers) having eight squares to the inch. This is cut to the size of the proposed chassis, including flanges, and the bending lines denoted by heavy pencil marks. The "top deck" components may now be placed on the template and moved around until the best positions have been found. This positioning should be done in conjunction with constant reference to the circuit diagram, visualising the position of wires and small components such as resistors, tubular condensers, etc., which may be "suspended" in the wiring.

The importance of a good layout cannot be stressed too highly, for upon it may depend the success or failure of the finished receiver. In general, the aim should be to place the components in such positions as to fulfil the requirements of short, direct wiring between them. Obviously every wire cannot be short, and it is necessary to discriminate between the "hot" and "cold" leads. Most readers will know that grid and anode leads are particularly subject to interaction and it is these which should receive prime consideration. Grid condensers and leaks should be soldered directly in to the valveholder socket where possible, the same applying to by-pass condensers. Coils should be mounted with a view to short connection with wavechange switches, and while on this subject it is important to note that although iron-cored coils give high gain, they also encourage instability, especially in conjunction with high efficiency valves, unless care is exercised. Unscreened coils should be mounted above and below chassis respectively.

High-tension wires may usually be treated with less respect in regard to their length, but low-tension pairs in A.C. receivers should be twisted to avoid hum pickup. Such wires may consist of screened flexible cable if trouble is anticipated in this direction. In A.C./D.C. receivers the mains dropping resistor should be placed so that the considerable heat may be easily dissipated and not cause damage to other components which may be susceptible to heat. Finally, the layout must be considered with a view to symmetry where panel components are concerned, and it is usually possible to effect a good balance in this respect. Time spent in layout is well repaid and an evening or two employed in this direction will not be regretted for although efficiency naturally comes first it must also be remembered that a pleasing appearance will have a lasting effect.

(To be continued)

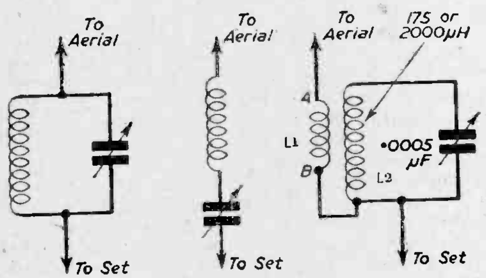
Wavetraps

Acceptor and Rejector Circuits and Their Function in Modern Equipment

By WILLIAM NIMMONS

WHAT is a wavetrap? We are apt to think of wavetraps as something that went out with the crystal set, when the inadequate selectivity made such a device almost imperative. In actual fact they are with us every day, recognised or unrecognised, for every coil and condenser is a wavetrap though it may go under another name.

However, the term wavetrap is reserved for a device comprising a coil and condenser made for the purpose of cutting out interference by another station when (a) the stations are too close together (under 10 kc/s) or (b) the receiver is so unselective that it cannot separate two stations which are fairly widely separated (say up to 50 kc/s) when the two stations, and particularly the interfering one, are very powerful or close to the receiver.



Figs. 1, 2 and 3.—Three simple wavetrap circuits, in which unwanted frequencies may be kept out of the receiver circuits.

Although not generally classed under the term of wavetraps, all devices for cutting out interference, whether at radio or audio frequency, fall under this category. Such devices as scratch filters to eliminate needle scratch in gramophone reproduction are, strictly speaking, wavetraps working on the rejector principle, and even the much maligned condenser and resistor tone control works by "trapping" the higher audio frequencies.

A practical demonstration of the efficacy of a wavetrap in cutting out interference is afforded by a detector-L.F. receiver used close to the local station. The local may swamp all stations over half the dial.

A Rejector

Suppose now we put a coil, tuned by a condenser in parallel with it, in the aerial lead to the set. The arrangement is shown in Fig. 1. When the condenser is so adjusted that the coil plus the condenser resonates at the frequency of the local station, the station is very much reduced in volume. It no longer spreads over the dial, and stations which were previously swamped by the local are now received clear of it.

The reduction in the strength of the local station (achieved without sacrificing the strength of other stations) is brought about by a peculiar property of the coil and condenser. At resonance, no current can flow through the device, which consequently presents a barrier to the frequency (the local station) to which it is tuned. At the same time, frequencies off-resonance can pass through quite freely. Although at resonance no current can pass through, there is nevertheless a circulating current which absorbs the energy of the interfering station. The statement that no current can pass would be true only of a circuit with no resistance; as this is impossible in practice there is always a small amount of current getting through.

An Acceptor

Such is the parallel, or "rejector" wavetrap. There is another type, called the "acceptor," which comprises a coil and condenser in series (Fig. 2).

The main difference between the two types is that with the rejector the circuit is a difficult path for current at the resonant frequency and easy for all others, while with the acceptor the circuit is an easy path at the resonant frequency and a more difficult one for all others. This is the essential difference, though there are others the causes of which need not concern us.

In Fig. 1 we have a plain coil and condenser, with the aerial going to the top and the set being connected to the bottom. It is, however, not essential that the aerial should be connected to the top of the coil; it may be tapped half-way down the coil, or even a quarter of the way up from the bottom—the so-called auto-coupling.

Or we may wind an entirely separate coil for the aerial (Fig. 3) with some advantage in the "spread" of the "hole" left in the tuning dial of the receiver.

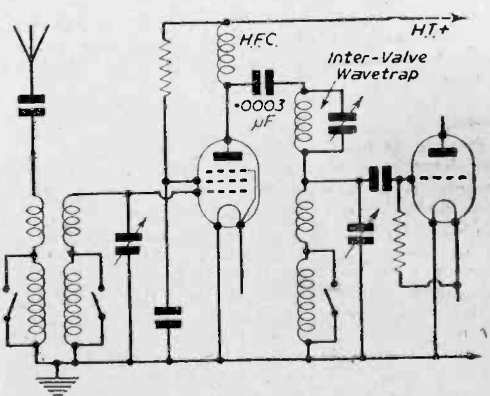


Fig. 4.—In this circuit the wavetrap is included in the H.F. coupling circuits.

In Fig. 3, L_2 is a coil with an inductance of about 175 microhenries for medium-wave rejection, or about 2,000 microhenries for long-wave rejection. The coil is tuned by a .0005 μF. variable condenser, which may be a pre-set. The coil, L_1, has about half the turns of the tuned coil, and the two coils are joined together at the bottom.

This arrangement has some merit in that it imposes very little restraint on the passage of frequencies other than the resonant frequency. It permits rejection to take place in the usual way, but because there is less copper wire between A and B it has very little effect on other parts of the spectrum than that of the rejection frequency.

It must not be thought, however, that the aerial circuit is the only place for a wavetrap. It may be just as conveniently placed in an intervalve position, and here it will perform its functions of blocking a transmission just as well as if it had been in the aerial. In fact, the writer once was puzzled by a pronounced "dip" in the sensitivity of a receiver when tested by a signal generator modulated by a 1 kc/s note. The injection was at the grid of the H.F. valve, so the possibility of any wavetraps was ruled out. It was eventually discovered that there was a wavetrap between the H.F. valve and the detector (Fig. 4) which had apparently been tuned to the local station. Unfortunately, the local station had since shifted its wavelength, but the wavetrap still acted as a trap at the original frequency, causing a dead spot. A dead spot can also be looked for in sets that have an aerial wavetrap, when the local station has changed its wavelength. Somtimes cases like this go undetected for years.

In Fig. 4, it will be noticed, the wavetrap is connected in series with the coupling condenser between the anode of the H.F. valve and the grid of the detector valve. This calls for little comment, save that the rejection takes place as usual by replacing the through circuit with a circulatory circuit at the resonant frequency. This applies equally well to a straight circuit up to the detector, or to a superhet up to the first detector. It could quite well be used in an H.F. transformer (Fig. 5), the wavetrap being in series with the primary.

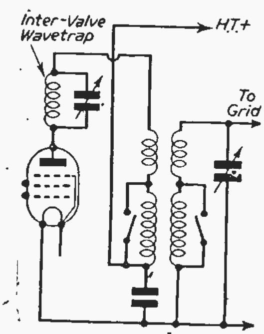


Fig. 5.—Another circuit in which the wavetrap is found between the H.F. and detector stages.

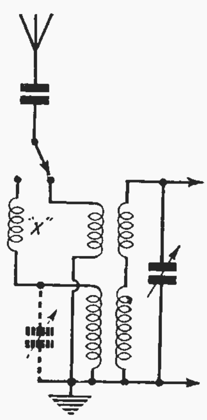


Fig. 6.—The use of an "anti-breakthrough" choke or coil is shown here.

However, such situations are hardly ever used, as the aerial situation does all that is required of it as a general rule.

Anti-breakthrough

Also belonging to this category is the anti-breakthrough coil or choke (Fig. 6). This is placed in position because, when the receiver is tuned to the long waves a certain amount of medium-wave breakthrough is experienced; particularly on the lower part of the band. The coil marked "X" is inserted in the long-wave winding, and consists of about 200 to 300 turns on a 1in. former. Sometimes a fixed condenser is inserted in the position shown in dotted lines, but it is really much better to use a pre-set of .0003 μF., as improved results are often obtained by varying this.

It will be seen that the combination results in a wavetrap of the acceptor type.

Sometimes with an efficient superhet distortion of the local stations occurs. The set may behave normally on stations other than the locals, or there may be whistles present on a number of transmissions. In such a case, a rejector wavetrap, tuned to the local station, may effect an immediate cure both of the overloading and of the whistles. For two or more local stations two or more wave-traps may be connected in series in the aerial lead.

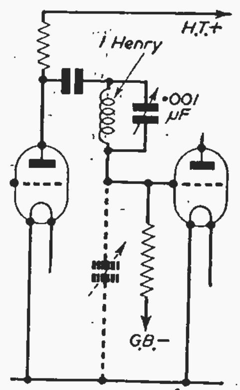


Fig. 7.—The trap circuit here is used to remove heterodyne whistles.

Scratch Filters

In dealing with the audio part of the spectrum to eliminate whistles or high-pitched reproduction or needle scratch, either an acceptor or rejector wavetrap may be employed.

For quality enthusiasts, such a wavetrap offers a far better solution to the problem of whistles and needle scratch than the conventional tone-control. For example, to remove a 9 kc/s whistle with condensers across the intervalve couplings or output valve would mean that all frequencies down to 2 kc/s would be so attenuated that the reproduction would be completely ruined. If a wavetrap is used, however, a sharp dip can be obtained at the requisite frequency without affecting the lower frequencies at all.

The constants are different from the usual wavetrap constants by an amount depending on the frequency to be eliminated. Generally, to eliminate a whistle of 8-9 kc/s a coil having an inductance of 1 henry is required, the condenser being a pre-set of .001 μF.

The best place for the wavetrap is in the anode-to-grid circuit of an R.C.C. stage, as shown in Fig. 7. The condenser shown in dotted lines (.0001 μF. to .0005 μF.) between the grid and the earth line is often an advantage in securing sharp rejection.

The 1 henry coil may be wound upon an old iron-core taken from a discarded coil, which materially increases the inductance.

Radio Valve Faults—3

Types of Fault and the Process of Fault Finding in the Modern Radio Valve

PART 2 of this series dealt with the matter of testing the emission of the valve, and this was dealt with in that article, as it became convenient to discuss the matter of emission whilst considering the cathode.

It was also mentioned that results of such a test could be misleading unless certain other matters were considered, and amongst these features the condition of electrodes in the valve other than the cathode came in for consideration.

In practice it is, of course, most desirable to check that the electrode assembly is without fault before attempting to test the emission of the valve. For instance, a control grid short-circuited to the cathode would obviously give a false reading of emission.

One of the first things we therefore require to know is that the electrode system is free from internal leakages or short-circuits, and this in itself presents a problem of testing which cannot be overcome by the simple use of an indicator and test voltage chosen at random.

A few comments concerning general insulation may not be out of place. The behaviour of various forms of insulation under test varies with differing materials. In the case of some insulators the leakage becomes almost directly proportional to the applied voltage. At the other extreme there are some forms of insulator which retain a high value of insulation until a certain critical voltage is reached, at which point they break down completely. There are also many insulators which fall between these two categories. In such insulators, the leakage is comparatively small at first, but becomes more rapid as the voltage is increased.

In testing insulation between the electrodes of a valve, one has to provide such conditions as will allow of a reasonable test whilst not endangering the valve.

There is also another very important matter to consider. In the case of directly-heated valves, especially of the miniature type, the clearances between the filament and the control grid are comparatively small, and the use of an excessive test voltage between these two electrodes may result in a sufficiently high electrical field strength to cause the filament to be physically drawn into contact with the control grid, with the result that a short-circuit is indicated which would not be present under normal conditions. It is important therefore to choose a test voltage suitable for the type of valve under examination.

Sensitivity

The sensitivity of the indicator then comes into the picture, as also does consideration as to how much leakage may be allowable.

It is exceedingly difficult to give a general answer to all queries that arise in regard to the conditions of this test, but with the above knowledge it is not too difficult to provide a test which will satisfy the majority of conditions for valves which are to be used for normal purposes.

Generally speaking, freedom from a very bad leak or actual short-circuit will be sufficient information and applied voltages in the case of battery valves of 50 volts and in the case of mains valves of 100 volts will be enough to indicate a fault without running an appreciable risk of damage.

It is probably unlikely that such tests will have to be made on sub-miniature valves such as those used for hearing aids, but in such cases it will be necessary to take particular precautions in regard to the test made between filament and control grid.

It is usual in many forms of valve testing apparatus to make such insulation tests by isolating one electrode at a time and testing its insulation in regard to the remainder. This is a useful method of carrying out such a test, as it indicates between which electrodes the short-circuit or leakage is present.

It is, of course, also necessary to know that all the electrodes in the valve are operative, and this is not at all an easy test to make. As a rule, it is possible to evolve some method of applying a suitable voltage to each electrode in turn whilst the valve is operating. The application of such a potential will alter the emission reading and thus give an indication that the electrode under test is properly connected. In applying such potentials it is, of course, important to ensure that their application does not cause the valve to operate under conditions which might damage it, or if added to the potentials already applied to the valve for the purpose of obtaining an emission reading, that they do not in total provide differences of potential between electrodes greater than those laid down by the manufacturer.

Misleading readings of emission can, of course, also be obtained by reason of the fact that the vacuum in the valve is no longer perfect. An indication of poor vacuum may, of course, be given by actual glow in the valve itself, and an interesting test can be made by observing if this glow can be deflected by a magnet held outside the bulb. If the glow can be deflected in this manner this shows it to be an electron glow which is unlikely to affect the operation of the valve, whereas if it is not affected by the magnet it is likely to be caused by ionisation, which is proof that the valve vacuum is no longer in proper condition.

A more scientific test would be by checking the amount of grid current flowing when the valve was put under certain operating conditions, but this test is one which it is not possible to undertake without the use of specialised apparatus and a knowledge of the permissible amount of grid current for each individual type of valve under test.

Whilst dealing with the electrode assembly, matters of microphony and noise come up for consideration. Whilst it is interesting to consider the possible causes of noise and microphony, it is not possible to give an indication of suitable test conditions for these faults, for which the apparatus in which the valve is used is probably the most convenient form of tester.

Microphony is, of course, caused by changes in the flow of anode current caused by variations in the electron stream due to mechanical vibration of the electrode system. Such variations must result from the conditions under which the valve is operating. For instance, a valve which exhibits microphony when placed in the immediate vicinity of a loudspeaker in the same circuit may exhibit no such symptoms when placed in another position in the apparatus. Again, the electrical conditions under which the valve is operating have an effect on the sensitivity to change of electron stream caused by mechanical vibration, so that we are driven to the conclusion that microphony is not a feature of the valve by itself, but a feature of the combination of the valve, its operating conditions, and the physical design of the apparatus in which it is used.

"Noise" in a valve may be the result of bad welds in the electrode structure, or in the case of valves used in the early stages of multi-stage receivers, it may actually be "electronic" noise caused by the bombardment of electrodes by the electron stream. This latter type of noise is, of course, a feature of the design of the valve, and special valves have been designed for use in multistage amplifiers, whereby such noise has been reduced to a minimum.

Noise due to bad welds in the electrode assembly of the valve comes under another category, but here again as in microphony, the test is best made with the valve in the receiver in which it is to operate, although even in such a simple test the valve should not be blamed without trial by substitution or a suitable test of the receiver itself. It is very easy to be misled in such a test by reason of the fact that in attempting to test for noise by tapping the valve whilst it is operating in the receiver, the resultant vibrations may easily be conveyed to a lose wire or some other component which is at fault.

On occasion it may be found that a valve which passes satisfactorily the checks so far outlined in these articles may be suspected of causing instability. This may be due to disconnected or high-resistance metallising. A test for this fault can be made from the appropriate pin to the metallising by means of any low-reading ohmmeter, but it should be remembered that some makes and types of valves employ a varnish or paint over the metallising which may cause some difficult in obtaining the necessary contact. A further cause of instability in some types of R.F. pentode may be a disconnection of, or intermittent connection to, grid 3. This is a most unlikely trouble in the case of pentodes in which G3 is internally connected to the cathode, but very occasionally in types of valves in which G3 is brought out to a separate pin, a dirty pin or other poor connection may result in such instability.

It will be appreciated from the information given in these articles that the effective testing of a valve, even from the point of view of a check as to whether it is in satisfactory condition for continued use in some apparatus in which it has been operating, is a complex problem requiring the use of somewhat elaborate and not inexpensive test apparatus and that, in general, it may be considered to be more satisfactory to have the suspected valve tested on apparatus which has been specifically designed for the purpose.

The Electrometer Valve

By E. G. BULLEY

VALVES of this type are to-day becoming popular in the various branches of scientific and industrial research where it is necessary to measure direct currents of a minute order.

Electrometer valves differ so much from the conventional radio valves with which the layman is familiar that a great deal of care must be taken not only in their design but in their manufacture.

The first important characteristic to which attention must be given is that the grid current of such a valve must be negligible. This, one will appreciate, is a difficult target to obtain.

Grid current is mostly the result of electrical leakage and the electron bombardment of the grid: in the latter case the electrons emitted from the filament strike the grid on their travel to the anode.

There are, of course, various other causes for grid current, and these all have to be taken into account when the electrometer valve is being designed. These causes include those of poor vacuum which would result in the ionisation of any residual gas in the valve. It is essential therefore that no gas must be present in such a valve, and it is for this reason that getters are usually avoided, because should the getter give off a little gas during the life of the valve, the emission of photo-electrons from the getter itself will result. Photoelectric emission can also result from the grid being subjected to too much light from the filament; dull emitter filaments are therefore found in most of these valves.

Leakage

Electrical leakage can be the result of the deposition on to the insulators of the chemical matter that is contained in the getter. This can be considered as another major point why getters are avoided if at all possible. This leakage problem is the main cause of currents flowing in the grid circuit; this, however, has been overcome by various manufacturers by careful insulation of the grid supports. The insulation of such supports is usually a tricky part of the actual valve assembly and is accomplished by covering the supports with quartz beads shrouded by glass tubing.

Should there be any likelihood of the deposition of conducting matter, the glass tubing protects the quartz insulators and so prevents electrical leakage.

Positive ions emitted from the filament will also result in grid current. To overcome this, various manufacturers insert what they call a space charge grid between the filament and the control grid. This space charge grid is usually maintained at a low positive potential and by this method emitted positive ions are prevented from striking the control grid. The space charge grid also prevents the electron bombardment of the control grid, so one will appreciate the care that must be taken in locating this grid.

It is as well to mention, however, that it is of the utmost importance that the grid is not subjected to high temperatures, otherwise grid emission will result. Furthermore, it does stress the importance of careful filament design, whereby the filament must be such that very little heat is radiated from it and at the same time satisfy the electrical characteristics of the valve.

B.B.C. Research Department

An Account of the Latest Engineering Developments at Banstead

AN account of the activities and aims of the B.B.C. Engineering Research Department was given recently by Sir Noel Ashbridge, the Corporation's Director of Technical Services. Broadly speaking, the function of the research department is to solve the problems that arise in improving and extending the service on both sound and television, and to investigate and evolve new ideas and techniques which may be applicable to broadcasting. Its activities cover every phase of broadcasting and include work on studio acoustics, microphones and loudspeakers, recording, aerials and transmitters, field-strength surveys and problems of coverage, v.h.f. broadcasting, and television. In the ordinary way, however, the work does not include the day-to-day problems of broadcasting.

The original home of the department was a converted convent in Nightingale Square, Clapham. During the war a medium-sized property on the outskirts of Oxford was acquired as well, and the work was carried on there and at Nightingale Square. At the end of war a search was made for a new headquarters large enough to accommodate the whole department, and in September, 1947, the choice fell on Kingswood Warren, Banstead. The B.B.C. immediately obtained an option to purchase, and by November, 1948, the first of the sections began moving in.

27 Acres

Kingswood Warren is about 20 miles from London, just off the Reigate road and, with its large house and 27 acres of grounds, makes an ideal headquarters for research. The house has been modified internally, and now accommodates nine laboratories, a television studio, a library, and a drawing office. In what were the stables there are now workshops and stores. As the house is not large enough to accommodate the whole department, a new building has been erected alongside it, and this will become the home of the television section as soon as it is ready—in September this year, if everything goes according to plan. Part of the electro-acoustics section will then move into the house, the remainder staying on at Nightingale Square until more building work can be undertaken.

Colour Television

Turning now to the work which is going on in the laboratories, the television section has on hand a full and varied programme. In the main this section is concentrating on a precise evaluation of the possibilities of higher-definition systems and colour. For this purpose a vision channel has been developed and built which can produce at will 405, 525, 625, or 819 line pictures having balanced horizontal and vertical resolution, and which can also be used for determining the effects of restricted band-width and other forms of distortion on pictures having these standards of definition. In addition, an experimental colour channel has been constructed in order that the engineers may gain first-hand experience of the potentialities and problems of colour television.

Of more immediate application are the experiments on co-channel interference between television transmitters. A thorough study of the interference resulting from transmitters on the same or neighbouring carrier frequencies has been made, and the criteria for successful channel sharing have been determined. These results are of immediate importance since the B.B.C. has at its disposal only five channels, which will eventually be shared between ten transmitting stations.

When the television section moves into the new building it will have at its disposal a studio comparable in size with the studios at Alexandra Palace The studio will be equipped with scenery and lighting so that cameras can be tested under realistic conditions.

Aerials

The development of the aerials for the new television transmitting stations and for v.h.f. broadcasting has been the aerial section's main task since the war. The aerials for both these applications—the ring system for television and the slotted cylinder for v.h.f.—were developed with the aid of small-scale models, thereby obviating the costly modifications which might have proved necessary had the full-scale aerial been built before experimental confirmation of its probable performance had been obtained.

The model television aerials were built to a scale of 1 : 7.5 and tested in the grounds at Kingswood Warren over the band 445 Mc/s. to 496 Mc/s. with equipment that the section had developed for the purpose. The use of small-scale models has been more than justified by the time and money which it has saved.

Another important activity of the research department, carried out by the field strength section, is the testing of sites for new transmitting stations. This is done by taking a mobile transmitter to the most likely sites and then touring the surrounding district with field-strength measuring equipment. With the information obtained in this way a field-strength contour map for the projected station is prepared, from which the probable coverage can be deduced. In prospecting for a television site, for example, a 1-kW transmitter is used with an aerial suspended about 600 feet above the ground by a balloon, or, in rough weather, supported on a 110-foot mast. The signal within the probable service area is then recorded continuously on a roll of paper as the field-strength van cruises round. By linking the recorder to the wheels of the van the movement of the paper is determined by the distance travelled, so that the signal strength recorded at any point on the paper can be related to a definite position on a map. At the moment the section is chiefly concerned with finding sites for new television stations, though some measurements of the field-strength of M.W. broadcasting stations are going on.

"YOU CAN RELY ON US"

FOR CLEAN COMPONENTS AT COMPETITIVE PRICES

IMMEDIATE DISPATCH

VALVES
EL33 10/- ; CL33, 10/- ; EF39, 10/- ; 12K7gt, 10/- ; U50, 7/6 ; KTW61, 7/6 ; W61, 7/6 ; X61M, 8/-.
These are Brand New, NOT Surplus. Many more types on our Valve List.

JACKSON SL8
Large glass scale MW/LW/SW new station markings, including complete drive. Spin-wheel control, glass and surround. 25/-.

COILS
Wearite "P" Coils. Full range stocked ; data supplied. Each 3/-.
Weymouth Coils. Full range stocked. Medium Wave (iron-cored) with reaction for P.W. Receiver. 3/6d.
TRF MW/LW with reaction winding, matched pair, 7/6d.

FILAMENT TRANSFORMERS
Midget type, finished in green crackle : 210/240v. Primary, 6.3v. 1.5a., 8/6d.
210/240v. Primary, 12v. .75a., 8/6d.
210/240v. Primary, 4v. 3a., 12/6d.

COIL FORMERS
Aladdin, ⅜in., 10d. each ; ⅜in., 7d. each with cores; ⅜in. with adjustable core, 9d. each.

VALVEHOLDERS
B7G (1S5 etc.), 1/- each ; B9G (EF50), 1/- Ceramic, I.O., 6d. ; M.O., 6d. ; B8A, 1/3d. ; UX, 6d. ; Loctal, 1/3d.

ALL VIEWMASTER AND HAYNES COMPONENTS for P.W. TELEVISOR.

Don't forget postage, chaps, and write for Catalogue No. 8 and Bargain Valve List. Price 3d.

RADIO SERVICING CO.

444, WANDSWORTH ROAD, CLAPHAM, LONDON, S.W.8
Telephone : MACaulay 4155
77, 77A Bus : 26, 28 Tram, S.R. Station, Wandsworth Road.

MAKE YOUR OWN E.H.T. UNIT

2,000-12,000 Volts.

We can now offer a range of R.F. E.H.T. coils and other components to cover this range together with full instructions for building.

Also complete units.

Prices :—

5.5 KV coil	22/6
5.5 KV unit	75/-
8 KV coil	30/-
8 KV unit	95/-

12 KV unit, use 8 KV coil with voltage doubler.

HAZLEHURST DESIGNS LTD.

34a, Pottery Lane, London, W.11.
'Phone : PARk 6955.

BEST BUY AT BRITAIN'S

Receiver Unit 25/73 (TR1196). Valve line-up : two of EF36, two of EF39, one of EK32 and an EBC33. Easily and rapidly converted to a very fine superhet receiver (see August, 1949, issue "Practical Wireless"). Supplied complete with necessary circuits and conversion data. In very good condition and offered at **22/6** post free.

Receiver R1155A. Aerial tested and perfect. **£9 10s.**, or packed in original transit case **£9 19s. 6d.** carriage paid. The specification of this justly famous 10-valve communications receiver is too well known to be repeated, but we can supply details and data upon request.

Power Pack and Output Stage for the R1155. Enables this receiver to be operated direct from A.C. Mains. Just plug in ! £3 10s. carriage paid.

Receiver type 6. Frequency range 3-7 mcs. Valve line-up : 5 of EF50, 1 of EBC33, 1 of EF36, and a 6K8. Slightly soiled externally. Only **29/6** plus 2/6 carriage and packing.

Medium-wave Command Receiver. Frequency range 200-600 metres. Valve line-up : 3 of 12SK7, 1 of 12SR7, 1 of 12K8 and a 12A6—all miniature types. Will readily convert into a car radio or domestic radio of outstanding performance. Unused and in excellent condition. Circuit diagrams provided. Super value at **£3 19s. 6d** plus 2/6 carriage and packing.

CHARLES BRITAIN (RADIO) LTD.
11, Upper Saint Martin's Lane, London, W.C.2. *TEM. 0545*
Shop hours, 9-6 p.m. (9-1 p.m. Thursday)
OPEN ALL DAY SATURDAY

L·R·S FOR PROMPT & EFFICIENT SERVICE

CASH OR EASY TERMS

When you purchase on L.R.S. Convenient Terms Formalities are reduced to a Minimum and you deal direct with us from beginning to end.

ARMSTRONG ALL WAVE CHASSIS

(incl. speaker and output transformer)

Model EXP 83/3. Cash £18/17/1, or £5 with order and 10 monthly instalments of 30/-.
Model RF 103/3. Cash £25/12/6, or £5/10/- with order and 11 monthly instalments of 40/-.
Model EXP 125/2. Cash £47/16/-, or £11/10/- with order and 10 monthly instalments of £4.
Model EXP 119 (less speaker). Cash £43/19/7, or £10 with order and 12 monthly instalments of 62/-.

Also available on our Easy Terms
Goodman's Loudspeakers
Hartley-Turner Loudspeakers
Wharfedale Loudspeakers
Leaflets available

Please let us know your Radio requirements (enclosing 2½d. stamp) and we shall be pleased to quote.

Personal attention to all enquiries.

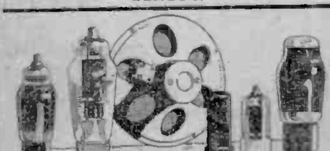
THE LONDON RADIO SUPPLY COMPANY Est. 1925

BALCOMBE, SUSSEX

STAN WILLETTS

SIX VALVE SHORT WAVE RECEIVER (TR9) 31-80 meters, complete with 6 battery operated valves, 3 VR22s, 2 VR18s, 1 VR118 or VR22, in working order, **12/6**, post 2/6.
R.F. UNIT, type 24, 12/6, post 1/6.
VIBRATOR UNITS, output 200 volts at 80 m/a, as new, **16/6**, post 1/9.
RECEIVER UNIT complete with 4 valves, 2 EF54s, EC52, CV66, as new, **19/6**, post 1/4.
PORTABLE TEST METER, 0-5,000 ohms, 0-60 m/a, 0-3 volts, brand new, **14/6**, post 9d.
CONDENSERS, new, 8 and 16 mfd. 350 v. wkg., **1/6** and **1/9** each. .01, .005 mfd. 450 v. wkg., **2/6** doz.
VALVES, 12A6, 1625, **7/6** ; 6SL7, 6SG7, **4/-**, 6K7, 6J7, **5/-**, SP41, **1/9**, 9D2, **3/6** each.
RECEIVER No. 18. Complete with 4 battery operated valves (6-9 mc/s), **15/-**, post 1/9. 5 pin 6 volt vibrators, **4/6**. Midget 5 H. chokes, 40 m/a, **2/6** each.

43, **SPON LANE, WEST BROMWICH, STAFFS.**



New and Boxed **VALVES,** 6/3 Post Free. 6V6, 6K7, 6K8, 6Q7, 6N7, 6F6, 6AC7, 6X5, 807, VU111, EF39, EBC33, EF36, 5Z4, 5U4. The following types at **7/3** Post Free. 6L6M, 80, 5Y3, 25A6, APV4, R3, IT4, 1S4, 1S5, 1R5, 3S4, 1C5. Rogers boxed EF50, **8/3**. Twin Meter Test Panel, comprising M/coil 0-5 m/a and 0-40v. Meters. Var. resistance stud control, 5-way Yaxley SP/ST Toggle ; 3 Potentiometers, etc. **12/6** Post free. One Valve Amplifier, containing EF36 valve, Relay unit, 2 transformers, Condensers, Resistors, etc., etc. Outstanding value at **8/6** Post free.

RADIO UNLIMITED, ELM ROAD, LONDON, E.17.

FIRST-CLASS RADIO COURSES . .

GET A CERTIFICATE!

QUALIFY AT HOME—IN SPARE TIME

After brief, intensely interesting study —undertaken at home in your spare time—**YOU** can secure your professional qualification. Prepare for **YOUR** share in the post-war boom in Radio. Let us show you how !

FREE GUIDE

The New Free Guide contains 132 pages of information of the greatest importance to those seeking such success-compelling qualifications as **A.M.Brit.I.R.E., A.M.I.E.E., City and Guilds Final Radio, P.M.G. Radio Amateurs, Exams., Matric., London B.Sc. (Eng.), A.M.I.P.E., A.M.I.Mech.E., Draughtsmanship (all branches)**, etc., together with particulars of our remarkable Guarantee of

SUCCESS OR NO FEE

Write now for your copy of this invaluable publication. It may well prove to be the turning point in your career.

FOUNDED 1885—OVER 150,000 SUCCESSES.

NATIONAL INSTITUTE OF ENGINEERING
(Dept. 461), 148, HOLBORN LONDON, E.C.1.

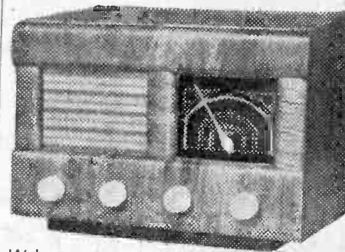
MIDLAND INSTRUMENT CO.

For New Govt. Surplus Stock

TRANSFORMERS (AUTO), 1.6 KVA., 230v. 1-phase 50 cycles, tappings for 40-80-110-120-150-190v. at 7 amps., 45/-, carriage 5/-. **TRANSFORMERS,** 0.4 KVA., tapped primary 180-200-215-230v. 1-phase 50 cycles, output 17.5v, tapped at 14v. at 20 amps., 35/-, carriage 5/-. **L.T. RECTIFIERS,** metal, full wave, 12v. 1¼ amp., with all data, 7/6, post 9d. **TRANSFORMERS,** input 210-230-250v., output tappings for 3-4-5-6-8-9-10-12-15-18-20-24-30v. at 2 amps., 20/-, post 1/-. **PARMEKO RADIO TRANSFORMERS,** drop through shrouded type, input 110-225-245v., output 250-o-250v. at 90 m/A., 5v. 2 amp., 6.3v. at 3 amps., screen, 17/6, post 1/-. **PARMEKO POTTED CHOKES,** 3.6 to 4.2 H. at 150 m/A., 20 H. at no D.C., weight 4 lbs., 7/6, post 1/-; ditto 100 H. at 10 m/A., 5,000 r.m.s., weight 1¼ lbs., 5/-, post 9d. **BELL TRANSFORMERS,** input 200/250v., output 4 and 8v. at ½ amp., 2/6, post 7d. **IMMERSION HEATERS,** 230v. A.C./D.C., 500 watts, fitted high grade thermostat which cuts out at 80 deg. C. and in at approx. 3 degrees less, 12/6, post 1/-. **ROMEC VACUUM PUMPS,** also suitable as air compressors, rotary vane type gives even pressure, fitted 2in. long ⅜in. dia. shaft, 15/-, post 1/3. **GENERATORS,** MK-11 "A", for electrical engine speed indicators, 10/-, post 1/-. **BOX KITES,** dinghy antenna type, 36in. x 17in. x 17in., flying cord and screw cap metal box container, 12/6, post 9d. **OIL TEMPERATURE GAUGES,** 0-100 deg. C., 40ft. flexible tube and mercury capsule, 7/6, post 9d. **TELESCOPIC DINGHY MASTS,** extend to 7¼ft., ⅝in. dia. tapers to 7/16in., ideal for T.V. aerials, microphone stands, fishing rods, etc., weight 6 oz., 7/6, post 6d., 3 for 20/-, post 9d. **SERIES MOTORS,** 12v. 20 amp. D.C., ¼ h.p., fitted ⅜in. dia. shafts, 7in. long, 4in. dia., an ideal motor for electric lawn mowers, etc., 15/-, post 1/4. **TELEPHONE SETS,** consists of 2 combined microphones and telephones, coupled with twin flex they provide Perfect 2-way communication, sound power, no battery required, with 25ft. twin connecting flex, 7/6, post 9d.

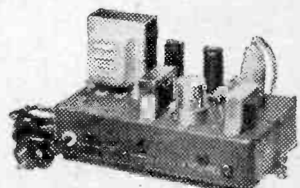
MOORPOOL CIRCLE, BIRMINGHAM 17
Tel. HARborne 1308 or 2664.

CABINETS & COMPONENTS



Walnut veneered cabinets approx. 12in. x 9in. x 7in. deep, **30/-.**

Any type of cabinets made to your specification. (Send a sketch and full details.) Send 2/6 for lists and blueprints to build either a T.R.F. or Superhet Receiver in above cabinet.



4 and 4½ watt **A.C. Quality Amplifiers** with neg. feedback from **£5 3s. 0d.** 5 watt Universal similar to above from **£3 16s. 6d.** 15 watt Universal Quality Amplifier with Push-Pull output and neg. feedback from **£9 15s.** Full details on request.

LEWIS RADIO CO. (Dept. K6),
322, High Road, Wood Green, London, N.22. 'Phone : BOWes Park, 5997.

DUKE & CO.
CLEARANCE

New Resistors, assorted, ¼ watt to 1 watt, 10/- 100, 5/6 50, 3/- 25. PHILCO TABLE CABINETS, NEW in brown bakelite, a few left only, 15/-, post and packing 2/6 extra. **Ex-Speaker Cabinet** walnut, metal grill, position for V/control, with baffle for 10in. speaker, OUR price 25/-, original price 5 gns.

H.T. Batteries, 180 v tapped 90 v, 21 v bias, 1½ L.T. All those tested so far are full volts. These are despatched in sealed case, but are not guaranteed. 5/6 plus 1/- post.

Speaker, new, in extension cabinet, 14/6.

Walky Talky's No. 38. All new valves, in first-class condition, one valve (ATP4) and switch (send-receive) only removed, 17/6 bargain. 200 only available now, circuit and switch connections supplied.

Short Wave No. 18 Superhet receiver complete and tested, free pair of headphones included for 17/6. NOTE set with little alteration makes first-class portable or car radio. IFs 465. Change to P. coils for medium wave.

Dunlopillo, 32 x 18 x 2 ins. 12/6 each, including post and 34 x 15 x 3 ins. tapered 12/6.

Dunlopillo seats, plywood backed, moquette covered. 12/6 plus 2/- post.

Plywood, 2ft. x 3ft., 3/- sheet ; 3ft. x 17in., 2/- sheet plus carr.

Rubber Dinghies, brand new, two pairs of paddles, repair outfit, inflator, etc., in two carrying bags. 90/- each. A few left only.

Special Valve Offer. 6J5GT/G or 6H6, 25/- doz., 2/6 each, brand new in maker's boxes. SP41, 25/- doz., 2/6 each. SP61, 35/- doz., 3/6 each. All tested.

Domestic Radio Kit in bakelite cabinet, 4-valve, T.R.F. Universal or (A.C. only) for only **£4 15s. 6d.**, or in Ivory 6/- extra. Assembled 30/- extra.

Speakers P.M. 2½in., 10/-. (Special super midget transformer, 6/6.) 5in. speaker, 10/-. 5in. with trans., 12/6 ; 6in., 12/6 ; 6in. with trans., 15/6 ; 8in., 15/6, with trans. 18/- ; 10in., 19/6 ; 12in., 35/6.

Cash with order, please, and allow sufficient for post. Stamps only for lists.

219, Ilford Lane, Ilford, Essex.

'GLOBE "JONRAD" SHORT-WAVE KING' REGD

"The World at your fingertips!" ★ Real LONG DISTANCE Radio Reception ★

SEND FOR **FREE** Copy of Catalogue (enclose 1d. stamp postage)

PROBABLY THE SMALLEST ONE VALVE SHORT-WAVE RADIO IN THE WORLD USING STANDARD PARTS WITH BANDSPREAD TUNING DEVICE

"Easy-Build" Kit COSTS ONLY COMPLETE **49/6d.**

★ MONEY BACK GUARANTEE ★ SENT ON APPROVAL

TRADE & OVERSEAS ENQUIRIES INVITED. WRITE TO:

JOHNSONS (Radio Specialists) **MACCLESFIELD** CHESHIRE (ENGLAND)

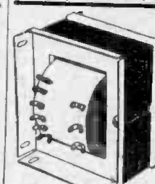
WALTON'S OF WOLVERHAMPTON!

2 Valve Mine Detector Amplifiers' a metal chassis approx. 11in. x 3½in. x 2in. and containing all you require for a Mains or Battery Amplifier, including 2 octol Valve Holders, Volume control, Inter-valve Transformer, 4 Mica and Paper condensers, 8 ½ watt Resistors, Valve caps, etc. All absolutely Brand New and contained in the actual sealed box as despatched by the Manufacturers.

Our Price for the complete Chassis **3/6** each or 2 for **6/-**. Carriage Paid.

HURRY ! Don't wait until it's too late ! They cannot last long at this price.

203, STAVELEY ROAD, WOLVERHAMPTON.



Mains Transformers
UPRIGHT—DROP THROUGH AS ILLUSTRATED
Two Types Only. Guaranteed.

No. 1 : 250-0-250v., 80 mA., 0-4-6.3v., 5 amp. 0-4-5v., 2 amp. No. 2 : Same, but 350v. Both 14/6, post 1/- for 1 to 3.

HILLFIELDS RADIO,
8, Burnham Road, Whitley, Coventry

FIXED CRYSTAL DETECTOR
THE CRYSTAL VALVE

as used in radar receivers.

Amazing Results

Size ⅝in. x ¼in., **3/6** each. Post 2½d. Protective Tube and Fixing Brackets, **3d.** extra.

Wiring instructions for a cheap, simple but high quality Crystal Set included with each Detector.

These Crystal Valves or Diodes are not Government Surplus but brand new goods manufactured by one of the largest and most famous Radar Equipment Manufacturers in the country. They can be used in any Crystal Set circuit and are fully guaranteed.

CRYSTAL SET

Incorporating Crystal Valve
Adjustable Iron-cored Coil
Reception Guaranteed
Polished wood cabinet, 15/- post 9d.

Send S.A.E. for lists of copper wires, screws, nuts, paxolin tubes, ebonite, tufnol rod and panels, etc.

Copper wires, 14 s.w.g.-48 s.w.g., in stock.

POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4

SUPACOILS
OFFER

★ **COILS.**—A complete range of High Q variable iron dust cored coils in wavelengths 10-30, 16-50, 30-75, 75-200, 190-550 and 800-2,000 metres : Aerial, H.F. or Oscillator.—**As recommended for the Practical Wireless 9 valve All-wave Superhet.** 3/- each

★ **MODEL 40** Coil Packs—superhet pack with R.F. stage, aligned. 57/6 inc.

★ **MODEL 30 TUNING UNIT,** consisting of 30 Coil Pack, pair of "M.M." I.F. Transformers, matched 2 gang and attractive dial. Components aligned together as a unit and sealed. 54/9 inc.

★ **MODEL 40 TUNING UNIT,** similar with R.F. stage. 86/3 inc.

★ **GRAMOPHONE MOTORS,** complete range available by all leading manufacturers from £5/3/6 inc.

★ **RECORD CHANGERS,** Collaro R.C. 500 automatic record changers, £10/15/- : Plessey auto changer, plays 10in. and 12in. records mixed, £18/6/8.

★ **PICKUPS,** B.T.H. magnetic, £2. B.T.H. pezolectric, £3/12/9. Goldring model 100, £1/16/2 ; Model 122, lightweight, £2/10/2 ; Model Royal Lightweight, £1/10/4.

★ **FREE. Home Constructor's Handbook,** containing 11 tested circuits forwarded **Free** with orders of 20/- or more, or obtainable for 1/6, from :

SUPACOILS, MAIL ORDER OFFICE
98, Greenway Avenue, London, E.17

Programme Pointers

This Month MAURICE REEVE Deals with Some More Recent Programmes

I AM glad to notice that I am by no means the only radio critic who deplores the licence given to B.B.C. variety artistes to joke and crack about each other.

Nepotism is scarcely too strong a word to describe the pitch at which it has arrived. Very few of them are exceptionally witty, and it looks like a heaven-sent chance of each keeping the other names before the enormous listening public at moments when he or she does not happen to be in the bill.

It cannot even be labelled "advertising," inasmuch as no one is ever praised, and no hint is given as to the whereabouts of the subject at the time. But, like many a poster containing no specific information, it is there for all to see, its sole object being to prevent your forgetting that certain article even for the solitary afternoon you may have chosen for a run out into the country. Just as the poster helps materially to ruin the countryside, so does the —alleged—joke help to ruin the music-hall and kindred programmes; at any rate when it is taken to its present lengths.

"A Play for Ronnie," by Warren Chetham Strode, was a long way behind "The Guinea Pig," and others of Mr. Strode's recent efforts. The story concerned a leading actor married to a leading thriller writer, each of whom wants a new subject with which to enhance their reputations. When a spurious couple invite themselves in, on the pretext of getting hold of the actor's valuable collection of coins, the two plots are provided in unexpected ways. Mildly amusing and entertaining. I do hope it doesn't reappear in a year or two.

Mrs. Cheyney

Frederick Lonsdale's famous play of the twittering and tipsy 'twenties, "The Last of Mrs. Cheyney," is, on the other hand, always welcome, at polite and discreet intervals, and providing it is re-cast and re-produced, as all radio drama should be—excepting one or two outstanding productions. This revival had the enchanting Googie Withers in the leading role. Miss Withers conveyed plenty of Mrs. Cheyney's subtlety and charm plus plenty of her own which, alas, cannot be given to us in full measure without an eyeful of her.

An Irish version—styled "The Light of Other Days"—of Chekhov's "The Cherry Orchard" was, I think, a mistake. The cherries were not even canned or made into a flan, they were just not cherries. Might as well a German Lorna Doone, or a Scottish Madame Bovary. The object of the adaptation, I'm afraid, quite passed me by. Fay Compton saying "Nothing seems changed—you wouldn't dream it was five whole years since I left school," left me feeling a bit cynical.

"Music in Miniature"

"Music in Miniature" is a peculiar entertainment. It has been running now for some considerable time and many of the biggest names in music appear in it. So presumably it has a sufficient number of fans to satisfy its sponsors. Whilst I take no objection to having to wait till the end of the programme to know the name of the piece with which I have been regaled, the whole thing leaves me curiously unsatisfied. I particularly dislike the single movements from major works. And no programme I know takes longer to sign on and, more particularly, to sign off. It is interminable. Not satisfied with having saved time with item announcing during the show, there is so much left over on hand at the end that the signature tune—don't be angry, Mozart, at the use made of one of your loveliest melodies—has to be played through three and four times.

Why music in miniature, anyway? Why not anything else in miniature as well? Why not music in gigantic proportions? And how can one movement from a sonata or a quartet, wrenched out of its context, be a miniature? A miniature what? Perhaps a miniature outrage.

A.T.S. Girl

When on the subject of plays, I should have mentioned that "A Play for Ronnie" contained the character of an ex-A.T.S. girl employed by the leading protagonists as a servant, who couldn't forget her army habit of having to salute her superiors whenever they addressed her. The result was that, whenever the master or mistress rang for her, from the drawing-room or wherever it might be, there was a click of the heels and a salute both on receipt of the summons and on departure to execute the commission. Mr. Strode, sir. I not only flatly refuse to believe that such a woman ever existed, but, if she did, that she wasn't righteously and mercifully murdered.

There was a very bad piece of timing on June 4, when the Sunday evening symphony concert, running from 6.15 to 7.45, overlapped the London Phil. concert, under Koussevitzky, from the Albert Hall, timed to commence at 7.30.

Few things are more boring than to listen to two news bulletins, the second of which is a word for word repetition of the first. This occurred recently, and it struck me as being an eminently reasonable suggestion that, on these occasions, the announcer, after reading the headlines, be instructed to say that nothing having occurred since the last bulletin was read, he would play some records.

"In Case. . ."

The B.B.C. must realise that, because two or three people may have missed the reading of the earlier announcement, they are not entitled to have the entire thing read out again. The idea is fantastic to a degree. The sporting commentaries, especially cricket, are back with us again, and the repetitions of the score cards and details are even worse than last year. "In case those of you who have just come in to your lunches missed the score card when I read it just now, here it is again." And "in case this," "in case that," and "in case the other" goes on all day long. If only everything else in life that we miss one minute were placed at our elbow the next, what a wonderful world it would be.

Scrapbook

The fault with "Scrapbook for 1904" lay rather with 1904 than the production. which was on the consistently high scrapbook level. What a quiet and uneventful year it was, and what an unbelievable life it was then. Easily the two outstanding events—and they would have been outstanding in any year—were the inauguration of Cecil Sharp's monumental collection of British Folk Music, and the first performance. at a promenade concert, of Debussy's immortal "l'Apres Midi d'une Faune."

The Sunday evening series of Childhood Memories, opened by James Stephens, promises to be delightful. "An Ideal Husband," with Fay Compton as Mrs. Cheveley, was capital, and Wilde's epigrams came over with all their sting and barb. I also enjoyed the latest in the "London Bus Ride" series.

News from the Clubs

THE BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: L. Hobden, 17, Hartington Road, Brighton.

THE club remains active although, as expected, attendances have dropped off due to holidays and other outdoor attractions. Several visitors from other clubs have come along while on holiday and got to grips with the local "hams." The club TX has been on the air and produced some nice 'phone and CW q-o's. Future programmes include a talk on the "Q-meter" and an exhibition of SWL and QSL cards.

STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: W. A. Higgins, 28, Kingsley Road, Kingswinford

MEETING held at King Edward VI School, Stourbridge, on Tuesday, July 4th, 1950. Bernard Whitehouse, G6WF, gave a very instructive talk, with demonstration on Directional Antennae. Meetings first Tuesday and third Friday in each month.

COVENTRY AMATEUR RADIO SOCIETY

Asst. Sec.: J. H. Whitby, c/o 11, St. Patrick's Road, Coventry.

ATTENDANCES at the fortnightly meetings of the society are high in spite of the holiday season.

Recent events included a lecture and demonstration by the Radiomobile Division of E.M.I., Ltd., a discussion on "The Lessons of Field Day" and a highly successful "Junk Sale."

Future meetings—at which new members will be cordially welcomed—take place at the B.T.H. Social Club, Holyhead Road, at 7.45 p.m.

September 11th. "Junk Sale" (Yes—another one!)
September 25th. Annual General Meeting.

The M.A.R.S./C.A.R.S. Team Contest will be held on October 15th, this year, and it is hoped to arrange a M.A.R.S./C.A.R.S. Field Day in the near future.

WATFORD AND DISTRICT RADIO AND TELEVISION SOCIETY

Hon. Sec.: R. W. Bailey (G2QB), 32, Cassiobury Drive, Watford, Herts.

RECENT meetings have included lectures in "A Course in Radio Fundamentals," being given by G2HAR; "Frequency Movement," by G2QY; and "Safety Precautions," by G2QB. Meetings are being held twice monthly on the first and third Tuesdays in each month, at the Cookery Nook, The Parade, Watford.

Future meetings will include lectures on Oscilloscopes, Radio Instruments, and 144 Mc/s work.

Visits are being arranged to points of interest in the vicinity, including the local telephone exchange, and an excursion is to be made outdoors with a hidden transmitter hunt.

Attendances continue to be good, and the membership is increasing steadily.

Participation in N.F.D. was much enjoyed by all the members who took part, and the sound organisation which had been done was brought out by the fact that no mechanical or electrical faults occurred.

TEES-SIDE AMATEUR RADIO SOCIETY

Hon. Sec.: J. H. Davey, 85, Cobden Street, Thornaby-on-Tees.

IT was decided that on account of members' holidays, etc., the club's summer recess would be from June 8th to September, 1950. National Field Day went off without a hitch except for a two-hour tussle with the petrol generator, but after that everything settled down. The club think that they have well beaten their last year score. The station's calls were G3YP/P and G3CFC/P.

WAKEFIELD AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: W. Farrar (G3ESP), "Holmcroft," Durkar, Wakefield.

THE society, which was inaugurated early this year, has a membership now of 34, including 10 licensed amateurs. The winter meetings were successfully concluded, and during the summer informal meetings are being held at Carr Lodge Cafe, Horbury. Proposed future activities include visits to the B.B.C., Moorside Edge, and one or two manufacturers; a field day and a social outing to Knaresborough. Slow Morse practice transmissions are made at 7.30 p.m. on 1,850 kc/s on Monday, Tuesday, Thursday and Friday by G2AQN, G2AVK, G3ESP and G3DMP respectively.

WARRINGTON AND DISTRICT RADIO SOCIETY

Hon. Sec.: J. Speakman, Dark Lane, Whitley, Warrington.

PROVISIONAL arrangements have been made for a local inter-club "Top-Band" telephony contest to be held on Sunday, September 24th. Operating periods will probably be from 3-5 p.m. and 7-10 p.m., and there will be a section for listener members.

In the near future G5LZ and G3BAK, who were the first to make two-way contact in this country on 3 cms., are to give a working demonstration of their gear.

LUTON AND DISTRICT RADIO SOCIETY

Hon. Sec.: E. Radford, 37, Wilesden Avenue, Luton.

NEW members are especially invited to attend meetings every Monday evening at 7.30 p.m. at Surrey St. School. An interesting programme of lectures, demonstration and visits has been arranged by the committee, but it is evident from visits to the local junk shops and dealers in components that many of local readers do not know that the club exists.

RICHMOND AND DISTRICT RADIO SOCIETY

Hon. Sec.: W. Crossland, 1 Spring Grove Road, Richmond, Surrey.

MEMBERS of the Richmond and District Radio Society and their friends attended the final function of the present session at the National Physical Laboratory on Saturday, July 8th, by kind permission of the Director. Many activities of the establishment were explained and demonstrated, but particular interest was shown in the array of apparatus used for the location of thunderstorms and in the technicalities of the ACE electronic computing machine.

Meetings and other activities of the society are now being arranged for the 1950/51 session and any interested readers are invited to communicate with the honorary secretary at the above address.

THE LOTHIANS RADIO SOCIETY

Sec.: I. Mackenzie, 41, Easter Drylaw Drive, Edinburgh, 4.

THE first meeting of the 1950/51 season will be held on Thursday, September 7th, at 25, Charlotte Square, Edinburgh, at 7.30 p.m., and thereafter at fortnightly intervals throughout the season—dates for September/October are the 7th and 21st and 5th and 19th.

An interesting and extensive programme is planned covering a wide range of subjects. Morse classes will be held at every meeting.

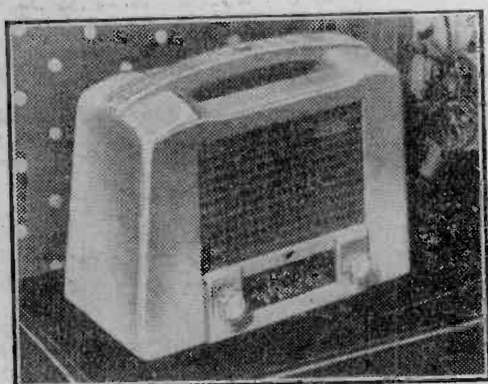
In anticipation of the forthcoming TV service in this area a series of lectures will be given by GM3BBW, taking the members step by step through the construction and alignment of a TV set of efficient design and suitable for the home constructor. (In fact, the series is so arranged that construction can be undertaken by anyone who can use a few tools and read a diagram.) The society extends an invitation to new members to attend these meetings.

News from the Trade

A New Ekco Transportable

E. K. COLE, Ltd., announce the release of an attractively priced transportable five-valve A.C./D.C. superheterodyne receiver for medium and long waves, housed in a "one-piece" thermoplastic moulded cabinet with carrying handle. An efficient in-built twin aerial system ensures excellent sensitivity. Permeability tuned, high Q coils, are used in the I.F. amplifier, consisting of four tuned circuits.

A double-diode-triode constitutes the detector, A.V.C. rectifier and low frequency amplifier which



The new Ekco Transportable. The speaker fret is repeated on the other side.

is resistance-coupled to the output stage. Selective negative feed-back is used to ensure the best quality reproduction.

The size is approximately 11½in. wide x 6in. deep x 9in. high, and the weight approximately 9 lb. List price, £12 1s. 7d., purchase tax £2 12s. 5d.

E. K. Cole, Ltd., Ekco Works, Southend-on-Sea.

1950 Mullard Valve Wall Chart

THE Valve Sales Department of Mullard Electronic Products, Ltd., announce that the 1950 edition of the well-known Mullard Wall Chart, has recently been circulated to the trade.

This is similar in form to the previous issue, but embodies a number of additions and improvements many of which were the outcome of recommendations from the trade. These additions and improvements are briefly as follows :—

1. New valves which have appeared during the past year have been included and particularly the Noval based range.
2. The screen grid current for each valve has been included for the first time and this, it is considered, will be of particular value to service engineers.
3. A list of photocells and flash tubes is included with typical operating conditions.
4. All the base diagrams have been re-drawn in such a way as to facilitate reference.
5. The equivalent and substitution lists have been considerably enlarged.

Mullard Electronic Products, Ltd., Century House, Shaftesbury Avenue, W.C.2.

New Aerials for Car Radio

LEE PRODUCTS (Great Britain), Ltd., announce the introduction of a range of "Elpico" telescopic car radio aerials. These aerials are finished in heavy chrome-plate on brass and three types are available—side fitting, roof fitting and wing or scuttle fixing, as follows :

Type CA/2 for side fitting, extends in three sections to 5ft. Retail price, 26s. 6d.

Type CA/5 for roof fitting. Spring loaded with one hole fixing. Extends in two sections to 2ft. 6in. Retail price, 33s. 9d.

Type CA/7 for wing or scuttle fitting with one hole fixing. Extends in three sections to 5ft. Retail price, 33s. 9d.

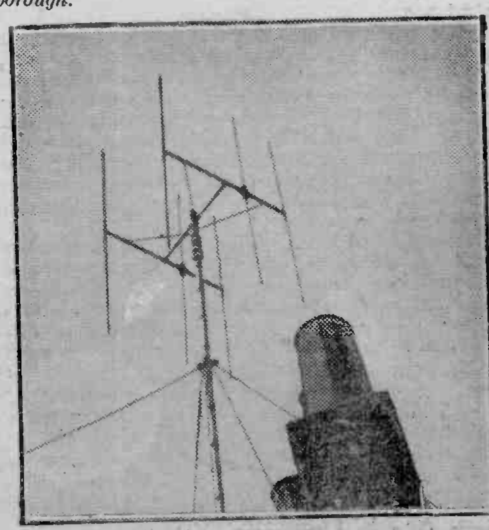
"Elpico" car radio aerials are available through the usual trade and retail channels.

Lee Products (Great Britain), Ltd., 90, Great Eastern Street, E.C.2.

Fringevision Aerials

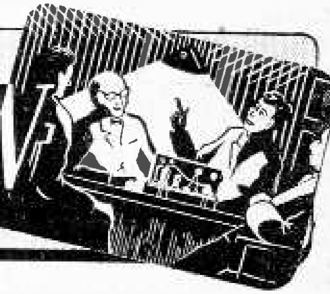
VARIOUS suggestions have been made from time to time to improve the strength of signals received in fringe areas, and an article was recently published in these pages dealing with the question. As a result we have received from Fringevision Aerial Service, details of a twin aerial system which they have developed. It consists of a twin "H" aerial and retails at £6 15s. As a further step they experimented and produced a twin six-element aerial (illustrated on this page), primarily for dealer demonstration purposes.

Fringevision Aerial Service, Angel Yard, Marlborough.



The twin "H" aerial produced by Fringevision Aerials.

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).

Magnetic Recording

SIR,—Our attention has been drawn to an article in your July issue on Magnetic Recording in which your contributor uses at the end of his article the term "tape-deck" as though it were merely the name of a piece of apparatus and then refers to the "tape-deck" of our manufacture.

We should like to point out that "Tape-Deck" is our registered trade mark, registered in respect of magnetic recording apparatus, and we would appreciate your co-operation in avoiding as far as possible misuse of our trade mark. We feel that it might cause embarrassment or difficulty to your readers and to those firms who advertise in your journal if they were encouraged to believe that Tape-Deck is a conventional term for a magnetic recorder, and for our part we are, of course, anxious to ensure that this trade mark is not invalidated in this way.—For WRIGHT AND WEAIRE LTD., R. W. MERRICK (Director).

"Impedance Meter"

SIR,—I was indeed surprised to read the article "An Impedance Meter" on page 304 of the July issue. The basis of the proposed meter is to apply a potential of 100 volts A.C. (range A) or 10 volts (range B) to a circuit consisting, on range A, of a 100kΩ resistor plus the unknown impedance in series with the milliammeter. So long as the unknown impedance is a resistor this method will be reasonably satisfactory (though it can never be very accurate, since the current drawn by the circuit will vary with different values of unknown impedance, and hence the voltage drop through R_1 and VR_1 will also vary). If, however, the unknown impedance is a capacitor or inductor, the meter will be wildly inaccurate. If the reactance of the unknown impedance is denoted by X ohms, the circuit assumes that the reactance of the series resistor and the unknown impedance together will be (100,000+X) ohms. In fact, of course, the total reactance (from first principles) is $\sqrt{100,000^2+X^2}$ ohms. A capacitor of 0.1μF has a reactance of about 30,000Ω at 50 c/s: tested on this meter it would have an apparent reactance of about 4,000Ω and consequently an apparent capacitance of 0.8μF.

There is a further source of error in the proposed circuit. An L.F. choke of 10 henries has a resistance of 3,000 ohms at 50 cycles; but a typical component will also have a D.C. resistance of 1,000 or 1,500 ohms. The meter will measure both together, and the result will not be an accurate measure of the inductance of the choke.

I suggest your readers use the old-fashioned bridge, which can easily be made by an amateur to give an accuracy better than 5 per cent.—C. P. SCOTT-MALDEN (S.E.21).

I.F. Gramo. Reproduction

SIR,—The article on I.F. gramo. reproduction by W. Nimmons that appeared in the June issue calls for some comments.

Firstly, an important point which was not mentioned is the percentage of modulation. Having generated the carrier at the I.F., it is necessary to modulate it with the output of the pickup to a maximum of about 100 per cent. An under-modulated carrier will give a weak "programme" output from the loudspeaker, accompanied by a relatively strong hiss, whilst an over-modulated signal will give rise to bad distortion. In the circuit of Fig. 5 the amplitude of the carrier could be varied over a small range by adjustment of the 50pF preset capacitor in the anode of the valve, to suit the modulation. If the pickup output were too great it could be attenuated in a conventional manner before feeding into the mixer.

Secondly, I must heartily refute the statement that ". . . the quality of reproduction with the radio method is superior to that of the orthodox L.F. method," and for the following reasons. In a correctly aligned superhet with the usual I.F. of 465 kc/s, and assuming two critically coupled I.F. transformers, with a Q of 150, the response at only 3 kc/s off resonance can be 15 db. down. Now the requirement for even mediocre reproduction is a reasonably level frequency response from about 100 to 5,000 c/s, whilst for good fidelity up to 10-15 kc/s is highly desirable.

The loss of higher audio-frequencies could be remedied, after a style, by reducing the low-frequency response of the L.F. stages, but this would entail quite a loss of gain, probably necessitating an extra stage of amplification.

So it seems to me rather pointless to use extra switches, coils and capacitors just to use all the valves in a superhet for the reproduction of gramophone records, especially when the quality is inferior to that obtained with the orthodox method. —A. S. FITCH (G3FPK) (E.10).

Impressions on the Wax

Review of the Latest Gramophone Records

THE combination of Wilhelm Furtwangler and the Vienna Philharmonic Orchestra is a guarantee of brilliant interpretation put into practical effect. For something like 40 years Furtwangler has been in the forefront of continental conductors. For their latest recording they give a fine performance of Mendelssohn's "Fingal's Cave" overture, given the alternative name of "The Hebrides." It was first written in Rome in 1830 and is one of the finest descriptive writings of the sea—*H.M.V. DB*6941.

The famous Austrian conductor, Karl Bohm, is famed as an interpreter of Mozart and Richard Strauss, and in choosing Mozart's attractive Rondo from the "Haffner Serenade" for his latest recording he will be treading favourite ground. This is another fine recording by the Vienna Philharmonic Orchestra on *H.M.V. C*3990.

In his day, before the end of the last century, Von Suppé was a man of some importance. To mark the fact, a monument in Vienna and a broad thoroughfare were named after him. To-day his fame rests almost entirely upon the overtures "Light Cavalry," "Poet and Peasant" and "Morning, Noon and Night in Vienna," the best known items from a composer who wrote over two hundred one-act operettas alone, apart from a large catalogue of other works. The versatile Constant Lambert, together with the Philharmonia Orchestra, give a satisfying performance of "Morning, Noon and Night in Vienna," on *Columbia DX*1665, and does the composer considerable service in the process.

One of the highlights among recent releases is the first recording of Haydn's "Symphony No. 83 in G Minor ('La Poule')," by Sir John Barbirolli, conducting the Hallé Orchestra on *H.M.V. DB*21076-8.

Revised Spmphony

Vaughan Williams' "Symphony No. 6 in E Minor" was acclaimed as a masterpiece when it was first introduced in 1949. In spite of this overwhelming mass of opinion, the composer had the courage to say he was not really satisfied with the Scherzo movement. He has now made alterations to the score and, in fact, several performances of the symphony with the new version of the Scherzo have taken place. It should be understood that the composer has not rewritten the movement, but has written in extra parts. "His Master's Voice" recorded this symphony very soon after it was written and issued in July, 1949. Since the development referred to above, the new version of the Scherzo movement has been recorded and henceforth records of the original version will not be supplied. The record number has not changed and all records supplied by H.M.V. in future will be of the new version—*H.M.V. C*3873-6.

Vocal

At the age of 60, Beniamino Gigli stills holds a unique position. In Britain he has been a household name for twenty years, and has made personal appearances several times since the war. His tenor voice has been employed for the vast majority of Italian operas, and for his latest record he has chosen an aria from Giordano's "Marcella." On the reverse side is the "Serenata" by the same composer—*H.M.V. DA*1925.

Tano Ferendinos, a British subject by birth, made his first concert appearance at the Royal Albert Hall in September, 1947. He has also televised, given many recitals for British and American troops, has broadcast, appeared in a series of concerts with the London Philharmonic Orchestra and had the distinction of singing with Grandi in opera. His fine voice can be heard on *H.M.V. B*9934 singing two well-known songs—"Dream of Olwen" and "My Heart and I."

The re-issue on *H.M.V. BD*1246 of the Irish songs "The Spinning Wheel" and "Three Lovely Lassies," sung by Delia Murphy, has rekindled a desire for other airs recorded by this artist. To meet this demand she has now made a recording of "If I Were a Blackbird" and "Down by the Glenside," on *H.M.V. BD*1237.

Variety

"Oh! You Sweet One" and "Dearie" are two American songs that have been wholeheartedly adopted by the British public. All who have favoured the many broadcasts given these fine tunes will particularly welcome their recorded presentation by Donald Peers on *H.M.V. B*9933.

The score of "Carousel," which is the latest American musical to appear in London, contains one of the best of all the Rodgers melodies, "If I Loved You." It has now been recorded by Frank Sinatra on *Columbia DB*2705 together with "You'll Never Walk Alone."

Ever since "Daddy's Little Girl" was first heard over the radio, requests have been piling up for recordings of this attractive little song. Steve Conway obliges on *Columbia DB*2703 with "It Isn't Fair" as a coupling.

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

R.S.G.B. "Amateur Radio" publications: Transmitting Licence, 32 pp., **1/-**; Service Valve Equivalents, 32pp., **1/3**; Transmitter Interference, 32pp., **1/6**; Simple Transmitting Equipment, 52pp., **2/3**; Microwave Technique, 68 pp., **3/9**; Receivers, 96pp., **3/9**; Valve Technique, 104 pp., **3/9**; V.H.F. Technique, 96 pp., **3/9**; 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.

ALIGNMENT PEAKS. Second edition, 5,000 superheterodyne alignment peaking frequencies, **4/9** post free. The Practical Radio Engineer, quarterly publication of the Institute, sample copy **2/-** post free. Membership and examination data **1/-** post free. Secretary, I.P.R.E., 20, Fairfield Road, London, N.8.

BRITISH SHORT WAVE LEAGUE, founded 1935, world-wide membership. Monthly publication, "B.S.W.L. Review" (members only), covering all short wave radio interests. Many services and activity departments. Full information on application to: B.S.W.L., 53, Victoria Street, London, S.W.1.

A PORTABLE TELEVISOR, 14 valves (all cut price types) on a 12in. x 3½in. x 2½in. chassis—that gives some idea of the design work in our remarkable **Portable Televisor**. How is it done? The complete details are given in our **56** pp. fully illustrated book at only **3/2** post paid. The set may be used in either TV area, and may contain either a 3in. or 6in. tube. Why not try "Personal Portables" too, at **2/8** post paid; judging by many congratulatory letters you won't regret it. BRADBROOKS, Sennen, Penzance, Cornwall.

MIDDLESBROUGH . . . Large stocks of Denco—Osmor—Eddystone—Raymart Coils and Components. All Bernards Manuals at PALMERS, 114, Waterloo Road.

TELEVISION COILS for TRF or Superhet Aerial, HF., Oscillator and Vision Single Winding, **2/-** each; other types up to **7/6**. London and B'ham Pre-amplifier, suits any set, complete **27/6**. RADIO MART, 22, Tubwall Row, Darlington.

POTS., 2K, 5K, 10K, 30K, 100K, ½M, 1M, 2M (no presets), **1/6**; 100 Kc/s Xtal, **20/-**; Xtal Diodes, **3/-**; Valves: EF50, 5Z4, 5U4G, EL50, U10, 2X2, 6F6G, 6G6G, 6K7G, 6N7GT, 6AG7, 6SA7, 6SL7, 6SG7, 6SN7, 7V7, 7Q7, VR105, VR150, 1T4, 9003, at **5/6**; VR92, 6H6, VR54, at **2/-**; 954, 955, at **4/-**; 6AC7, 6J5GT, ML4, at **4/6**; 6V6GT, EBC33, at **6/6**; 6L6G, 807, PX25, at **10/-**. Post 6d. under 20/-. Stamp for list. R.T. & I. SERVICE, 254, Grove Green Rd., London, E.11.

VACUUM CLEANERS and Gram. Motors, repairs our speciality. Armature rewinds, new bearings and commutators fitted, also transformers rewound, speakers repaired. Competitive prices. Trade enquiries invited, 2 to 5 days c.o.d. service. Send s.a.e. for price lists to: A.D.S. CO. (V.E.M. Dept.), 261-3, Lichfield Road, Aston, Birmingham, 6. Est. 1935.

YOU are bound to try an Osmor "Q" Coilpack eventually and be delighted with the results. Why not save time and money now? Send a stamp for free circuits and latest lists of coils, coilpacks, dials, etc., etc. OSMOR RADIO PRODUCTS LTD. (Dept. P.C.A.), Borough Hill, Croydon, Surrey (Tel.: Croydon 1220.)

BEL.—For all Tele. Coils; London Type EE **15/-**, V/M **19/6**, PW **16/6**, WW **48/-**; Midland Type EE **18/6**, V/M **19/6**, PW **19/6**, WW S'het, **52/6**, WW, EE, PW Chassis. Special Coils to order. Trade supplied. BEL SOUND PRODUCTS, Marlborough Yard, Archway, N.19.

RATES: 4/- 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.

RADIO HARDWARE in 1/- packets.—3-pt. Tag Strips; Mounting Boards; Fuse Holders; Spindle Couplings; Eye Bolts; 2, 4 or 6BA Bolts; Shakeproof Nuts; 2, 4 or 6BA Studding; Grommets; Solder Tags; Pin Tags; Spade Tags; Tinned Copper Wire, 16, 18, 20 or 22 swg.; Sleeving, 1, 1½ or 2mm; Resin Cored Solder; 14/36 Single Flex (6 colours); Single or Twin-screened Flex; Ae/E Socket Panels; Voltage Change Panels*; Ruby Indicator Lamps*; Jack Plugs*; Jack Sockets; 5-amp. Plugs; BC Adaptors; Flex Connectors; Flexible Couplers; Grid Caps Octal or Standard; Insulated Tape; Insulated Staples; Co-ax Wiring Cleats, ½in.; Pointer Knobs; Plain Knobs. All packed in generous 1/- packets (*these items **1/-** each), 12 packets **10/6** inc. post, 25 packets **£1** post free. Any type or assorted as you wish. See our lists, free on request, for many other items. FRITH RADIOCRAFT, LTD., 69-71, Church Gate, Leicester.

PRACTICAL WIRELESS TELEVISOR Aladdin Formers, **10d.** each; Tag Ring, **2½d.**; Set of Coils (London or Birmingham), **16/6**; Chassis, **£4**; Mains Transformer, 350-0-350v 250ma, 5v 2a, 6.3v 4a, 6.3v 4a, **68/6**. S.A.E. list. R. F. SHILTON, 19, Clarendon Rd., Salisbury, Wilts.

PHOTO-ELECTRIC meter components: Selenium Light Cell, **6/6**; Micro-amp. Meter Movement, **10/6**; Perspex Case, **10/-**; Assembly Instructions, **2/6**. All standard Photo-Cells in stock, s.a.e. for details. G.R. PRODUCTS, 22, Runnymead Avenue, Bristol, 4.

VALVES (all new/bxd.).—6AC7, 6F6, 6J7, 6K7, 6K8, 6N7, 6Q7, 6V6, 6X5, 5U4, 5Z4, EBC33, EF36, EF50, 807, KTW61, 6J5GT, VU111, U17, CV73, 8D2, at **6/3** ea.; 1S4, 1S5, 1R5, 1T4, 3S4, at **7/6** ea. Speakers, all PM less/tran., 3in. **12/9**, 3½in. **14/11**, 5in. **10/6**, 6½in. **11/9**, 8in. **12/9**, 10in. **14/9**. Vol./Cntls., **25K** to 2M, less/cw., **2/9** ea. With/sw., **4/-**. 2½in. Spindle Mgt. Output Trans., **4/-** ea. V/Hldrs., B7G **9d.**, EF50 **7d.**, Int. Oct. **8d.**, Mazda Oct. **9d.**, British 5, 7, 9, pin, **9d.**, UX 4, 6, 7, **9d.** ea. Cons.: 8/16 450 **3/-**, 8/8 450 **3/-**, 8 450 **2/11**, 16 500 **3/9**, 16/16 450 **4/9**, 8/24 350 **3/3**, 32 450 **4/6**. Many other lines. Stamp for list. LORNE RADIO SUPPLIES, 7, Lorne Rd., Walthamstow, E.17.

NEW BOXED VALVES.—1R5, 1T4, 1S5, 3S4, **7/6**; 3Q4(3V4), **10/-**; 1S4, **6/6**; 1C5, **8/6**; 6K8M, 6K7GT, 6Q7GT, 6V6GT, 5Z4M, 6X5GT, **6/6**; ECH35, EF39, EBC33, **6/6**; EL33, **10/-**; EM34, **8/6**; TP22, 4THA, CL4, **10/-**; ACVP1, SP4, VP4, VP133, HL133DD, 11D3, EL35, U18, U52, **7/6**; 15D2, KTW61, DL63, U50, MU12/14, 5U4, 5Y3, 6AC7M, 6B8G, 6F6G, 6J7M, 6L7M, 6SJ7GT, 6SN7GT, 6Y6G, 80, 807, 9002, **6/6**; 6K7G, 6U7G, 6SG7M, **5/-**. Valves unboxed, but guaranteed: EF36, EL32, TT11, ML6, 8D2, VP23, KTZ63, 6AC7M, 6SH7M, 12A6M, 12SC7M, **4/-**; HL23DD, 5R4GY, 5U4, 9001, 9003, **5/-**. New boxed 723A/B Klystron Tubes, **70/-**. Electrolytic Condensers, 8 + 8 mfd, **450v**, wkg., **2/9**; 50 mfd, 50v, wkg., **1/6**. Volume Controls, less switch, lin. diam., 50K, 100K, 200K, 250K, **1/6**; ½ meg., 1 meg., **2/-**. Meters, 2in. scale, 0-500 micro-amp, 0-1 ma, **7/6**; 2½in. scale, 0-1 ma, **10/6** 0-100 micro-amp, **21/-**. Please add postage on orders under £1. Many other lines, send for lists. ELECTRAD RADIO, 64, Gt. Victoria St., Belfast, N.I.

EVERYTHING for Radio constructors, Condensors, Coils, Valves, Resistors, etc. Send stamp for list. SMITH, 98, West End Road, Morecambe. Quick service.

RODING LABS. have the following out of season brand new stock for disposal. Buy now at unrepeatable prices! Mail only. Loudspeakers: P.M. 5in., **10/-**; 6½in. w/t, **15/-**; 8in., **16/6**; 10in., **22/-**. Mains energised 8in., 1,250 ohms and 400 ohms field, **15/-**; 10in. w/t 1,250 ohm field, **22/-**. Please add 1/- post per speaker. Condensers: .005 1,000v, .002 1,000 v, **2/9** doz. .002 miniature, **3/6** doz. (Special bulk prices for manufacturers), 100pf S.M., **4/6** doz. (post extra). Resistors: ½ w., **2/-** doz., **10/-** 100 (2.7 k., 270 k., 1.2 meg.) (post extra). Cathode Ray Tubes: New VCR97 (in crates) especially selected for television receivers, **40/-**, plus 3/- carriage. Valves, etc.: VR91's **4/-**, 71A **2/-** or **15/-** doz. ! ! ! VR91 Holders, **6d.** Selenium Rectifiers 230 v. 30 mA., **4/3**. Neons (no resistance), **2/-** (post extra). Chassis, polished Ali., 12 x 9 x 2½, 16 swg., folded 4 sides, **8/6** (post 9d.). RODING LABORATORIES (Dept. PC), 70, Lord Ave., Ilford, Essex.

SALE.—81 copies P.W., Dec., 1941-Dec., 1949. Offers to A. MACMILLAN, 8, Muirpark, Beith, Ayrshire.

NO. 19 TX/RX, complete, what offers? H. HARDING, 169, Cowhill, Chadderton, Oldham.

SERVICE SHEETS, loan, sale, (S.A.E.), 8, Currea St., Oakenshaw, Bradford.

97/6 CHARGING SWITCHBOARDS, 12/32v., 500 and 1,260 volts, amps., cut-outs, fuses, resistances, etc., 4 take-off superb unit, in case, **75/-**; Dynamos, 24v., 1,000 w., 9in. x 7in., ⅜in. spindle, **75/-**; Motor Alternators from 1-12 kw., 110 and 220v. D.C. to 230v./1/50 A.C., from **£15**. Motor generators 1-6 kw., 110 and 220v. D.C. to 24/35v. D.C., **£5-£59**; Mains Transformers, 1-200 kva., all types. POWERCO, Wandsworth Town Stn., York Rd., London, S.W.18. BAT 5234. (10 mins. Waterloo.)

BRAND NEW GUARANTEED GOODS. Electrolytics, 8 mfd, 450v Small Metal Tubulars, **1/9**; 8-8mfd 450v Small Cans, **2/9**; 8-16mfd 450v Cans, **3/3**; 8-24mfd 350v Cans, **2/6**. T.V. Masks, Cream 6in., 9in. **7/6**, 12in. **14/9**. T.V. Focus Coils, **9/6**; Selenium Rectifiers, H.W., small, 250v 75ma, **4/3**; 12v ½ amp, **1/3** ea., **11/9** doz. Mains Trans., fully interleaved and impregnated. Screened Primaries 200-230-250v 50 c/cs. Drop Through Types with Top Shroud 260-0-260v 70ma 6.3v 3a, 5v 2a **12/11**; 350-0-350v 70ma 6.3v2a, 5v 2a, **14/11**; Midget 2½-3-2½in. 250-0-250v 70ma 6.3v 2a, 5v 2a, **15/6**; 250-0-250v 100ma 6.3v 6a, 5v 3a for 1355 conversion, **22/9**; 350-0-350v 100ma 6.3v 3a, 5v 2a, **16/9**; 350-0-350v 100ma 4v 3a, 4v 2a, **13/11**; 350-0-350v 150ma 6.3v 4a, 5v 3a, **25/9**. Fully Shrouded Types Midget 3-3-2½in. 250-0-250v 60ma 6.3v 2a, 5v 2a, **15/6** Standard 350-0-350v 100ma 6.3v-4v 3a C.T., 0-4-5v 3a, **21/9**; 350-0-350v 120ma 6.3v 4a, 5v 3a, **25/-**; 425-0-425v 200ma 6.3v-4v 4a C.T., 6.3v-4v 4a C.T., 0-4-5v 3a, **42/6**. Ex-Gov. Valves, mostly boxed: D1, EB34 (6H6), **11d.**; SP41, EA50, 12J5GT, **2/3**; 6J5GT, **2/6**; SP61, **2/11**; 6SK7Met, VU133, VU111, 9D2, SG215, **4/3**; AC6PEN (4v Output Pentode, British 7 pin), **4/6**; 6C5GT, 6K7G, EF36, **4/11**; EK32, EBC33, **5/3**; 6J5Met, 5Z4Met, U22, 6V6GT, **5/9**; 6V6G, 6J7Met, 6F6G, 25A6, 6X5GT, **5/11**; 6V6Met, 6K8, 6Q7GT, 6K7Met, 5U4G, 6N7Met, **6/6**; 1S4, 3S4, 1R5, 1T4, **6/11**; 6L6, **8/11**. C.W.O. or C.O.D. over £1. Postage extra under £2. Bargain List 3d. Special list for trade 3d. RADIO SUPPLY CO., 15, Queen Square, Leeds, 2. Callers welcome, 9 a.m. to 5.30 p.m.

ELECTROLYTICS, 8 mfd, 600 All., 1/3; 16 mfd, 2/-; 2.4 mfd, 350 round cardboard, 4/6 doz.; 0.1 350v 1/9 doz.; Resistors, popular asstmt, 50 new, 50 used, 5/6. AUTOREX MOTORS, New Whittington, Chesterfield.

MAGNETIC SOUND Recording Wire, stainless steel, temporary wooden spools, approx. 1½ hours running time at 2ft. per sec.; 14/- per spool. A. SMART, 40, Grange Rd., Halesowen, Worcs.

R.F. UNITS type, 24, mod. 27, 12/6 ea.; 60-80mcs approx. by 6 pos. switch, ideal for Midland T.V., type 25 for A.P., 12/6; T.V. Pre-Amps. adaptable for either station, uses two EF50's, less valves 9/6 ea.; Indicator units, type L, similar to 6a, new and boxed £4/5/- ea., others from 50/-; Valves, new, 6AK5 8/6, 9001 5/-, 6AC7 7/6, EA50 2/6, soiled VR65s at 18/- doz.; Sprague & Micamold 0.1 350v. 4/- doz., 36/- gross. We have hundreds of bargains in ex-Gov. Radio and Elec. items; also a wide range of Optical Gear. Booklet on ex-Gov. Lenses, etc., 2/6 ea. New 16-page lists free on receipt of your stamped and addressed envelope. H. ENGLISH, Rayleigh Rd., Hutton, Brentwood, Essex.

VALVES, guar. boxed surplus and Gov. equivs.: EF50 6/6, 4 for 25/-; EF54, EF55, 5Z4, 5U4, 6K8, 6Q7, MU12/14, 5/6, 4 for £1; 1T4, 1R5, 1S5, 354, 6/6, 4 for 25/-; EBC33, 6V6, 6K7, 5/-; soiled EF50,3/6, 6 for £1; SP61, SP41,3/-, 7 for £1; VR92, 2/6, 5 for 10/-; 807, 6/-; HVR2A 7/6. Speakers, P.M., from 9/6; M/E from 13/6. 0-500 Micrometers, 5/6. H.R. Phones, 6/-; Browns ditto, 8/6 6d. extra p and p. £1 orders post free. T.R.S., 71, Meadvale Rd., E. Croydon.

VALVES. Ex-Govt.: EF50 4/9, 807 5/-, EB34 1/9, VU133 3/9, 8D2 3/6, etc., IFT's. 465, 6/- pr.; 3WB Midget Iron Cored Coil Pack Kit, L.M.S., 9/6; 8 mfd. 450v, 2/-; .01 mfd, 4 Kv., 1/3; 301, 450v, 2/9 doz.; .1 350v. 2/3 doz.; .1 500v. 3/- doz.; .1+.1+.1 1/6 doz.; 50 assrtd. Mica, 8/6; 50 assrtd. Res., 1/6; "P" Coils, 2/3; Knobs, 2½d.; Mains Trans., 17/-; Sleeving, 6d. doz. yds.; Console TV Cabinets, really super job, £10. Many more bargains. Send for latest "Cheapest List in England." SUSSEX ELECTRONICS LTD. (W.), Riley Rd., Brighton. 7.

LANES RADIO

"Radio by Post" Bargains

ALL POST FREE

IMMEDIATE DELIVERY

P.M. SPEAKERS		4 SIDED CHASSIS 16 s.w.g.	
"Rola" — "Celestion," "Goodmans," etc.			
6 x 4 Eliptical,	14/-	7x4x2,	3/3.
8in. with /T,	18/-.	9x5x2½,	4/-.
8in. without/T,	15/-.	10x6x2½,	4/11.
10in. without /T,	21/-.	10x8x2½,	5/6.
12in. without/T,	37/6	12x9x2½,	6/8.
		14x9x2½,	6/11.

HEADPHONES 4000 Ohms, 10/6

11 GARDNER ST., BRIGHTON

CARLTON COILWINDING CO.

"A Name to Note and Remember"

Medium-wave Coil Units for BC453, BC454, BC455, 10/- with Data. State which model required. Mains Transformers for above receivers, 31/6, for BC348 30/-, BC221 26/-. **Inexpensive Television** Mains Transformers for R1355, 31/6. For VCR97 C.R.T., 52/6. Filament Transformer, 0-4-5-6.3-12.6v. 2a., 12/6 Rewinding Service. Send for catalogue, 3d. Postage extra. **Carco Works, Church Rd., Birkenhead.** Phone 3585.

NEW VALVE SNIP ! ! 6J5M's, 6AC7M's, maker's cartons, 3 for 13/-, 46/- doz. 1T4, 1R5, 1S4, 1 of ea. for 15/6. 100 ass. waxed Tub. Conds., .01-.5mfd, 350-1,000v wkg., 9/6. 100 ass. Resistors 1/10-2 watt, 9/6. 10K 10W Pot'meters, 3/-. All C.P. ANGLIN, 106, Cleethorpe Rd., Grimsby.

"TELEVISION SPECIAL !"—In response to 1,000 ! ! requests, we now offer the E.S.3 "Foundation Kit"; uses VCR 97 tube (not radar conversion). Send large S.A.E. for illustrated brochure. Dept. P.W., T-H PRODUCTS, 92, Leathwaite Road, S.W.11.

LONG-PLAYING Records and Record Players by Decca now available from stock. Send 2½d. stamp for list of 1st release Records and Record Players (33⅓ r.p.m.) with pick-up (price £8/18/-). Records available from us by post. G.P.20 Pickups, 71/5. Sensational new Amplifier by N.R.S.: The Symphony No. 1 is the most flexible on the market to-day! Three separate channels giving entirely independent control of bass, middle and top, also scratch cut for records. Gram. and tuner inputs. 5 watts undistorted output. Price £8/19/6. No. 1 High Fidelity Tuner, L. and M. wave I.R.F., infinite impendance detector. Complete kit £4/10/-; ready built, £5/10/-. No. 2 Superhet Tuner, L.M. and S. wave, special quality bandwidth, elaborate full-vision dial assembly; kit, £7/10/-; ready built, £8/10/-. Terms: c.w.o. or c.o.d. Full bargain list 2½d. N.R.S., 16, Kings College Rd., London, N.W.3. (Primrose 8314.)

TELEVISION.—The only school in Great Britain devoted solely to training in television. Write: Registrar, GOTHIC TELEVISION SCHOOL, 13, North Avenue, London, W.13.

MERCHANT NAVY and Air Radio. Here is an opportunity to train as Radio Officer. The big liners are open to you, but you must qualify for the P.M.G. Certificate. Day, Evening and "Radiocerts" postal courses. Prospectus from Director. THE WIRELESS SCHOOL, 21, Manor Gardens, Holloway, London, N.7. (Estd. 30 yrs.) (Phone; ARC 3694.)

NO B.N.R.S. Student has ever failed to pass his examinations after completing our appropriate study course. Now in our eleventh year and this claim is still true. All our courses are conducted by correspondence and our syllabus includes Brit.I.R.E., City and Guilds exams. Also maths, physics and radar. Nothing succeeds like success and what we have done a thousand times already for your colleagues, we can do again, for you —and all for £1/1/- per month. Free booklet from BRITISH NATIONAL RADIO SCHOOL, 66, Addiscombe Road, Croydon, Surrey. (Telephone: ADDiscombe 3341.)

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

WIRELESS. Postal Course of Instruction for Amateur Radio Transmitting Licence complete with text book at a moderate fee. Apply BRITISH SCHOOL OF TELEGRAPHY, LTD. 179, Clapham Road, London, S.W.9. (Estd. 1906.)

WIRELESS, Land, Sea and Air. Students, both sexes, from 14 yrs., trained for good appointments in all branches of radio. Low fees. Boarders. Stamp for pros. WIRELESS COLLEGE, Colwyn Bay.

SUPREME RADIO, 746B, Romford Road, Manor Park, London, E.12. (Tel.: ILF. 1360). Midget Valves: 1T4, 1S5, 1P5, 1S4, 7/- ea. new. 0.0005 mfd. Mica Dialectric Variable Condensers, 2/9 ea. 2½in. Moving Coil Speakers, 2-3 ohm, voice coil, 14/11 ea. Midget Personal Output Trans. for DL92; valves, etc.; really tiny, 4/- ea. B.7.G. Amphinol type Valve Holders, 9d. ea. ¼ watt Resistances: 10 ohm, 22, 47, 27, 82, 120, 180, 250, 330, 390, 820 ohms, 1K, 3.9K, 11K, 470K and 10 megohm, 1/9 doz. or assorted doz., 18/6 gross only. ½ watt Resistances, 1K ohm, 2.2K ohm, 6.8K, 16K, 18K, 33K, 100K, 150K, 220K ohms, 2/- doz., or assorted doz., 21/- gross only. 630 ohms 0.2 amp Flat Type Mains Dropper, tapped for 200-250v, 1/6 each. Mica PF/S: 40, 50, 60, 65, 70, 305, 307, 500, 530, 570, 1,800 and 4,550PF, all at 2/6 doz. or assorted doz. only. Balanced armature type Headphones with headband and lead, 3/6 per pair. CV102 Crystal Diodes, 2/6 ea. 2 Pole 2-Way Small Switches, 8d. ea. 200v, 120 M/A Selenium Metal Rectifiers or 250v 75 MA, 4/- ea. 1 meg. Carbon Vol. Controls, 1/- ea. 5 k-ohms Vol. Controls, 6d, 3 meg. Controls, 7½d. ea. Noise Suppressor Units, consisting of 2, 0.1 mfd Cond. and Iron-Cored Choke, 6d. ea., 5/- doz. 100 k-ohm Long Spindle Vol. Controls with S/P switch, 2/6 ea. 0.25 meg. Vol. Cont., less switch long spindle, 2/- ea. Terms C.W.O. No C.O.D. Send 6d. extra for postage orders under £5. 2½d. S.A.E. all enquiries and lists.

1355, R.F.25, A.C. Pack, £4; IF Strip 14 mc/s. Valves, 12/6; A.C.-D.C. Gram Motor Pick-up Turntable, 110-230v., £3/10/-; offers. CLIFTON, 23, Crawley Rd., Horsham.

TELEVISION CONDENSERS, .1 mfd 4000v, wkg. (4½ x 1½ tubular), 2/9 each; Suppressor Type Condensers, metal tubular with flying lead, .25 mfd, 5/6 doz. High-grade Wire-end Metal Tubular Coupling Condensers, .1 mfd, 1000v test, 4/6 doz. See last month's P.W. for Electrolytics, etc. ELECTRONIX, 220B, Canterbury St., Gillingham, Kent.

200 Service Sheets, as new, at half cost, with binder. £3. Box 196.

RADIO G200 ANNOUNCES

RF25 Units. For London T.V. New, Boxed. 15/-, Post 1/4.
RF27 Units. 35/-, post 1/4.
Enamelled Copper Wire. 16-20 S.W.G., 1/4. 22-24 S.W.G. 1/9. 26-28 S.W.G., 2/-. 30-32 S.W.G., 2/2. 34-36 S.W.G., 2/6. 38-40 S.W.G., 3/-. Per ½lb. reel. 140ft. coil 14 S.W.G. 10/-.
VALVES. Sylvania EF50-VR91, 6/9; 6V6, 717a, 6SN7gt, 5T4, 807, 2x2 high voltage rectifier, 6/6; VR92, VR78 (T.V. Diodes), 2/6. 6AM6 (8D3) TV., High Slope Button Base Pentode, 10/6.
Morganite Volume Controls with Switch. 2 meg., 1 meg., ½ meg., ¼ meg., 100 k. Limited quantity at 4/6 ea.
Dry Batteries. 90 v.—180 v. H.T., 21V.G.B. 1v. L.T. ex 58 set, 5/6, plus 1/4 post. 2 volt 10 Amp. Hr. celluloid accumulator. Ideal for portables. 9/9, plus 1/4 post.

ARTHUR HOILE

55, Union Street, Maidstone, Kent.

Phone: 3155

EB34, CV63, 1/-. VT61A, SP41, 1/6. P61, CV73, CV72, 6J5GT, 2/6. VU120, EC52, 3/-.

Post Extra. SAE Lists. No C.O.D.

J. E. ANNAKIN

25, Ashfield Place, Otley, Yorks.

SURPLUS BARGAINS

RECEIVER 18. With four battery valves, covers 6-9 mc/s, and has an amazing performance. ONLY 17/6. Circuit and connecting data, 2/-. Spare Valves (AR8 or ARP12) 2/9 each.

RECEIVER 21 covering 4.2-7.5 and 18-31 mc/s is complete with 9 battery valves and super capacity all-dry battery. 41/6. Circuit and connecting data, 2/3.

RECEIVER 25. Complete with 6 (6.3v) valves ; conversion was covered in "P.W.". August, '49. OUR PRICE. 20/6. Circuit 2/-.

MIDGET MOTORS. Will operate from 12-24v A.C. or D.C., from 110v A.C. or from the mains with a suitable dropper such as a lamp. A detachable fan and housing are supplied. ONLY 9/6.

RECEIVER 1355. In original maker's cases, but with slightly discoloured metal work, due to storage. These are complete with 11 valves, and are ideal for TV. 62/6 carriage paid ; callers, 57/6.

FIELD TELEPHONES of American manufacture and complete with bell, ringing generator, and standard type handset. In stout webbing cases, 37/6, or in solid leather cases, 45/-.

STATIC INTERFERENCE LIMITERS ready to plug into any low-impedance output, and fitted with jack-plug and socket, 3/9.

PANELS contains two .17 μF., 450v, one .01 μF. 350v, one .1 μF. 600v, one 8 μF. 150v condensers, an L.F. choke, valve-holder, etc. BRAND NEW and individually boxed, 1/9.

MIDGET ACCUMULATORS. Only 1½in. x 1½in. x 4½in., and brand new. 2/6. 2 for 4/6, 12 for £1.

MALLORY MERCURY BATTERIES. 94v H.T., 1.3v L.T., with extra-long life. In sealed metal cases, 8½in. x 3½in. x 3in. ONLY 6/-.

METERS, 0-1 mA, new and boxed, 6/6 ; 0-8A thermocouple, 3/6 ; 0-3A thermocouple, 3/6 ; 0-2.5A thermocouple, 3/6.

VIBRATOR 21, delivering 150v at 40 mA from 6v input. 19/6 complete. Store-soiled 8/6.

TRANSFORMERS. 115/230v auto-transformers, 6/6. Heavy duty multi-ratio output transformers, 4/6.

RADIO EXCHANGE
9, Cauldwell Street, Bedford
Phone 5568

Recently Published

Antenna Theory and Design

By H. Paul Williams, Ph.D., A.M.I.E.E., Sen.M.I.R.E. ; Head of Electronics Dept., The Fairey Aviation Co., Ltd. ; formerly Antenna and Propagation Specialist with Standard Telephones and Cables, Ltd. An important two-volume work giving a complete account of the theoretical basis of antenna design, followed by comprehensive guidance on the practical aspects. Both volumes are profusely illustrated, Vol. II in particular containing numerous design curves based on a logarithmic scale.

Vol. I.—FOUNDATIONS OF ANTENNA THEORY—142 pages. 21/- net.

Vol. II.—THE ELECTRICAL DESIGN OF ANTENNAE—522 pages. 63/- net.

Pitman
Parker Street, Kingsway, London, W.C.2

SPARKS' DATA SHEETS

Now recognised as the Safest, the Simplest and the Finest Radio Constructional Sheets obtainable.

The "**CRITERION**" A.C. RADIOGRAM. For Quality Reproduction of Radio and Records. Bass and Treble Controls. Widely praised. M. & L. waves ... 7/6

The "**CONQUEST**" A.C./D.C. SUPERHET. All-wave. Fine output on Radio and P.U. Good range ... 2/9

The "**CHALLENGER**" A.C. D.C. PORTABLE. Radio in any room without A. or E. Noted performance ... 2/9

The "**CUB**" A.C./D.C. 2-Valver plus Rect. M. & L. waves. A most useful Set giving good power and tone ... 2/6

The "**CORVETTE**" All-dry Superhet. All-wave. Compact and Portable ... 3/-

The "**COMPACT**" 2-Valver. A neat little battery Set for Speaker results on M. & L. waves. Widely used. ... 2/6

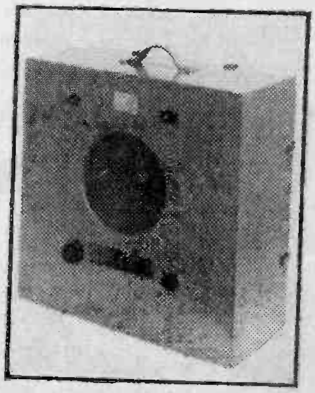
The "**EMPIRE**" ALL-WAVE TWO. A small 2-Valver for S., M. and L. waves. All-dry batteries. Very popular. 2/6

The above are another 7 of my 40 Tested and Guaranteed Designs. Send Stamp with Order or for detailed List.

Components Supplied

L. ORMOND SPARKS (P)
48A, HIGH STREET,
SWANAGE, DORSET.

EX. RAF 4 VALVE BATTERY RECEIVER



Designed for Medium Wave Broadcast Reception. Neat Grey Cabinet 18in. x 18in. x 8in. 4 valves ARP4 (2), VT51, VR21. Powerful 8in. Moving Coil Speaker. Very simple to operate. Ideal for all outlying locations requiring a simple but efficient receiver. Operates from 120 volt H.T. and 2 volt L.T. Supplied Aerial Tested and Guaranteed Perfect. Complete with valves but less batteries. (H.T. and L.T. 32/6 extra if required.)

CARRIAGE PAID OUTSTANDING VALUE **59/6**

H.P. RADIO SERVICES, LTD.,
Britain's Leading Radio Mail Order House.
55, County Road, Walton, Liverpool, 4.
Estab. 1935. Telephone : Aintree 1445.

LYONS RADIO

3, Goldhawk Road, Dept. M.P., Shepherds Bush, London, W.12.
Telephone : SHEpherds Bush 1729

RECEIVERS TYPE R1155. Once again we have a limited quantity of these popular communications receivers which cover the principal 20, 40 and 80 metre "Ham" bands and medium and long wave transmissions. In condition as new and unused, supplied in maker's transit cases. PRICE, £11/10/0. Carriage, 7/6. For callers only, a few in varying condition from £6.

MAINS TRANSFORMERS. Primary 200-250v., 50 cps. Secondaries: 350-0-350v. at 80 mA. 0-4 6.3 v. at 5 A.. and 0-4 5v. at 2 A. Can be mounted upright, sideways or as drop through chassis type. Brand new, fully guaranteed. PRICE, 18/6. Post 1/6.

100Kc. CRYSTALS. Brand new American made. Size 2½in. x 1½in. x 13/16in., with standard 3-pin U.S.A. base. PRICE, 15/- post free.

VALVES. All brand new and tested. EC52 and OZ4 at 6/- ; VU111 and VU133 at 5/-. Postage 6d.

STAGE - LIGHTING DIMMERS. Full-bright to Black-out at 230v. for 300 watts load. Sliding type, fully enclosed. PRICE 15/-. Post 1/6.

LINE CORD. 0.3 amp., 60 ohms per foot, 3-way, best quality. PRICE, 6d. per ft., post free.

METAL RECTIFIER UNIT TYPE 21. A.C. input 200-250v., 50 cps. Output : 160-200v. D.C. at 0.25 A. Size 12 x 6½ x 6½ins. In perfect working order. PRICE 42/6. Carriage, 2/6.

Introduction to HAM RADIO. A splendid book for those who have just, or wish to, obtain a Transmitting Licence. PRICE 3/8 post paid.

Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS

No. of Blueprint

CRYSTAL SETS

Blueprints, 1s. each.

1937 Crystal Receiver .. PW71*
The "Junior" Crystal Set PW94*

STRAIGHT SETS

Battery Operated

One-Valve : Blueprints, 2s. each.

The "Pyramid" One-valver (HF Pen) .. PW93*

Two-valve : Blueprints, 2s.

The Signet Two (D & L F) PW76*

Three-valve : Blueprints, 2s. each.

Summit Three (HF Pen, D, Pen) PW37*
The "Rapide" Straight 3 (D, 2 LF (RC & Trans)) PW82*
F. J. Camm's "Sprite" Three (HF, Pen, D, Tet) PW87*

Four-valve : Blueprints, 2s. each.

Fury Four Super (SG, SG, D, Pen) PW34C*

Mains Operated

Two-valve : Blueprints, 2s. each.

Selectone A.C. Radiogram Two (D, Pow) PW19*

Three-valve : Blueprints, 2s. each.

Double - Diode - Triode Three (HF Pen, DDT, Pen) PW23*

Four-valve : Blueprints, 2s. each.

A.C. Fury Four (SG, SG, D, Pen) PW20*
A.C. Hall-Mark (HF Pen, D, Push-Pull) .. PW45*

SUPERHETS

Battery Sets : Blueprints, 2s. each.

F. J. Camm's 2-valve Superhet PW52*

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : Blueprint, 2s.

Simple S.W. One-valver PW88*

Two-valve : Blueprints, 2s. each.

Midget Short-wave Two (D, Pen) PW38A*

Three-valve : Blueprints, 2s. each.

Experimenter's Short-wave Three (SG, D, Pow) PW30A*
The Prefect 3 (D, 2 LF (RC and Trans)) .. PW63*
The Band-spread S.W. Three (HF Pen, D (Pen), Pen) PW68*

PORTABLES

Four-valve : Blueprint, 2s.

"Imp" Portable 4 (D, LF, LF, Pen) .. PW86*

MISCELLANEOUS

Blueprint, 2s.

S.W. Converter-Adapter (1 valve) PW48A*

AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated

One-valve : Blueprint, 2s.

B.B.C. Special One-valver AW387*

Two-valve : Blueprints, 2s. each.

A modern Two-valver .. WM409*

Mains Operated

Two-valve : Blueprints, 2s. each.

Consoelectric Two (D. Pen), A.C. AW403

SPECIAL NOTICE

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

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

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

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : Blueprints, 2s. each.

S.W. One-valver for America AW429*

Two-valve : Blueprints, 2s. each.

Ultra-short Battery Two (SG, det Pen) WM402*

Four-valve : Blueprints, 3s. each.

A.W. Short-Wave World-beater (HF Pen, D, RC, Trans) AW436*
Standard Four-valver Short-waver (SG, D, LF, P) WM383*

Mains Operated

Four-valve : Blueprints, 3s.

Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) WM391*

MISCELLANEOUS

Enthusiast's Power Amplifier (10 Watts) (3/-) WM387*
Listener's 5-watt A.C. Amplifier (3/-) .. WM392*
Harris Electrogram battery amplifier (2/-) WM399*
De Luxe Concert A.C. Electrogram (2/-) .. WM403*

HINTS COUPON

This coupon is available until Oct. 2nd, 1950, and must accompany all Practical Hints.

PRACTICAL WIRELESS, SEPT.-OCT. 1950.

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by W. SPEAIGHT & SONS, LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia), LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rate including postage, for one year: Inland and Abroad 10s. 6d. (Canada 10s.). Registered at the General Post Office for the Canadian Magazine Post.