CRYSTAL DIODES

1/-

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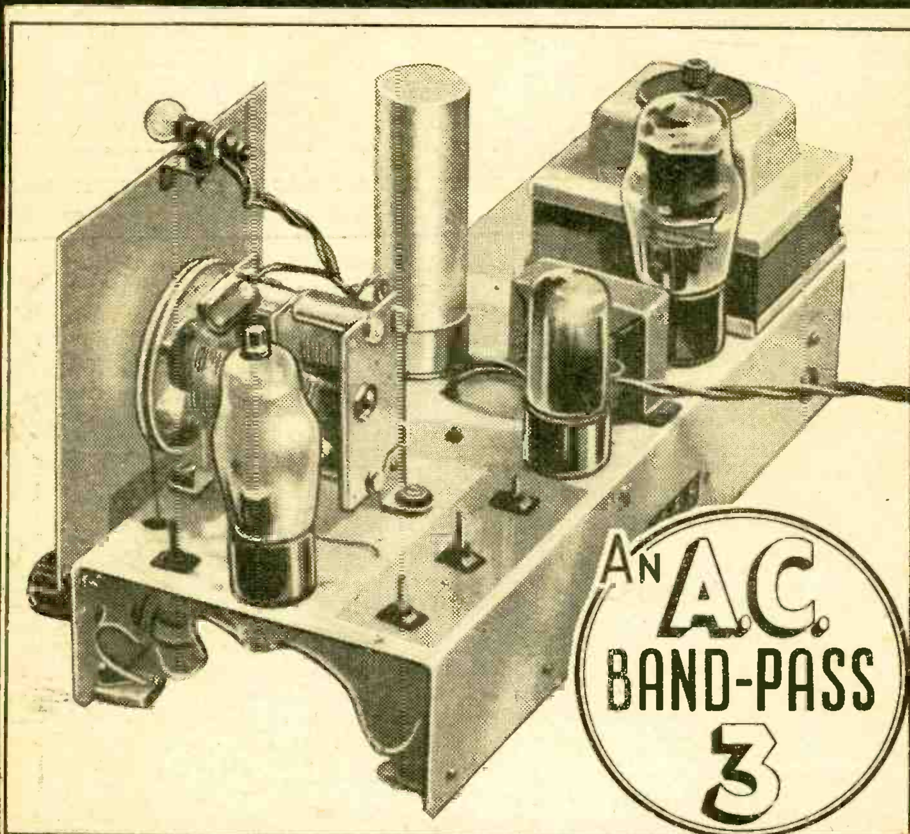
DECEMBER, 1952

EDITOR:
F.J.CAMM

PRACTICAL WIRELESS



AN A.C. BAND-PASS 3

IN THIS ISSUE:

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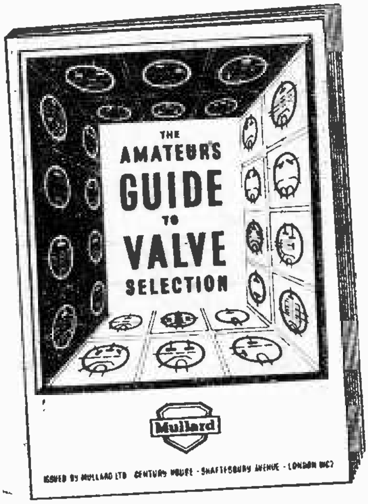

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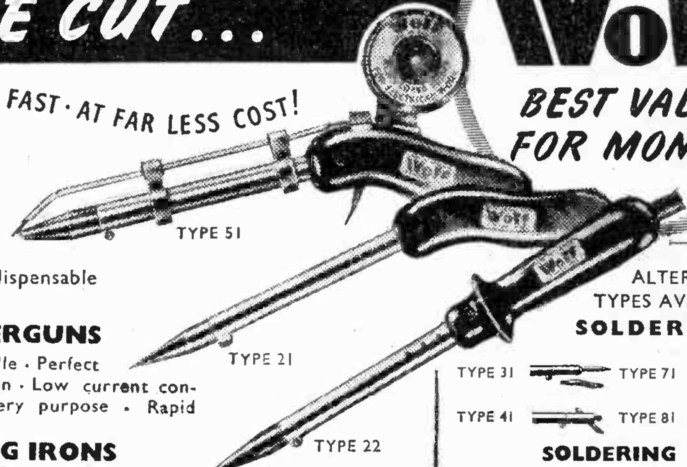

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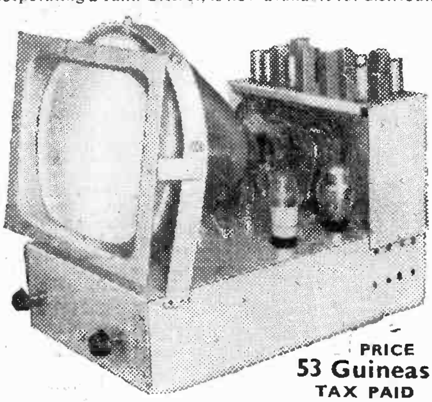

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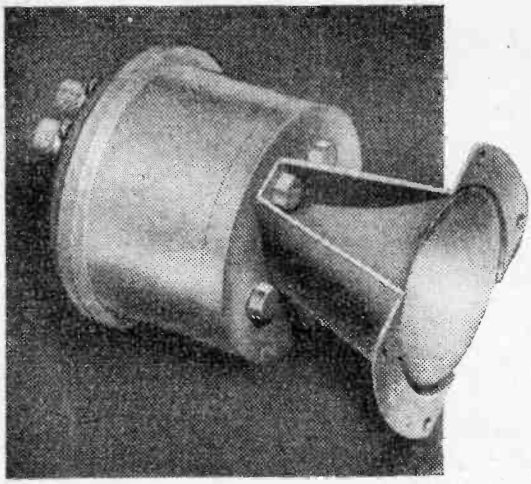

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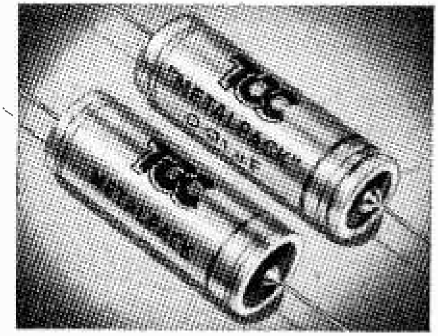

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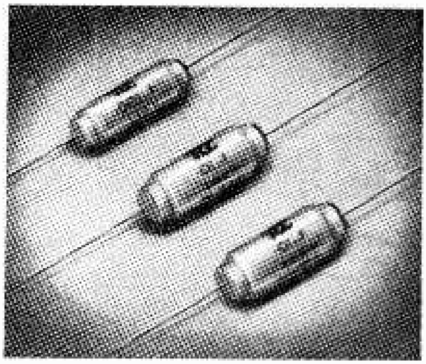
(in Aluminium Tubes)

Capacity µF.	Wkg. Volts D.C.		Dimensions		Type No.
	at 71° C.	at 100° C.	Length	Dia.	
·005	1,000	750	1½in.	¼in.	CP45W
·02	750	600	1½in.	⅜in.	CP45U
·1	350	200	1½in.	½in.	CP45N
·25	500	350	2¼in.	¾in.	CP47S
·5	500	350	2¼in.	1 in.	CP91S
1·0	350	200	2¼in.	1 in.	CP91N



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Capacity µF.	Wkg. Volts D.C.		Dimensions		Type No.
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·0002	500	350	⅝in.	·2 in.	CP110S
·0005	500	350	⅝in.	·2 in.	CP110S
·001	350	200	⅝in.	·2 in.	CP110N
·002	350	200	⅝in.	·22in.	CP111N
·005	200	120	⅝in.	·22in.	CP111H
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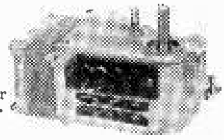

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0—25 ,,	0—100 ,,
0—100 ,,	0—250 ,,
0—250 ,,	0—500 ,,
0—500 ,,	
D.C. Current	**Resistance**
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Practical Wireless

EVERY MONTH
VOL. XXVIII, No. 554 DECEMBER, 1952

Editor F. J. CAMM

20th YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

The BBC and Copyright

THE Copyright Committee which was set up in April, 1951, to consider copyright law has recommended "with some reluctance" that a new performing right should be given to broadcasting authorities, especially in relation to their television programmes. We can understand the reluctance with which this recommendation has been made, for we, too, are opposed to vesting in the BBC any further powers which would still further increase their monopoly.

The recommendation has been made with the object of ending the deadlock between sporting promoters and the BBC over the televising of sporting events. The recommendation does not, therefore, affect ordinary sound broadcasts of commentaries of sporting events; but we must remember that long before television became a serious competitor the same deadlock existed between the BBC and the promoters of sporting events. It is true that the Committee rejects the claim of sports promoters for a performing right, and it equally rejects the suggestion that the BBC should be given compulsory powers to televise events on terms agreed by arbitration.

The BBC has had a difficult time with promoters for many years, and it is possible that the frustration which the attitude of these promoters has created resulted in the suggestion being made in a spirit of desperation. We must remember that the BBC has no inherent right to provide its listeners with programme material which has been prepared for them by somebody else; and the fees which they have offered to promoters in the past have not been particularly generous. At the same time the BBC has been quite right in turning down offers to permit broadcasts on fantastic terms. The promoters rightly think that with the advance of television fewer people will be encouraged to pay for seats at, say, a boxing match and that they will suffer thereby.

Much fuss has been made about sporting broadcasts, such as boxing matches and cup finals. It is doubtful whether the public would complain if such topics were entirely removed from the programme. The compulsory powers which it was suggested should be given to the BBC would necessarily involve the recognition of a statutory right to enter other people's premises.

"We are no more prepared to recommend that the BBC should have a legal right to take its television cameras into private places than we should be to give a right of access to a newspaper man or a newsreel photographer."

The recommendation that only one performing right should be recognised would enable the broadcasting authority to control the public performance of the spectacle and to satisfy the reasonable requirements of the organisers. Compulsion, one way or another, would undoubtedly do more harm than good and that is why the Committee was not prepared to give sports promoters and others a statutory right additional to their present right to refuse admission.

The Committee also recommends that no performing rights should be given in a purely sound broadcast and it suggests that the device of first recording the commentary has opened the way to safeguarding the interests of sports promoters and others. The Committee does not accept the proposal that performing rights should be given to performers in the presentation of their recorded performances.

The most important recommendation made is that a permanent tribunal should be set up to decide disputes between organisations controlling performing rights and the users. Other recommendations are that a broadcasting authority should have the right to prevent the copying of its programmes either by re-broadcasting or the making of records for sale; the performing rights in gramophone records should be maintained; the Dramatic and Musical Performers' Protection Act could be extended to prohibit clandestine broadcasting of performances, and the Government should accede to the revised Convention signed at Brussels in 1948.

Briefly, the deadlock over the televising of sporting events is because the sports associations require fees the BBC is unwilling or is unable to pay and also because it is felt that control should be exercised over the exhibition or performance. A performing right could not be restricted to sport promoters but would have to be granted widely.—F. J. C.

ROUND the WORLD of WIRELESS

New Marconi Director

SIR NOEL ASHBRIDGE, B.Sc., Director of Technical Services, BBC, since 1948, has joined the board of directors of Marconi's Wireless Telegraph Co., Ltd., the Marconi International Marine Communication Co., Ltd., Marconi Instruments, Ltd., and the English Electric Valve Co., Ltd.

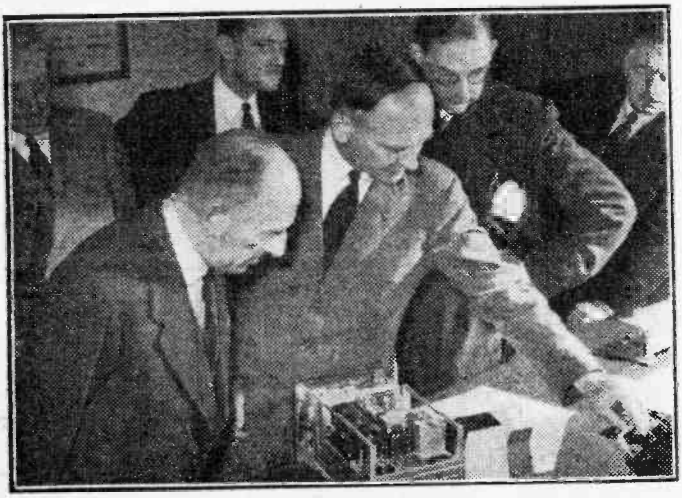
Sir Noel, who was knighted in 1935, was born on December 10th, 1889. Educated at Forest School and King's College, London, his early training was acquired with Yarrow and Co., Ltd., and British Thomson-Houston Co., Ltd. In 1920 he joined Marconi's, being head of their experimental broadcasting station at Writtle for several years. In 1926 he joined Captain Eckersley (then chief engineer of the BBC) as his assitant. He took over as chief engineer in 1939 and later was appointed Controller, Engineering Division, and Deputy Director-General.

Munich Exhibition

THE German Communication and Transport Exhibition will take place in Munich from June 20th to October 11th, 1953, and will offer the first comprehensive survey since the war, an impressive summary of conditions and problems facing communication and transport to-day.

The Bavarian capital is already preparing for this exhibition; the Munich Exhibition Park is being modernised, new halls and a congress hall are being erected. The exhibition ground covers a total area of 470,000 sq. yds., including 14 halls covering 42,000 sq. yds. and open ground extending over 170,000 sq. yds.

The exhibition will cover all sections of modern transport and communications, including road and rail transport, navigation, aviation, postal services, telegraphy, telephony, radio, forwarding agencies, storage and tourist traffic.



Senior officials from the Ministry of Supply recently made a special visit of inspection to Marconi's Wireless Telegraph Co., Ltd., at Chelmsford, to examine new types of equipment. Left to right :—G. M. Wright, Engineer-in-chief; L. A. Sweny, Manager, Aeronautical Division; R. R. Stanford-Tuck, Sales Manager of the Aeronautical Division; S. S. C. Mitchell, C.B., C.B.E., Controller of Guided Weapons and Electronics, Ministry of Supply; F. S. Barton, Principal Director of Electronics Research and Development, Ministry of Supply; F. S. Mockford, Commercial Manager.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound licences issued during the year ended August, 1952. The grand total of sound and television licences was 12,806,012.

Region	Number
London Postal ...	1,818,120
Home Counties ...	1,512,453
Midland	1,401,682
North Eastern ...	1,831,594
North Western ...	1,490,913
South Western ...	1,063,500
Welsh and Border ...	725,017
Total England and Wales	9,843,279
Scotland	1,151,058
Northern Ireland ...	213,728
Grand Total	11,208,065

EKCO Assists Education

MR. G. W. GODFREY, executive director, radio sales, of E. K. Cole, Ltd., and Mr. E. W. Shepherd, service manager, participated in the recently concluded radio and TV Teachers' Vacation Course organised by the Ministry of Education in conjunction with the R.I.C. Mr. Shepherd's lecture dealt with "Wound Components as Applied to TV," and a final talk was given by Mr. Godfrey on "The Future of Television and its Industrial Possibilities." This is the third year that Ekco have taken part in the course.

Mr. Shepherd has also been invited to deliver the opening lecture of the season at the Leicester College of Technology, and he will deal with the Ekco T164 television receiver and "spot-wobble."

New Appointments

TO meet with the increasing demand on its specialised wireless equipment for aeronautics, Marconi's Wireless Telegraph Co., Ltd., has found it necessary to expand and reorganise its Aeronautical Division into three distinct sections: Technical, Sales and Contracts.

The division was formed as a separate unit of the company after the first world war, its object being to design radio to meet the growing needs of civil aviation. Mr. L. A. Sweny (with the exception of war service between 1942 and 1946) has been its manager since 1936.

To meet with the gresent re-organisation, Dr. B. J. O'Kane has been appointed chief air radio engineer and joined the company on October 1st.

Former Battle of Britain pilot R. R. Stanford-Tuck, D.S.O., D.F.C., who joined the company in 1949, is now appointed sales manager of the division, and Mr. F. Wheeler, who has been with the company since 1928, is appointed contracts manager.

International Telegraph Conference

MR. CHARLES CARPENTER, traffic manager of Cable and Wireless, Ltd., sailed from Southampton recently for Buenos Aires to join the British delegation to the International Telecommunications Plenipotentiary Conference, of which he is a member.

The object of the conference, at which more than 70 countries will be represented, is to revise the current International Telegraph Convention, drawn up at Atlantic City in 1947. Mr. Carpenter is an authority on international telegraph affairs. When the conference ends in December he will return to London by air via Washington and New York for talks with the U.S. State Department, the Federal Communications Commission and the American telegraph companies.

Local Authority Aids Exports

A PROTOTYPE of the Ekco airfield radar approach aid has been ordered for evaluation purposes by the U.S. Air Navigation Development Board. Mr. Bernard Collins, manager of Southend Airport, will go with the equipment to the U.S. to demonstrate its capabilities throughout America. His journey is the result of a unique act of co-operation between a municipal authority and an industrial organisation.

E. K. Cole, Ltd., has arranged with the corporation, whose municipal airport was used for development and testing of the approach aid, for the granting of leave for Mr. Collins to make this trip at the express request of the U.S. authority.

Treatment by Wireless

IN Italy, a service has been put into operation for aeroplane passengers taken ill. Doctors are always available on the ground, ready to advise treatment by means of a radio link with the aircraft.

Price Control Suspended

A REPORT from America states that the price control on gramophones, wireless and television receivers has been suspended.

Modern Radio and Television Laboratory

IT is stated that the radio and television laboratory at the Oldham Technical College, Ascroft Street, is equipped with the most modern servicing and testing apparatus in the country.

The laboratory was designed by the staff of the electrical engineering department.

Sir Ian Jacob

THE new Director-General of the BBC, Lieut.-General Sir Ian Jacob, who takes over his new position from Sir William Haley on December 1st, was once Controller of the BBC European Service before becoming Director of the BBC's Overseas Service.

It is understood that Sir Ian's salary will be in the region of £7,000 a year. At least £4,000 of this, however, will be taken as tax.

There is a strong possibility that one of the first moves of the new Director-General may be the raising of licence fees.

Amateur Licence Interchange

ON May 13th this year a treaty became effective between Canada and the U.S.A. under which certain mobile and amateur radio stations licensed by the respective countries are permitted to operate across the border in each other's territory. Amateurs have to apply for a permit to avail themselves of this privilege, and when operating are subject to the regulations of the country in which they are operating.

Microwave Radiation

DR. JOHN P. HAGEN and N. Hepburn, of the American Naval Research Laboratory, have reported that tests have proved that sun spots and activity around the sun are definitely responsible for radio blackouts and noises on various frequency spectra. Work with a highly directional beam have shown that the intensity of the sun's radiation at 35,000 Mc/s was much more constant than at a lower frequency. The latest equipment, however, showed that the changes in the intensity of the radiations nowhere lasted more than five minutes.

Radar Guard

THE G.E.C. research laboratory at Schenectady is now provided with a radar-like device which detects cars as well as pedestrians approaching the area. The radiated wave is only 5in. in length and is focused by an 18in. parabolic reflector. A pedestrian is detected at about 100ft., and a car approaching rings a bell. The device is particularly valuable at night as it relieves the security guards.

Lt.-General Sir Ian Jacob, who at 53, has recently succeeded Sir William Haley as Director-General of the BBC.

Calibrating a Home-built Signal Generator

USING KNOWN TRANSMISSIONS IN PLACE OF LABORATORY EQUIPMENT

By Angus D. Taylor (G8PG)

DUE to the high initial cost of the commercially-built article, there is an increasing tendency for experimentally-minded amateurs to build their own signal generators. While the home-built article may lack some the refinements of the commercial product it is usually adequate for the requirements of the experimenter, but, particularly in the case of the beginner, the great snag appears to be accurate calibration—especially over the 300 to 500 kc/s range where accurate calibration is so important if successful superhet alignment is required. The great majority of amateurs do not own a receiver covering this range, and even those who do will be little better off unless they are reasonably expert at reading morse, as the only available stations for use as calibration markers are telegraphy stations of the ship-to-shore service. At first sight the above would seem to indicate that the amateur who has no access to an accurately calibrated oscillator might give up the idea of building his own signal generator, but in actual fact there is a simple solution to the problem which only requires the use of a simple broadcast receiver together with a sheet of graph paper and a list of the frequencies of the more easily identified broadcasting stations. This method will be described in detail later in the article, but first, in order to help readers who have not previously attempted to calibrate an oscillator, the method of obtaining a calibration chart for the ordinary medium- and long-wave broadcast bands will be briefly described. Once again the required equipment comprises a broadcast receiver, a sheet of graph paper and a list of broadcasting station frequencies.

Procedure

The procedure is as follows: First carry out the calibration during the evening hours so that the more distant broadcasting stations will be audible. Having assembled the required apparatus, switch on the signal generator with the wave-range switch set to the medium-wave position and allow it to run for half an hour. This allows the components to warm up to their normal working temperature and ensures that the oscillator will be reasonably stable during the calibration. During the half-hour wait, bring the receiver into operation and identify accurately fifteen or so broadcast transmitters spaced throughout the medium-wave band—as many as possible of the BBC transmitters, Athlone, A.F.N., Luxembourg and so on. At the end of the half-hour, tune the receiver to the highest frequency transmitter which has been identified (say the Third Programme on 1,546 kc/s), switch the signal generator modulation on and tune up from the high-frequency end of the signal generator dial until the modulated note is heard in the receiver. As soon as the modulated note is heard switch off the modulation. A whistle will then be heard as the unmodulated oscillation heterodynes the Third Programme transmitter carrier wave. If the signal generator tuning is swept across the third programme frequency, this whistle will start off at high pitch, gradually drop to inaudibility and then rise again. The correct setting is the centre position where the whistle is completely inaudible, as at this point the frequencies of the signal generator and the Third Programme transmitter are exactly the same. Carefully adjust the signal generator tuning to this point, then note on a sheet of paper the dial reading of the signal generator and the frequency of the Third Programme. Having done this, tune the receiver to the next known transmitter (say Luxembourg) and repeat the procedure, noting the dial reading obtained and the Luxembourg frequency. Repeat the process on all the known stations until some ten or fifteen calibration points have been obtained throughout the tuning range of the signal generator.

Once these calibration points have been obtained, they can be permanently recorded on a graph as shown in Figs. 1 and 2. The points for plotting the graph are obtained by running a horizontal line out from the frequency of the known station and a vertical line up from the equivalent signal generator dial reading. At the point where these two lines intersect, make a dot on the graph paper. Repeat the process for each calibration point obtained and, when all have been plotted, carefully sketch in a line to join all the dots together. Once this is done, the frequency-dial reading relationship of the signal generator has been plotted and it is a simple matter to find the dial reading for any given frequency or

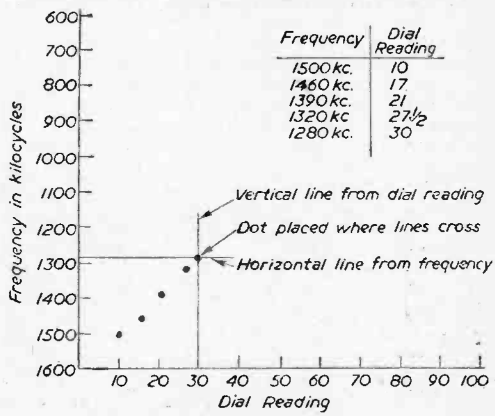


Fig. 1.—Method of recording the frequency and dial readings of the calibration points together with the methods of plotting them on the graph paper. The plotting of the 1280 kc/s calibration point is shown in detail.

the frequency represented by any given dial reading. If the dial reading for a given frequency is required, lay a straight edge horizontally from the desired frequency to the line on the graph. Note where the straight edge cuts the graph and run it down vertically from this point through the dial readings scale. The point at which it cuts the dial readings scale indicates the dial reading for this particular frequency. To find the frequency corresponding to a given dial reading reverse the process—run the straight-edge vertically upwards from the dial reading scale then horizontally across to the frequency scale. Once the medium-wave calibration is drawn up in this way carry out the same process for the long waves, where, of course, there are fewer stations and therefore fewer calibration points.

Having calibrated the two broadcast bands, the next operation is to calibrate the 300 to 500 kc/s range. To do this, we make use of the property possessed by an oscillator of generating, besides the frequency to which it is tuned, multiples of this frequency known as harmonics. As an example, an oscillator tuned to say 300 kc/s will also generate oscillatory energy at 300 x 2 kc/s, 300 x 3 kc/s and so on. As the multiplier increases the amount of energy generated drops rapidly, but the second harmonic (300 x 2 kc/s) will be quite strong and easily audible in a nearby receiver tuned to 300 x 2 which is of course 600 kc/s. If we use this property of the oscillator, therefore, we can use it to calibrate itself! The method is as follows: With the aid of the medium-wave calibration graph, set the oscillator to 600 kc/s with the modulation turned on and tune in the signal from the oscillator accurately on the receiver. Switch the signal generator to the uncalibrated 300-500 kc/s range and tune from the low-frequency end of the dial until a signal is heard in the receiver. Adjust the signal generator, tuning carefully for maximum volume from the receiver. The signal generator is now tuned to 300 kc/s as we are listening to the second harmonic, the fundamental frequency of which is equal to $\frac{600}{2} = 300$ kc/s. Having obtained and noted this point, switch the signal generator back to medium wave and tune it to 620 kc/s, locate this point on the receiver, switch back the signal generator to the uncalibrated range and adjust the tuning for maximum signal in the receiver. The signal generator is now tuned to $\frac{620}{2} = 310$ kc/s. Note this point and continue the calibration in 20 kc/s steps from 600 kc/s up to 1,000 kc/s which will, of course, equal 10 kc/s steps from 300 to 500 kc/s on the uncalibrated range of the signal generator. Once all the calibration points are obtained they should be plotted into a permanent graph as already described. The process may sound a little laborious, but it is fairly simple in practice and provides an ideal means of calibration where other means are not available.

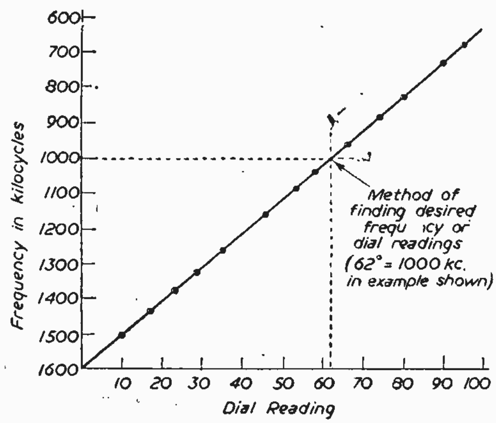


Fig. 2.—Completed calibration graph together with the method of reading off frequency from dial reading or vice-versa.

In conclusion, a word of warning. When calibrating the 300-500 kc/s range make sure that the coils in use do not tune as low as 150 kc/s as the fourth harmonic of this frequency is also equal to 600 kc/s, the calibration setting used on the receiver. This can be simply checked by switching the receiver over to 150 kc/s and making sure that nothing can be heard from the signal generator on that frequency. If this is the case, the signal generator can be taken as being on the desired 300 kc/s frequency. If signals do happen to be audible on 150 kc/s, it means that the coils are too large and turns will have to be removed until 300 kc/s comes near the maximum capacity setting of the signal generator tuning condenser.

Philips Competition Result

WINNERS of the Philips Competition held during the National Radio Show are announced by Philips Electrical, Ltd., Century House, Shaftesbury Avenue, W.C.2. They are:

FIRST PRIZE—a Philips Projection Television Set, value 89 gns.—Mrs. H. B. Collett, 11, Heaton Avenue, Romford, Essex.

SECOND PRIZE—a Philips Radiogram, value 65 gns.—Mr. R. Lakeman, Caravan Site, c/o R.A.F. Medmenham, Marlow, Bucks.

THIRD PRIZE—a Philips Radio Set, value 30 gns. —Mr. R. Merrett, 11, Avondale Rise, Peckham, S.E.15.

In addition, 68 other prizes have been awarded. These include: Philips "Philishave" electric dry shavers, decoration lighting sets, and parcels of the famous Philips "Argenta" lamps.

Competition forms were handed to the public during the radio show, and entrants were asked to do the following:

(1) Decide the best three designs in a range of seven radio receivers.

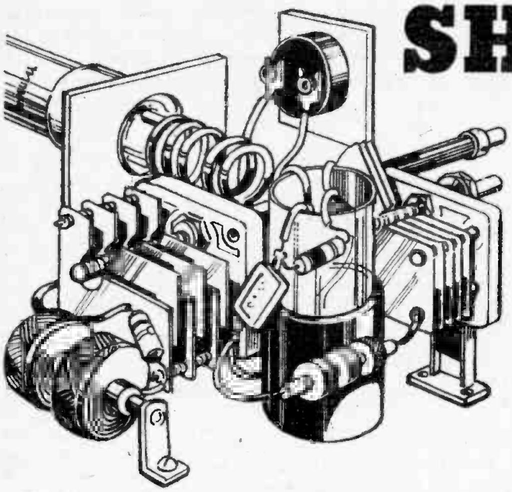
(2) Place in order of importance four features of Philips radiograms.

(3) Choose an original and descriptive name for Philips projection television.

A total of 13,000 entries were received.

In accordance with regular practice in such cases, the three main prize-winners will receive their sets through a local Philips dealer.

Mr. Eric Robinson kindly consented to make a formal presentation in the head office showrooms of Philips Electrical, Ltd., at Century House, to the first three winners.



SHORT-WAVE SECTION

A ONE-VALVE TOP-BAND CONVERTER FOR THE R.1155

By T. Griffin (G3GUV)

AT the present time many of the firms advertising in this magazine are offering the R1155 communications receiver in brand new condition at prices varying from £10 to £15. The types advertised, however, do not include the R1155N model. This is the only one of the series which covers the 160-metre amateur band. The other models cover the following frequency ranges:

Range 1: 18 to 7.5 Mc/s.
Range 2: 7.5 to 3.0 Mc/s.
Range 3: 1,500 to 600 kc/s.
Range 4: 500 to 200 kc/s.
Range 5: 200 to 75 kc/s.

It will be noted that there are two gaps in the frequency coverage: from 500 to 600 kc/s and 1.5 to 3.0 Mc/s. The first gap is unimportant to the average short-wave enthusiast and is understandable, as the intermediate frequency of the receiver (560 kc/s) falls within this range. The second gap, unfortunately, deprives the S.W.L. of one of the most interesting of the amateur bands, not to mention the trawler band with its attendant well-seasoned vocabularies! It is to those who feel attracted by the low price of these fine receivers, but who are deterred by the above disadvantage, that this article is directed.

A few months ago, the writer obtained one of these sets (type R1155E) and decided to rectify the omission by making the converter herein described in two easy stages—easy on the pocket as well as easy in construction. The first stage was to build the simplest possible one-valve mixer stage, the output of which would fall within one of the ranges covered by the receiver. The next stage was the improvement of the converter by substituting an I.F. transformer for the original choke-capacity coupling. The improvement proved well worth while. The mixer output frequency (first I.F.) chosen was the obvious one of the 465 kc/s, and it was chosen for two reasons. First, it falls conveniently at the "high-Q" end of Range 4 on the receiver and, secondly, because the necessary coils are easily obtainable. The unit was designed around the EK32 valve (VR57 is the Service type number), obtainable very cheaply from suppliers of war-surplus equipment. In the interests of economy and simplicity of adjustment the first unit built used choke-capacity coupling from converter to receiver.

Circuit

The circuit, Fig. 1, follows normal mixer stage practice, except that the anode circuit is untuned. In spite of this a fair degree of gain is obtainable from the stage and it allows plenty of latitude in tuning-in the output from the converter on the main receiver. The coils used will produce in the output a frequency of 465 kc/s. When the main receiver is tuned to this frequency and the unit connected, the set and converter function as a double superhet with the first I.F. 465 kc/s and the second, that of the receiver, 560 kc/s. The selectivity of this arrangement is quite high and, due to the low ratio of signal frequency to first intermediate frequency, no trouble is experienced from image interference.

The coils used in the writer's unit are "OSMOR"

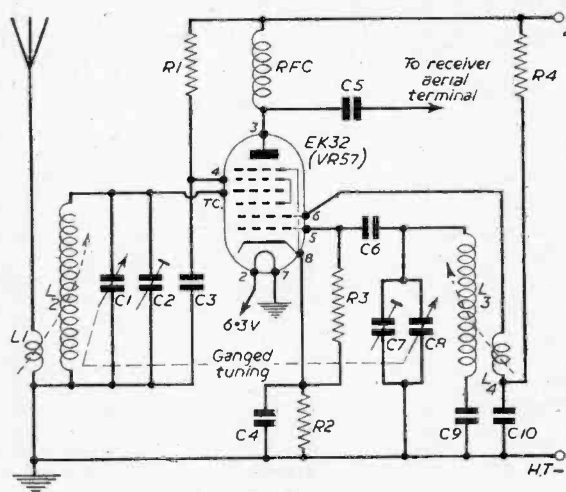


Fig. 1.—Circuit of the converter stage.

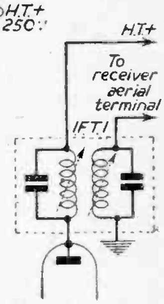


Fig. 2.—Modification in which an I.F. transformer is employed.

type "T.B." (Trawler band) and give a coverage of 1.3 to 4.3 Mc/s (70 to 230 m.)—more than sufficient to bridge the gap between ranges 2 and 3 on the R1155. "Supacoils" and "Wearite" P-type coils have been used on other units of a similar nature and both these types give excellent performance. If coils other than those specified are used, care must be taken to adhere to the maker's circuit recommendations, particularly regarding the value of the oscillator padding condenser C9. Any gross departure from the recommended value will certainly result in great difficulty in making the oscillator cover the range required, and in consequent tracking difficulties. The oscillator and H.F. tuning capacitors are shown ganged in the circuit, but they may with advantage be separately tuned. Separate tuning greatly simplifies tracking, enabling a signal to be readily "peaked up" at any point on the band, and obviates the necessity for the trimmers, C2 and C7. The disadvantage of separate tuning, having to adjust two controls simultaneously, has not proved to be so great as was at first thought. With a little practice they may be kept near enough "in line" from one end of the band to the other when searching broadly. When a signal has been tuned with the oscillator control only slight readjustment on the H.F. control is necessary to peak the signal.

LIST OF COMPONENTS

C 1, 8, 500 pF variable.
C 2, 7, 50 pF trimmer.
C 3, 4, 5, .01 μF.
C 6, 100 pF mica.
C 9, 2,500 pF silver mica.
C 10, .1 μF.
R 1, 250 kΩ.
R 2, 470Ω.
R 3, 47 kΩ.
R 4, 20 kΩ.
R.F.C., M.W. R.F. choke.
I.F.T. 1, 465 kc/s I.F. transformer.
L 1, L 2, "OSMOR" coil "T.B. Ae."
L 3, L 4, "OSMOR" coil "T.B. Osc."

Power Supplies

The power requirements of the EK32 are very modest; 6.3 volts at 0.2 amp. and 250 volts at 4.3 mA. Power for the converter may thus be taken from the power pack supplying the main receiver. If this is done certain precautions must be taken to safeguard the correct working of the R1155 bias circuits, because H.T.— on the receiver is *not* connected to earth. No direct connection must be made between the chassis of the converter and the chassis of the receiver. A 0.1 μF condenser should be connected between the two chassis, and the lead connecting the output of the converter to the receiver should have its outer braid earthed only at the receiver end. If the extra load on the power supply causes the H.T. voltage to drop slightly, this is no great disadvantage as the converter valve will perform quite well on 200 volts or less. In point of fact the writer has heard such a combination working with just over 100 volts on both receiver and converter!

Construction

Any small chassis will do and layout diagrams are given (Figs. 3 and 4) for either separately tuning H.F. and oscillator circuits, or ganging the tuning. The chassis on the prototype measures 7in. × 5in. × 2in., is of thin aluminium and fits inside a slightly larger metal cabinet and there is much room to spare on the chassis. In order that the danger of I.F. break-through be minimised it is strongly recommended that the unit be placed in a metal box or cabinet.

Adjustment and Operation

Connect the output of the converter, via shielded lead or coaxial cable, to aerial and earth terminals of the receiver, and apply power to both units. Adjust the dust cores of the coils until they are level with the top of the coil formers. If separate tuning is employed no further adjustment is necessary to the converter. Just tune the R1155 to a "quiet spot" around 465 kc/s and carry out main tuning on the oscillator capacitor, "peaking-up" with the H.F. capacitor. If ganged tuning is employed tune in a station on the converter near the H.F. end of the band (several medium-wave broadcast stations will be heard in the evenings). Adjust C7 until the station occupies the desired position on the main tuning scale by setting the main tuning dial to the desired setting and tuning the station with C7. If no exact frequency coverage is desired, C7 may be left at half-mesh. Now peak the signal by adjusting C2. Tune towards the L.F. end of the band (main tuning capacitor vanes almost fully in mesh) until a signal is heard. Its position on the scale may be set by adjusting the core of L3, L4. If this adjustment is not required, leave the core level with the top of the coil former. To obtain maximum signal strength

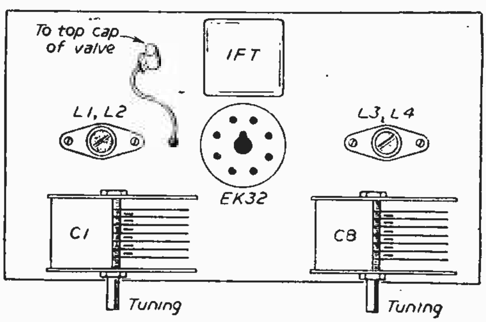


Fig. 3.—*Suggested layout for separate tuning.*

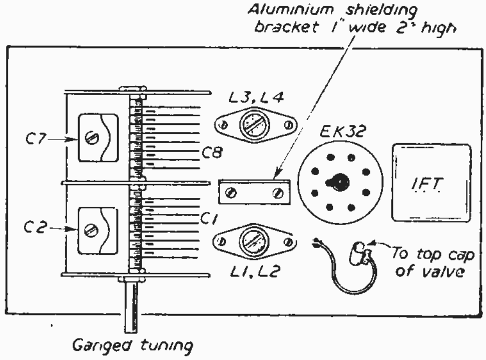


Fig. 4.—*Suggested layout for ganged tuning.*

adjust the core of L1, L2. The converter should now give a fairly good response over the complete tuning range.

The substitution of an I.F. transformer for the choke and coupling capacitor C5 brings about a marked improvement in stage-gain and selectivity. Fig. 2 shows the circuit of the modification. Any 465 kc/s I.F. transformer will do in this position, preferably one having iron dust cores. (A 460 kc/s transformer from an old type 25 set was tried with one unit and gave excellent results.) To align the transformer tune the converter until a steady signal is picked up on the receiver and adjust the cores of the I.F. transformer for maximum signal strength.

The converter, both in its original and in its modified form have been in use at the writer's station and at the station of a friend for some months. The performance is undoubtedly good. The sensitivity and selectivity compare most favourably with a well-aligned civilian communications receiver of well-known and reputable make, although the signal/noise ratio, a weak point of the R1155, is not as good.

A further modification to the R1155, carried out by the writer, was the removal of all the range 5 coils and alteration of the unit to cover 1.2 to 4 Mc/s. If any readers may be toying with the idea of a similar conversion, let them be warned that the mechanical difficulties, though by no means insuperable, are great. A thorough familiarity with the circuit of the receiver and an exact knowledge of placement of all components in the coil box are essential prerequisites, plus a steady hand and a stout heart.

News from the Clubs

WELLS AND DISTRICT AMATEUR RADIO AND TELEVISION SOCIETY

Hon. Sec.: W. L. Woodcraft (G3HUE), Haversham House, New Street, Wells.

THIS society, which is associated with the Wells Evening Institute, meets every Wednesday evening in its own premises in Milton Lane, Wells. During the past few months members have been building up, decorating and equipping the club's workshops and meeting rooms in preparation for the long winter nights.

A club TX is in course of construction. Talks by G3AWZ, G4DA and G3HUE also appear on the programme.

THE SOUTH SHIELDS AND DISTRICT AMATEUR RADIO CLUB

Hon. Sec.: W. Dennell (G3ATA), 12, So. Frederick Street, South Shields.

THE above club held their annual meeting last month and election of officers took place.

It was resolved that the club shall now be known as The South Shields and District Amateur Radio Club.

A number of new members enrolled and a programme was arranged for the year which includes lectures, film shows and socials.

Meetings are held every Friday evening at the "Trinity House Social Centre," Laygate, South Shields, commencing at 7.30 p.m.

Anyone interested please write or call on the secretary.

MIDLAND AMATEUR RADIO SOCIETY

Hon. Sec.: G. W. C. Smith (G3HDK), 84, Woodlands Road, Birmingham, 11.

THE annual general meeting of the above society was held on September 16th, when the officers and committee for the ensuing year were elected.

At the Sutton Coldfield and North Birmingham Model Engineering Society's exhibition on October 2nd, 3rd and 4th, a combined M.A.R.S./Slade stand was on view and attracted much attention from the visitors. The Lord Mayor and Lady Mayoress of Birmingham, who opened the exhibition, spent some time on the stand and obtained first-hand experience of "ham radio" by speaking to a well-known "old timer" over the air. Meetings of the society are held on the third Tuesday in the month at the Imperial Hotel, Birmingham.

WELLINGBOROUGH AND DISTRICT RADIO AND TELEVISION SOCIETY

Hon. Sec.: N. M. Seabrooke, 85, The Drive, Wellingborough.

MEETINGS are held fortnightly on Thursdays, at the British Railway Sports and Social Club, Wellingborough, and an enterprising programme has been planned for the winter months ahead.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: F. C. Ward (G2CVV), 5, Uplands Avenue, Littleover, Derby.

THE winter session having now commenced, meetings are held weekly on Wednesdays at 7.30 p.m. Permanent installation of the club transmitter is nearing completion and in the near future it is hoped that an "on the air" night will be a regular feature of the society's programme. A copy of "Future Events" can be obtained from the hon. sec. New members and visitors are welcome at any society function.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: T. Arch, 11, Boyson Road, S.E.17.

THE Junk Sale, as reported last month, which was held on October 3rd, was very well attended and some very useful gear was sold.

The club TX G3GHN will very shortly be on the air again, having been under the process of rebuilding.

The Xmas Party will be held this year on December 12th, when the programme that everybody enjoys will be put into top gear. Preparations for the event have been in hand for three months, so everybody will have a swell time. The Clifton extend to visitors and prospective members a cordial welcome any Friday evening at 225, New Cross Road, S.E.14, or enquiries to be written to the secretary.

IXWORTH RADIO CLUB

Hon. Sec.: P. G. Wright, Thurston Road, Gt. Barton, Bury St. Edmunds, Suffolk.

ANYONE who is in any way interested in experimental radio or television is welcome at this club.

They are putting on a demonstration at the Handicrafts Exhibition, at The Art Gallery, Bury St. Edmunds (November 17-22), when it is hoped to have an 80-metre phone TX running, and they will be pleased to meet any local readers.

THE LOTHIANS RADIO SOCIETY

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

THE opening meeting of the 1952-53 session was held on Thursday, September 18th, at 25, Charlotte Square, Edinburgh.

A comprehensive programme has been arranged covering receivers, transmitters, V.H.F. and H.F., tape recorders and amplifiers, television, etc. Classes covering the Radio Amateurs examination syllabus have also been arranged, together with morse code instruction. These classes are available to all members of the society.

A cordial invitation is extended to prospective members to attend these meetings. The hon. sec. will be glad to supply further information, together with a copy of the 1952-53 programme.

THE ROCHDALE RADIO AND TELEVISION SOCIETY

Hon. Sec.: J. Riley, 1, Darley Bank, Britannia, Bacup.

DECORATION of the club-room is now completed and electricity is installed. Morse classes are starting on the first Friday in November.

Meetings are held in the club-room at 1, Law Street, Sudden, Rochdale, on Friday evenings at 7.45, visitors being welcome.

The winter season should be very interesting as RX, TX and test gear is to be constructed.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: R. T. Parsons, 14, Carlyle Avenue, Brighton, 7.

ATTENDANCES on club nights have improved, perhaps helped by a very interesting programme organised by the hon. sec. G2CMH is rebuilding the club TX and hopes to have the club station QRO on 80 metres soon. Forthcoming events include:

November 11th.—The Williamson amplifier, by Mr. Goodsell.
November 25th.—Aerial Fundamentals, by G6QB.
December 2nd.—The Germanium Diode, by the General Electric Co.

On your Wavelength

by THERMION

Patents

APROPOS my comments on Patents in the October issue, I have received a letter from a patent agent disagreeing with my statement that readers may build anything which is described in PRACTICAL WIRELESS or our associated journals without fear of prosecution, provided that they do not offer for sale what they build. The patent agent says that this is not a true statement of the law (with which I profoundly disagree) "though it may be true in practice." The position as I have stated it is the law and there is plenty of case law to support my statement. Indeed, my views represent the views of eminent patent counsel given in a written opinion to me.

My correspondent goes on to say if a reader were to make a patented article other than for experimental use he would infringe the patent and could be sued for that infringement, and that it is quite immaterial in such circumstances whether or not the article is offered for sale.

In practice it is highly improbable that any patentee would consider it worth while bringing an action for infringement against someone who makes only one infringing article. As it would be impossible for any patentee to prove that a person had made a patented article for any other purpose than experiment I quite fail to see the drift of my correspondent's remarks.

He also disagrees with my statement that the most an inventor can do as regards an invention on which a patent application has been filed is to mark goods embodying the invention with the words "Patent applied for." I went on to say that if subsequently it is found that the idea has been anticipated, and in the meantime the applicant has commenced to market, the maker may be and probably will be sued for damages. I should have thought that statement was crystal clear, but not so to my correspondent. He says that it is true that if an inventor's idea is covered by the claims of a prior dated patent which is still in force, the patentee of the latter could sue for infringement, and this would be irrespective of any marking with the words "patent applied for." He says that an invention may be anticipated without there being any risk of infringement.

The gravamen of my comments on this latter subject was that in order to warn the public against infringement it was necessary to mark goods "patent applied for," as the absence of such marking might lead some to presume that anyone could make the article.

World's Illiterates Increasing

I WAS very surprised to read in a recent UNESCO report that half the world's population cannot read or write, a condition which it describes as a denial and travesty of human rights. The total as well as the percentage of illiterates is rising, says the report with the comment : "It is impossible to stand by and do nothing. The situation grows worse as the population of the world rapidly increases."

This is a damning indictment of present educational methods and it also implies that the educational broadcasts throughout the world have failed. The school-leaving age has been raised, there are State-sponsored scholarships, education is free, there are evening classes and unceasing educational broadcasts. Now that States tend to becomes mass-thinking machines and people prefer to listen rather than to learn it may mean that illiteracy will increase. As all children are compelled to go to school it is astonishing that they can leave school without learning the most important two of the three R's.

Components for Constructors

AS a result of my comments on the manner in which certain firms who built their businesses on the constructor market have deserted it, I am glad to be able to say that some of them intend to return to the fold. It is noteworthy that at the R.S.G.B. Amateur Radio Exhibition, many more components were available than hitherto. If this exhibition gives the impression that it caters more for the transmitter than the man interested in receiving, it must be remembered that it has been organised by the Radio Society of Great Britain whose main interest is in amateur transmitters.

Several readers have suggested that this journal should undertake the organisation of a constructors' exhibition, and I should like to have the views of other readers on this subject so that I can pass along a consensus of opinion to the proper quarters. Obviously at present such an exhibition could not be made to pay on gate money alone, for there are far too few firms catering entirely for constructors who could exhibit and help to make the exhibition of interest.

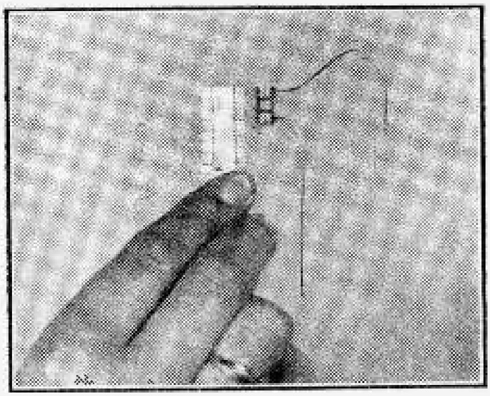
Aerials

DRIVING round suburbia the other day I was struck by the large number of different types of television aerials and my mind was carried back to the early 'twenties when every conceivable variety of receiving aerial was erected, each of which had its adherents and for which the wildest and widest claims were made. We know to-day how false some of those claims were, for outside receiving aerials have practically disappeared. I prophesy that television aerials will go the same way. I strongly suspect a large amount of bunkum has been written about aerials and the advantages of the various types.

Germanium Crystal Diodes

SOME DETAILS OF THESE MODERN CRYSTALS WITH SOME CIRCUITS FOR THE EXPERIMENTER

By B. L. Morley



RADIO has developed rapidly since the "crystal" days, and valve has superseded valve, new types being developed to keep pace with the ever-widening range of frequencies which were made available for reception.

The wheel has now turned full circle, and electronic devices, which can no longer be called valves, produce radio waves of such high frequencies that they cannot be successfully handled at the receiving end by accepted valve technique, and so the crystal (though a much more robust and efficient crystal) has come back into its own, and is being used where its erstwhile usurper is much less efficient.

The ultra-high frequencies such as are generated by the magnetron cannot be amplified by thermionic valves, and the procedure is to convert them to a much lower frequency by the superheterodyne principle, using diode mixers. A circuit of this nature is shown in Fig. 1.

Under these conditions it has been found that the silicon crystal diode is superior to the thermionic diode, as it has a much lower shunt capacity and covers a much wider frequency range, using less power from the oscillator.

The development of this technique during the war led to intense research work on crystals and has resulted in the present mass production of highly efficient germanium diodes, which can be used to construct amazingly sensitive crystal receivers, and to perform functions previously considered to be the exclusive field of the valve.

Mainly Historical

In the early part of the war, silicon diodes were used for micro-wave mixers in oscillators. The method was first developed in Britain and it was found that these crystals could handle efficiently frequencies which were beyond the capabilities of valves. The circuit of such a mixer is shown in Fig. 2.

Although a very efficient frequency converter at ultra-high frequencies, it was found that the silicon crystal was very easily destroyed if subjected to overloads, and this limited its use in electronic pulse systems such as radar. The result was the investigation of other materials suitable for use as diode mixers, and eventually led to the development of germanium.

In the early stages of production the germanium crystal was able to withstand quite heavy overloads, but it was not as efficient as silicon and its noise factor was rather higher. However, as it could handle quite a wide frequency range it began to replace thermionic diodes.

Extensive research was carried out by British manufacturers and in 1946 the British Thomson-Houston Company (B.T.H.) had reached the stage where actual production on a marketable scale could be undertaken. The main source of supply of germanium was the U.S.A. and even her production was only 2,000 lbs. per annum. It was difficult and expensive to obtain really pure metal.

The G.E.C. laboratories succeeded in extracting germanium from the flue dust in the chimneys of gas works. This method was further developed by John Matthew and Company to produce the germanium in economical quantities. A pure and ample supply of the metal was thus made available to British manufacturers, and resulted in the development of mass production methods to supply crystals to the public at a low price.

Further research in the U.S.A. resulted in the

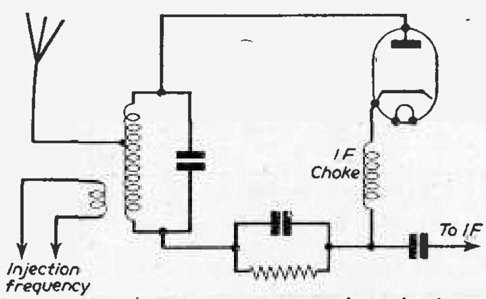


Fig. 1.—A diode in a superhet circuit.

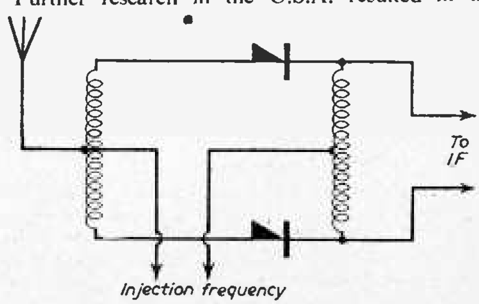


Fig. 2.—The crystal has replaced the valve in this circuit.

discovery that, by adding a second electrode (or cat's whisker) to the crystal, a triode was formed which would amplify signals in a similar manner to the thermionic triode. In 1948 a valveless loudspeaker radio receiver was demonstrated in the Bell Laboratories in New York, the driving current of only a few milliamps being obtained from a small dry battery.

British manufacturers were working on the same lines and later the same year a crystal triode was produced by B.T.H. and a valveless loudspeaker radio receiver was successfully demonstrated in their laboratory.

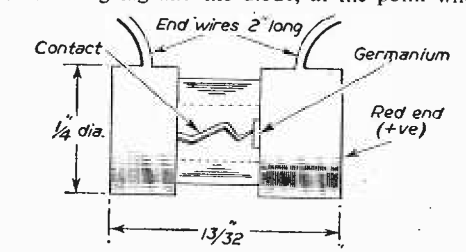
Research work and the exploration of the possibilities of germanium crystals is being pursued vigorously. The latest development is the discovery of a new method of making contact with the crystal. This is by forming the rectifying barrier (or junction as it is called) *inside* instead of on the surface of the germanium to render the contact extremely robust and stable. This method of construction enables crystals to be produced whose power-handling capabilities range from less than one microwatt, to water-cooled rectifiers which will carry 100 amps. in an area of one square centimetre.

Construction of the Diode

There are three main firms which manufacture germanium crystal diodes in Britain. They are the B.T.H., the G.E.C., and Westinghouse.

The construction of the B.T.H. crystal is shown in Fig. 3. The crystal is actually a flake of germanium which is fixed inside the glass tube. The "cat's whisker" is a tungsten wire contact which is soldered into the negative end. The actual contact is made during manufacture and requires no adjustments whatsoever. The crystal is equipped with two wire ends 2in. long which can be soldered directly to the other components in the receiver. The robust construction makes it no longer necessary to "tickle" the cat's whisker to find the best position.

When soldering, care should be taken to avoid excessive heat getting to the diode. The connecting wire should be gripped with a pair of pliers between the soldering tag and the diode, at the point where



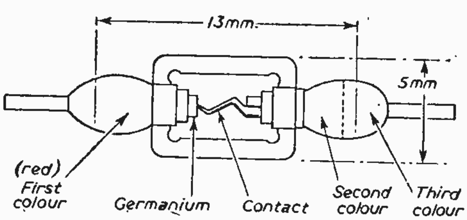


Fig. 3 (Above).—Dimensioned outline of B.T.H. type, and Fig. 4 (below).—Dimensioned outline of G.E.C. type.

the connection is being made, so as to divert the heat. This precaution should be taken with all crystal diodes.

The construction of the G.E.C. type is shown in Fig. 4, and it will be observed that the principle is similar to that of the B.T.H.

Polarity Markings

The general practice is to mark one end in red; this is the cathode end. If A.C. is applied to the other end (the anode) a positive potential will appear at the red end.

Different types have differently coloured anodes. With the B.T.H. the following colours are used:

Type	Colour of anode
CG1-C	Green
CG4-C	Blue
CG5-C	White
CG6-C	Black
CG8-C	Brown

The G.E.C. use a two-colour code at the anode as follows:

Type	Colour of anode
GEX33	Orange/Orange
GEX44	Yellow/Yellow
GEX45	Yellow/Green
GEX55	Green/Green

Equivalent Table

The following table indicates types which can be substituted for each other, for general use:

B.T.H.	G.E.C.	Westinghouse
CG4-C	GEX55	WG7A
CG5-C	GEX45	WG7B
CG6-C	GEX45	WG5A

It must be borne in mind that these equivalents are only approximate and the serious experimenter should study the characteristics of the type he intends to use.

Characteristics

As with valves, each manufacturer has produced his own types of diodes with their own particular characteristics, and it is not possible to give here a complete list of all the characteristic curves available. However, the graph in Fig. 5 shows a curve indicating the performance to be expected.

An example of the performance ratings is given overleaf for a crystal detector.

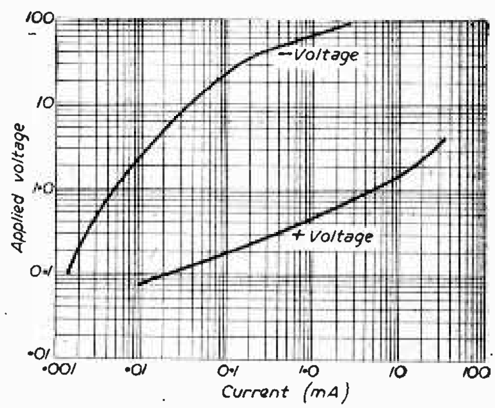


Fig. 5.—D.C. characteristic curves of typical rectifier.

Characteristic	CG6-C	GEX45	WG4B
Max. voltage (peak) reverse)	50	60	40
Max. input current continuous (mA.) ...	50	50	50
Transient surge (mA.)	400	500	500
Min. forward current at + 1v. (mA.) ...	2	5	5
Max. reverse current at −10v. (μ/a.) ...	100	33	100

The average figure for resistance taken at plus 1 volt is 500 ohms and the minimum back resistance taken at minus 10 volts is 100,000 ohms. These figures will, of course, vary from one type to another. The capacity is less than 1 pF.

Advantages of Germanium Crystals

This modern version of the crystal has many advantages over the thermionic valve for many radio and electronic devices. A summary of these is given below :

(a) Great sensitivity. (They make really super crystal receivers.)
(b) Long life. (Shelf life 10 years ; operating life more than 10,000 hours.)
(c) No adjustments to be made.
(d) No current consumption. (This means no heater current and therefore no heater wiring.)
(e) Low self-capacity. (One of the disadvantages of the small metallic oxide type was its comparatively high self-capacity, making it unsuitable for VHF work.)
(f) Superior frequency response.
(g) Wide frequency range.
(h) Robustness.
(i) Can be soldered directly into the circuit.
(j) Can handle high voltages.
(k) Able to withstand heavy transient overloads.

Practical Uses

A short list of the practical uses to which the crystals can be put is given below. This list is not intended to be fully comprehensive, but is given merely as a guide, and doubtless the experimenter will be able to find many other uses for them.

Application	Suggested types B.T.H.	Suggested types G.E.C.	Westinghouse
Narrow band V.H.F. detector	CG5-C	GEX44	WG5A
Interference limiter ...	CG6-C	GEX44	WG6A
Medium frequency detector	CG6-C	GEX44	WG7A
Detector for crystal Rx ...	CG6-C	GEX45	WG4B
Instrument rectifier	CG5-C	GEX55	WG7B
Discriminator FM receivers	CG5-C	GEX55	WG7A
Ratio detector (FM) ...	CG5-C	GEX55	WG7A
H.F. indicator (standing wave)	CG5-C	GEX55	WG4A
Medium frequency A.V.C. circuit	CG5-C	GEX45	WG6A
General purpose diode ...	CG6-C	GEX45	WG6A

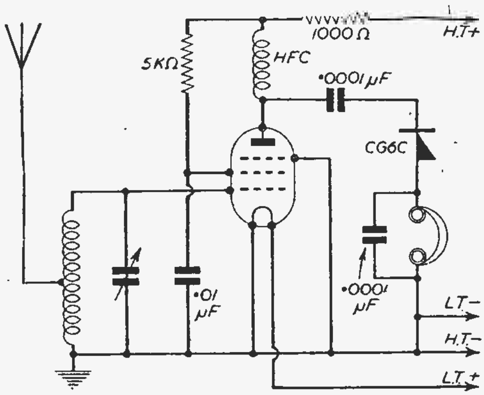


Fig. 8.—H.F. stage followed by crystal detector.

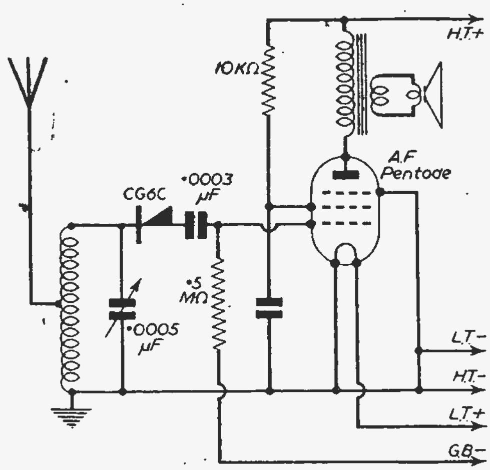


Fig. 7.—Crystal plus pentode loudspeaker crystal set.

Circuits

Figures 6 to 9 give some circuits for experimental purposes, which the beginner can build. Battery type valves have been shown, though mains type can, of course, be used. No particular valve types are specified as the circuits are purely for experiment, and the constructor will doubtless wish to use any he may have on hand. Each circuit given is a working circuit and will give good results.

Some more circuits for the advanced worker are given later.

Figure 6 shows the basic crystal detector circuit. The coil can be home-made and one consisting of 50 turns 26 S.W.G. wire enamelled, silk and cotton covered close-wound on a 2½ in. diameter former will cover the medium waveband. The tap is made 15 turns from the earthy end of the coil. High-resistance headphones should be used.

If desired, a commercial type of coil can be used with switching to cover the long and medium wavebands.

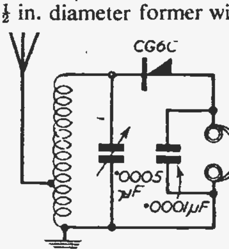


Fig. 6.—Single crystal receiver circuit.

Used with an outdoor aerial the results are surprising, due to the highly sensitive crystal. The B.T.H. type is indicated on the diagram.

In Fig. 7 we have a circuit which employs a crystal for the detector and a pentode valve to provide sufficient amplification to work a loudspeaker on the local station.

Figure 8 shows a circuit using an H.F. valve before

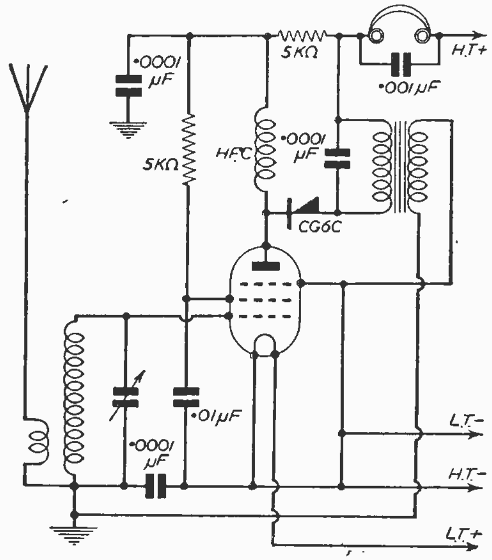


Fig. 9.—One-valve reflex circuit.

the crystal detector. It may be found that extra selectivity is required with this circuit and, if desired, the coil can be given an extra winding to couple the aerial loosely.

Figure 9 gives a circuit of the reflex type which was very popular at one time. The valve not only acts as an H.F. amplifier but also as an L.F. amplifier, the output from the crystal detector being fed back into the grid circuit of the H.F. valve.

These circuits are worth experimenting with, and provide a good knowledge of the capabilities of the modern crystal.

For the more advanced worker, the circuit shown in Fig. 10 is a tested working circuit, which will not only provide second detection, but A.V.C. voltages as well. This circuit, and also those in Figs 11 and 12, are given by courtesy of B.T.H., Ltd., and use the CG5-C crystals. Fig. 10 is suitable for V.H.F. working.

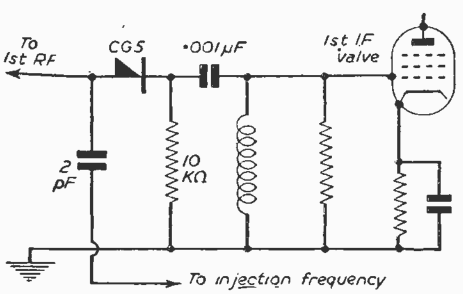


Fig. 12.—Discriminating circuit in F.M. receiver.

Figure 12 shows two CG5-C crystals used in the discriminating stage of an F.M. receiver and can replace the usual duo-diode valve.

The germanium crystal used as a mixer is shown in Fig. 12, and this circuit can be used for V.H.F. working.

A combined detector and noise limiter for short-

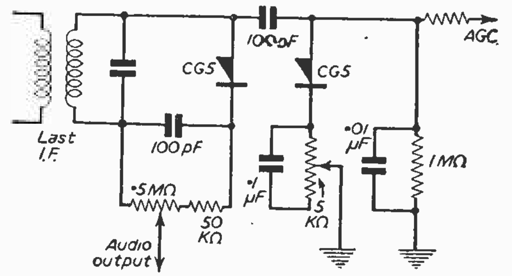


Fig. 10.—Detector and A.V.C. circuit.

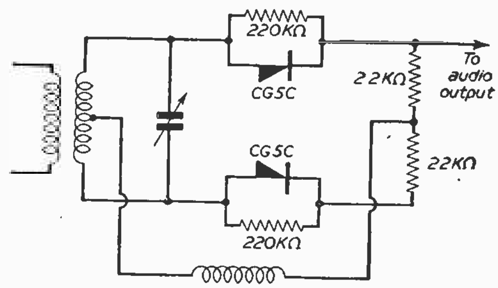


Fig. 11.—A B.T.H. circuit.

wave and V.H.F. receivers is given in Fig. 13. The limiter portion acts as an effective suppressor of car ignition interference.

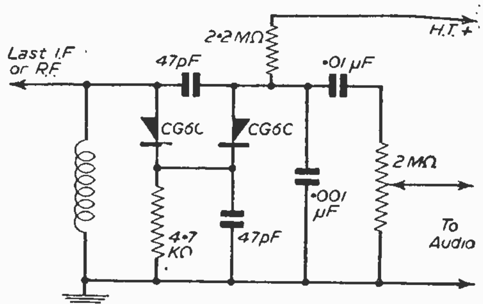


Fig. 13.—Noise limiter in a S.W. receiver.

Testing Condensers

QUITE a large number of beginners, and even some that have been in radio for a number of years, have no means of measuring capacity at low frequencies, and absolutely no means of measuring insulation. One of the most useful measuring devices and perhaps one of the cheapest is the neon indicator, and there are many types available on the surplus market at the moment; some can be obtained for a matter of one shilling.

An article dealing with the construction of a very simple condenser testing and capacity measuring instrument. The components can for the most part be found in the average spares box.

It will be remembered that there is a phase difference of 90 degrees between the voltage across the condenser and a resistor in series. The formula for the combined impedance is $Z=\sqrt{R^2+\left(\frac{1}{wo}\right)^2}$ and since the voltage developed across either the resistor or the condenser is dependent on the ratio of the two impedances, if the capacity of the condenser is reduced then the resistor must be increased to maintain the voltage ratio.

Simple Circuit

Fig. 1 shows a simple capacity tester circuit; the resistance is adjusted with the condenser connected so that the neon is only just struck; the variable resistor can quite easily be a potentiometer and it is a simple matter to calibrate it in terms of capacitance, by the simple expedient of connecting a condenser of known value to the device and "balancing," then marking the scale at the appropriate point. It is as well to use close tolerance condensers in order that the calibration shall be accurate. The disadvantage with using a potentiometer is that the higher capacitances are all cramped at one end; it is a better idea to find the resistance to be placed in series with, say, a 0.1 μF for balance. The value of this will depend on the neon used, as the striking voltage of neons varies from about 75 to over 250 volts, and wiring a series of multiples and sub-multiples of this resistance to a wafer switch. If, say, a resistor of 30,000 ohms is required, then the resistors required for the range would be: 3,000 for 1 μF, 6,000 for 0.5, 12,000 for 0.25, 30,000 for 0.1, 60,000 for 0.05, and so on; in this way it is possible to build up quite a range of capacities that can be measured. With condensers it is not usually essential that the capacity be measured to a high degree of accuracy. For decoupling condensers the value is not particular to 200 per cent. above, but lower values cannot be tolerated. As A.C. is used for the testing, this device is not suitable for the testing of electrolytics, as there is no polarising voltage and the large current drawn would burn out the mains transformer, the most suitable type of which is one of the numerous little Pre-Amp transformers manufactured by quite a number of reputable firms. The instrument can, of course, be used direct off the mains, but the use of a transformer greatly improves the factor of safety.

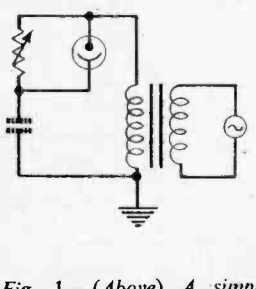
Insulation

Insulation is another thing that is very important. How often does the user of surplus or second-hand condensers make an amplifier or receiver and find that the output valve is running very hot, and the mains transformer seems to be overloaded? The most likely cause of this is a condenser of doubtful insulation value between the anode of the drive valve and the grid of the output valve. A simple insulation test on the condenser before use would prevent numerous troubles of this type.

An Improvement

The circuit shown in Fig. 2 is an improvement on the capacity-measuring device, so that insulation can also be measured. The rectifier is shown as being of the metal type, but almost any six-volt valve with all the spare electrodes strapped to the anode can be used. If size is of consequence, then a 6H6 is indicated, although the writer prefers the Mullard EZ41, as it is of small diameter and of much lower impedance. The condenser can be almost anything over 1 μF in either paper or electrolytic and as small 8 μF electrolytics are readily available one of these was chosen. The 1 MΩ resistor acts as a bleeder to bleed away the charge from the condenser when the unit is not in use.

The operation of the unit is to connect the condenser or component under test between the insulation test terminal and the common, and if there is a permanent light, the insulation of the condenser is at fault. There should be a flash when the condenser is connected and then a flash every several seconds if the condenser is a good one; if the condenser is exceptionally good, it may be a flash every several minutes. One point here is that the terminals must be very well insulated, I might even say exceptionally well insulated.



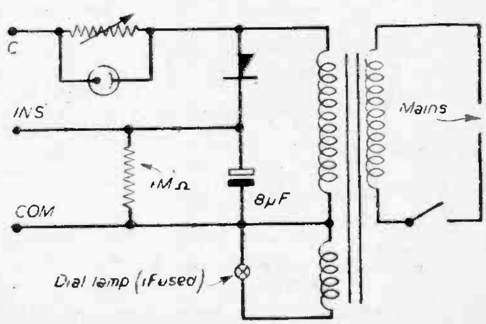


Fig. 1.—(Above) A simple capacity tester, and Fig. 2 (right) the final circuit adopted. A neon should be included in the INS lead.

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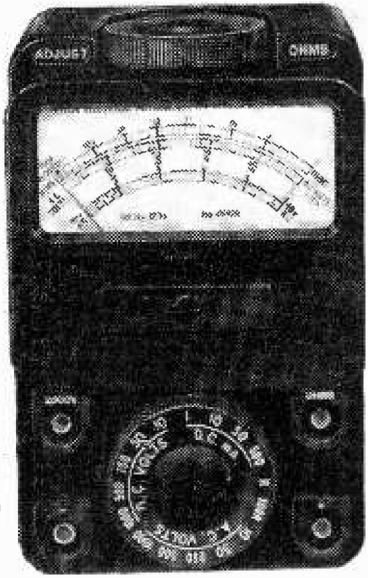

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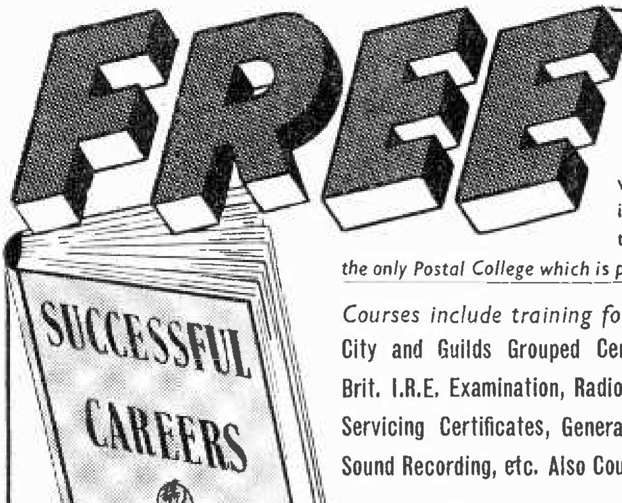

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Predicting Amplifier Response

FACTORS USED IN WORKING OUT FREQUENCY AND GAIN VALUES

By N. J. Wadsworth, B.Sc.

AN amplifier is often required which will give a stated voltage gain between certain frequency limits and provide a certain output voltage. Examples of this are audio frequency amplifiers of various kinds and amplifiers for oscilloscopes, the latter having the more stringent specifications. Many people can calculate the gain of an amplifier from the valve data and the component values using the formulæ: (1) gain of a pentode = g.Rl where g is the mutual conductance and Rl the anode load, and (2) gain of a triode = μRl/(Rl + ra) where μ is the amplification factor of the valve and ra is the anode impedance with Rl as before. They do not know, however, how to calculate the frequency response curve, i.e. how the output will vary with frequency. Thus, while it is well known that the larger the coupling capacitor the better the low-frequency response, it is not always known how large to make it for a given low-frequency cut off. Other questions which arise are—how large should the screen decoupling capacitor be? Is 25μF sufficient to by-pass the cathode bias resistor? What will be the high-frequency limit of the amplifier? How much phase shift will there be at 50 c/s? These and related problems will be covered in this article.

The first point to consider is the response curve necessary for various types of amplifier. For quality audio work the gain should be reasonably constant from about 30 c/s to 15 kc/s although, if it is constant between 50 c/s and 10 kc/s, the reproduction is still good. In audio work, small phase shifts have very little effect. An amplifier for an oscilloscope must have zero phase shift over a wide range of frequencies, say from 30 c/s to 50 kc/s or perhaps up to 200 kc/s. This needs much more careful design.

There are a number of different ways of presenting the response curve of the amplifier. For audio work the gain is usually expressed in "db." Here db is interpreted as

$$20 \log \left(\frac{\text{output volts at f}}{\text{output volts at a standard frequency}} \right)$$

and is not a power ratio at all. This is a very convenient, although not strictly correct, use of db. In this system, each halving of the gain appears as a 6 db drop whether the gain is reduced from 2 to 1 or from 1,000 to 500. Phase is normally unimportant and a 1 or 2 db drop is inaudable.

For C.R.O. amplifiers, since the output is presented visually, it is more usual to use the actual voltage gain rather than its log, and to keep it as accurately constant as possible; even a 2 per cent. drop being readily visible. Also, if complex waveforms are to be presented unaltered, it is essential that the phase shift in the amplifier be very small over the working range. This is also necessary when using X and Y amplifiers to plot external variables such as the anode voltage and current of a valve.

In television video amplifiers, and C.R.O. amplifiers when square waves are used for testing, the "transient response" is of importance. This is the output waveform when a square wave of very rapid rise time and long duration is applied to the input.

We will now consider a single valve amplifier in detail and discuss the response of each portion in turn and then discuss the effect of using more than one valve and also of various gain control circuits.

Low Frequency Response

The most well-known cause of loss of output at low frequencies is the coupling capacitor. The basic circuit is shown in Fig. 1. The response of this

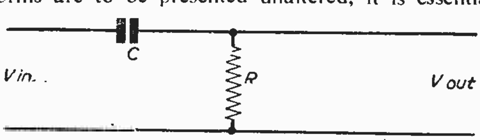


Fig. 1.—Basic circuit of L.F. input arrangement.

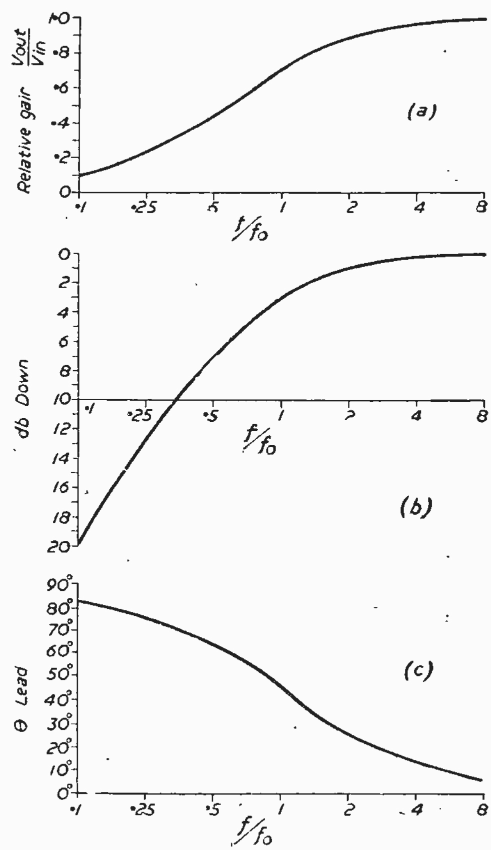


Fig. 2.—Graphs showing gain, frequency response and phase shift.

circuit is given by Fig. 2. To use these curves, which apply for all values of C and R, first calculate $f_o = \frac{1}{2\pi RC}$ and then for any frequency, f, the response may be read off opposite the appropriate value of f/f_o.

In all formulæ in this article all frequencies are in cycles per sec., all resistances in megohms, all capacities in μF, all conductances in μA/V and all times in seconds.

For example, to find the response of the circuit of Fig. 1 at 30 c/s if C = 0.05μF and R = 500 K Ω we calculate $f_o = 1/(2\pi \times \frac{1}{2} \times 0.05) = 6.36$ c/s. Therefore at 30 c/s $f/f_o = 30/6.36 = 4.78$ and from the curve 2a the output 0.975 is ofmax, from 2b it is 0.17 db down and from 2c the phase shift is 12 deg. leading. Thus while the drop in amplitude is very small the phase shift is not negligible. Since

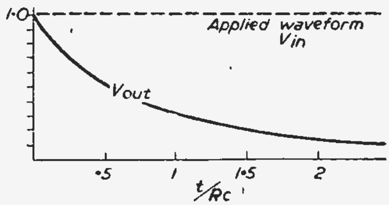


Fig. 3.—Response to a square wave.

it is the start of the output drop and phase shift that is often of importance, Table I is provided giving the relative output, the db drop, and the phase shift φ for various values of f/f_o. The table or the curves may of course be used in reverse. Thus, if a phase shift of less than 5 deg. is wanted at 50 c/s we see that at this frequency f/f_o must be at least 12, so f_o is about 4 c/s. Therefore RC 0.04 M Ω-μF and a 0.04 μF capacitor and a 1 M Ω resistor will do. In practice, a 0.05 μF capacitor would be used. The response of this circuit to a square wave is given by the formula $V_{out} = V_{in} . e^{-\frac{t}{CR}}$ where the time after application of the voltage is t. This is plotted in Fig. 3 and, as will be seen, the voltage has dropped about 10 per cent. after a time CR/10 and is down to 37 per cent. of its maximum after t = CR.

To keep phase shift low at very low frequencies, R is made as large as the valve manufacturers allow, normally about 2 M Ω, and C is made as large as possible consistent with low leakage.

If the load resistance of the preceding valve is comparable with R, for high accuracy in calculating f_o, R in the formula should be replaced by $R + \frac{Rl.ra}{Rl+ra}$ where Rl is the anode load and ra the anode impedance of the preceding valve. In almost all practical cases this correction is negligible.

A lesser known cause of drop in output at low frequencies is the capacitor, Ck, across the cathode bias resistor, Rk, in the circuit of Fig. 4. As the frequency falls this becomes less effective and the output drops. The shape of the curve is shown in Fig. 5 where G1 is the gain calculated assuming the capacitor has zero impedance, i.e. the usual valve gain, and G2 is the gain with no capacitor, that is G1/(1 + gRk) where g is the mutual conductance as before. The upper part of this curve is similar to that of Fig. 2 putting $f_o = \frac{1 + g\,Rk}{2\pi\,Ck\,Rk}$ and this may be used with reasonable accuracy till the loss of gain is about half the maximum. For frequencies below this, the phase shift returns to zero and the gain slowly drops to G2. As an example, consider

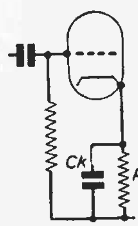


Fig. 4.—Cathode circuit of an L.F. stage.

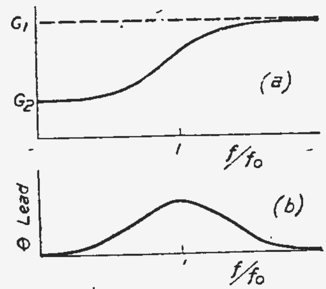


Fig. 5.—Curves for L.F. stage as at Fig. 4.

the circuit of Fig. 4 with Ck = 25 μF, R k = 150 Ω, g = 7 ma/V, typical values for an SP61 or an EF50. f_o is about 80 c/s and from Table I the phase shift is about 19 deg. at 250 c/s. This shows one cause of phase shift that is often unsuspected in oscilloscope amplifiers. The square-wave response of the circuit is shown in Fig. 6 where V1/V2 = G1/G2. It is often impracticable to make Ck large enough to cause little phase shift at the lowest frequencies wanted in an oscilloscope amplifier, and it is then necessary to leave it out all together, thus reducing the gain to G2 at all frequencies and improving the valve linearity by the negative feedback.

A third cause of drop in response at low frequencies is the screen decoupling capacitor Csg in Fig. 7. This has much the same effect as the cathode capacitor just described. To keep the phase shift and drop in gain low, either the resistance of R1 and R2 in parallel must be much less than the screen grid impedance rsg (analogous to anode impedance) of the valve, in which case Csg may be dispensed with, or the reactance of Csg at the lowest wanted frequency must be very small compared with R1, R2 and rsg in parallel.

(*To be continued.*)

TABLE I

f/f_o	Relative output	db down	φ
0.5	0.44	7.2	64°
1.0	0.71	3.0	45
2.0	0.89	1.0	26
5.0	0.98	0.16	10.5
10.0	0.995	0.05	5.5
20.0	1.0	0.01	2.9
50.0	1.0	0	1.0
100.0	1.0	0	0.4

TABLE II

f/f_1	Relative output	db down	φ
0.01	1.0	0	0.4°
0.02	1.0	0	1.0
0.05	1.0	0.02	2.9
0.1	0.995	0.05	5.5
0.2	0.98	0.16	10.5
0.5	0.89	1.0	26
1.0	0.71	3.0	45
2.0	0.44	7.2	64

Making a Tape Deck

HINTS ON THE CONSTRUCTION OF TAPE-RECORDING MECHANISMS

By R. Bissett, M.A.

AN essential part of most tape recorders is a capstan whose function is to drive the tape at a constant speed. The spooling of the tape may be on shafts driven by the capstan motor or, more simply, each spool may be mounted on its own motor shaft. The making of the capstan and its associate flywheel presents a real difficulty, almost an impossibility, to those with no facilities. Only the machining expert can approach the standards of wow-free and flutterless traverse claimed for commercial machines.

It occurred to the writer from a study of wire-recording mechanisms that constant speed is not a pre-requisite. In many designs the take-up spool

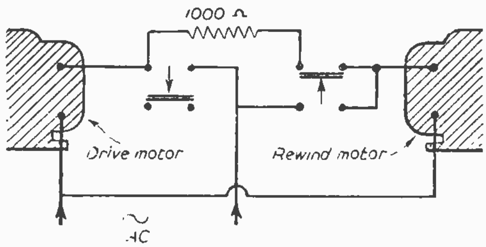


Fig. 1.—Mains supply to motors—switch set off. Cam operates one or other of the micro-switches.

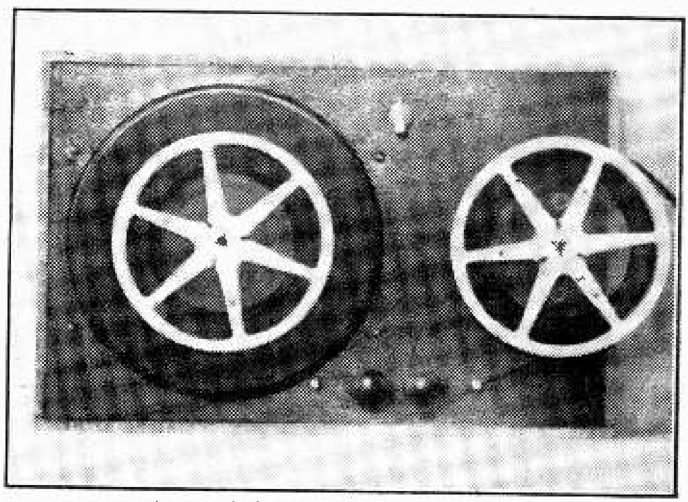
supplies the drive to the wire, and the speed of the wire varies as it winds on to a larger diameter. Admittedly the change in speed of the wire from start to finish may only vary 10 per cent. or less. The mechanism to be described here employs the take-up spool as a drive for the tape and the spools used are non-standard. It will be appreciated that the standard 7in. spool with inner diameter of 1½in. would cause a variation in tape speed of more than four to one between start and finish. This has two objections. First, if the slower speed is high enough to make a recording, there is excessive waste of tape as the speed increases. Secondly, the frequency corrections would have to be changed during the course of the recording. With the arrangement here, however, the speed variation is less than one and a-half to one.

Drive Motor

The drive motor is a BSR MU-10 gramophone motor complete with rubber-covered turntable. These motors employ between the driving shaft and the turntable a spring-held idler wheel, and this acts as a mechanical filter which, together with the inertia of the turntable, ensures that the speed is very regular indeed. The two-speed collar should be removed from the motor shaft and a thin piece of rubber sleeving slipped over the shaft in its place. By choosing a suitable thickness of sleeve, the turntable may be made to revolve at any speed from about 40 r.p.m. down to 26 r.p.m. In order that the turntable may revolve in an anti-clockwise direction (for rewind), a thin flexible wire should be fixed to the nut below the idler wheel spindle. A soldering tag is a good way of fixing the wire if the tag is soldered to the underside of the nut. The other end of this wire is attached to the switch controlling the motors and it pulls away the idler from the turntable when rewind is in progress. There is sufficient adhesion between the spool and the rubber mat to carry the spool round without slip.

Rewind Motor

For the rewind motor the writer uses a Hoover model SP 202 running anti-clockwise at 950 r.p.m. with a shaft $^9/_{32}$in. diameter, the same size as the turntable spindle. Any shaded-pole motor of reasonable torque made to run anti-clockwise and preferably not less than four poles will serve if the shaft is made up to $^9/_{32}$in. by a sleeve. To this shaft must be fitted a disc about 1¼in. to 2in. in diameter on which the spool is carried. The disc must be a tight fit on the shaft (or sleeve) or it may be held by a grub-screw. It is important that the centre hole be drilled truly vertical. The writer uses a bakelite disc ¼in. thick, but a flat surface radio knob might serve. A 6 B.A. pin is screwed into this disc and engages with a hole



A tape deck constructed by the author.

in the spool to give a positive drive. When the tape is driven forward the rewind motor is partially energised via a resistance of about 1,000 ohms. (A mains dropper from A.C./D.C. radio is suitable.) This is the usual method of ensuring that sufficient drag is applied to the tape to keep it taut as it winds off.

The Spools

These are the only parts which call for machining. Two discs 3/16in. thick and 4½in. diameter are required, and they must be true to a 9/32in. centre hole. The material may be a close-grained wood, ebonite or one of the plastics. Some firms will supply plastic items ready made. These form the spool centres. For the cheeks, 7in. plastic spools were cut (Scotch Boy type). The centre drum should be sawn through and the remains of the drum filed away, taking care not to split the cheeks in the process. These cheeks were first cemented to the centre discs. Holes were then drilled through alternate spokes 1⅛in. from the centre and tapped 6 B.A. to take short countersunk brass screws from both sides. Such a spool can hold 600ft. of tape. Two spools were made in order to use double-track recording. Storage of tape, of course, should be on standard spools.

The Heads

The writer prefers heads to which the tape makes contact on the "wrap round" principle as these obviate the use of pressure pads and their mechanism. Those wishing to make their own heads may, as the writer did, procure mumetal and radiometal laminations (ready cut and stacked if desired). The shape preferred is shown in Fig. 2. A housing may be made from thin-walled brass tube about 1in. in diameter. A length of ¾in. is cut off for each head and an extra ring ⅛in. wide to provide tape guides. A slot is filed so that the laminations peep through the circumference of the tube and make contact with the tape, but not so far through as to push it away from the guides. A brass or copper disc with a centre hole should be soldered into the lower end of the tube. Two arcs about ¾in. long are cut from the ring and soldered to the outside making a ¼in. channel for the tape. The head is held in place inside the housing by a rubber pad. An extra refinement consists of two discs and a band of mumetal to line the inside of the housing, the lower disc having a hole so that the screened lead may pass down through the mounting bush, which is soldered to the underside of the mount. A metal or bakelite cap cemented into the top of the housing completes the head except for smoothing off with 00 glasspaper and metal polish.

The Switch

The switch uses the locking mechanism of a three-way rotary. A cam makes or breaks micro-switches for the motors and carries the flexible wire to pull off the idler on rewind. The length of this wire should allow the idler to engage as soon as the switch is turned to the central "off" position, thus braking the turntable and preventing spilling of the tape. No brake is required on forward drive. With suitable wafers on the switch spindle a four-way rotary may be used to make appropriate amplifier connections as well as controlling the motors; record—playback—off—rewind.

Mounting the Parts

The drive motor should be mounted on a small sub-baseboard about 11in. x 7in. The deck is most readily made from ¼in. plywood with a hole 10⅛in. diameter cut so as to leave ½in. of deck at the back, front and left-hand side. The motor board is fixed to this by four 3/16in. bolts with ¾in. spacers so that the surface of the turntable lies ¼in. to ⅜in. above the deck. The rewind motor has two metal tags fitted within the clamping bolts and these tags may be used to bolt the motor to the underside of the deck after a ½in. hole is made to let the shaft through. Other types of motor will require other methods. The distance separating the two shafts and the minimum

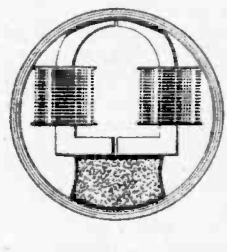


Fig. 2 (Above).—Plan view of head held within housing by rubber edge.

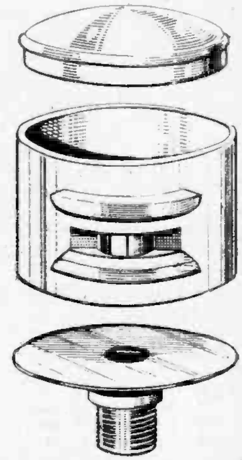


Fig. 3 (Right).—Parts of housing for the heads. Dotted lines show how guides are placed in relation to slot.

length of the deck depend on the size of the spools to be used (see below). Two pieces of ¼in. brass rod about 1in. long should be fixed to act as tape guides, so that the tape approaches and leaves the heads always at the same angle irrespective of the amount on the spools.

Playing Time

Assuming 30 r.p.m. the 7in. spool takes on 600ft. in 13½ minutes and the tape speed varies between 7.2in. and 10.4in. per second. By making larger spools, say 9in. flanges with centre hubs 5½in. diameter, 1,200 ft. may be accommodated and at the slowest turntable speed (26 r.p.m.) a playing time of 25 minutes may be obtained, with a speed variation from 7½in. to 11½in. per second.

One special application of this tape drive is used for office dictation. A normal 5in. spool carrying 600ft. is used for the feed. The take-up spool is 7in. with a 4in. centre hub and full track heads are used, giving about 18 minutes running time.

The limitations of this drive mechanism should be apparent to every reader, but it is very suitable for many uses that an amateur may require from a recorder.

Electronic Organs

ANSWERS TO SOME QUERIES REGARDING OUR OWN ORGAN DESIGN, AND DETAILS OF SOME OTHER PRINCIPLES

By W. J. Delaney (G2FMY)

A VERY large number of queries were received concerning the organ design which has recently been published in these pages, and many of these showed that the general principles of electronic organ design are not realised. Quite a large number of readers could not understand why the organ only played one note at a time and could not see why chords could not be played ; others wanted to know whether the design could be extended to include more octaves ; still others wanted to change the range of the instrument to another part of the musical spectrum.

Dealing first with the design as published, it should be stated right away that experiments were made over a considerable period of time and that the range and design, as given, are the very best which can be obtained with the minimum of cost. If expense is no object, the design can, of course, be modified in various directions, but with a small additional outlay very little can be done. If much is to be spent, then it would undoubtedly be worth while to build a polyphonic instrument.

Pitch

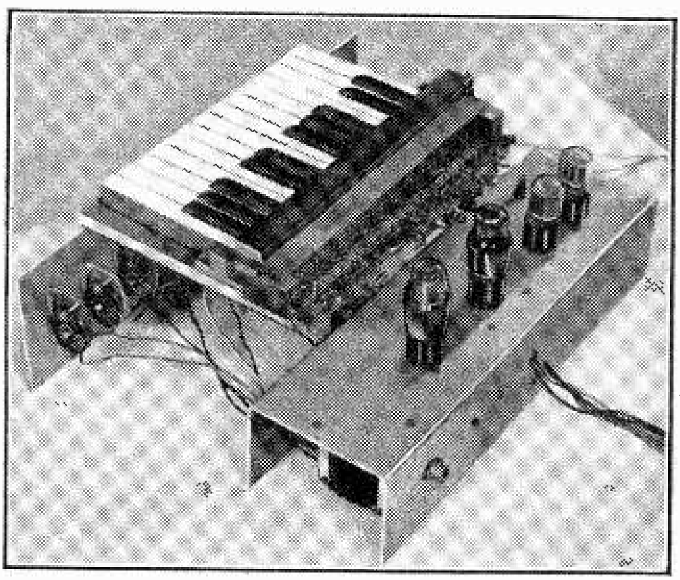
The instrument was suggested with a two-octave keyboard (actually 24 notes), and this may be modified by taking the lower C to the top of the keyboard, or moving the entire keyboard up or down two or three semitones *only*. This will answer those queries who wanted to know whether it would be practicable to make it a three-octave range. As indicated in Fig. 3 on page 414 of the September issue, the relationship between adjacent half-tones is by no means constant, and it will be found, if the keyboard is extended, that at extremes of the range the notes will not bear the same relationships and accordingly, although it could be tuned up on one range of the octave switch, when switched to the other ranges it would go out of tune on certain notes. The differences may be slight, but to anyone with a musical ear the notes will sound unnatural, being very slightly sharp or flat. For this same reason, the octave switching condensers C4, C5 and C7 should not be increased to widen the range of the instrument. It has been suggested that each value could be four times that of the lower, so that the shift would be by the entire range of the keyboard. On the face of it this should work, and actually it will in one part of the piano keyboard, but in general it is not a practical proposition.

Chords

With regard to the playing of more than one note at a time, it should be realised that the note is formed by the valve V2 being set into oscillation, the frequency of this type of oscillator being dependent upon the values of the anode condenser, the grid resistance, and/or both. Thus, the frequency may be changed by changing the value of either the condenser, the resistance or both. In playing, the grid resistors are changed by the action of the keys, and obviously the pressure of more than one key at a time will merely mean that the value of the grid resistance is that between grid and the highest key pressed, all keys lower than that merely being on the earth side and having no effect whatsoever on the grid circuit. Thus the highest note always sounds, and there is no way of arranging that two separate notes can be produced at the same time in that stage. One reader thought that a duplicate range of switches could be wired into circuit so that two notes could be played at once, but a little thought will show that if another range of resistors is wired across the grid circuit, pressing two keys would merely place two resistors in parallel and still produce only one note.

Polyphonic Arrangements

Whilst on this subject of playing two or more notes, it may be explained that in an electronic organ



Only two octaves were specified in the "P. W." organ, but multipliers increased this to five. It is not recommended that a three-octave basis be used.

designed for the playing of chords each note of the scale must be produced by a separate generator. This may be a triode or double-triode valve, with arrangements similar to that used in the present design, but there will have to be 12 of these to produce a single octave. Therefore, the minimum number of valves which can be used in a polyphonic organ is 12, plus at least a further 12 for each additional octave, which can only be obtained by using a frequency multiplying circuit. For a normal five-octave keyboard, therefore, the customary arrangement is to make a note generator with three frequency multipliers, giving four valves per note for five octaves, which means that for the 61-note keyboard there would be 4×12 or 48 valves, plus those used for vibrator, tone and amplification.

Pedals

Two ambitious readers wanted to know whether a pedal attachment could be added, the idea being to use the instrument in conjuncrion with another electronic organ to produce a fuller tone. This could most simply be done by adding another oscillator on the lines of V2, with a .1 μF anode condenser and appropriate grid resistors for one octave only. The output could be taken from the anode of the oscillator through a .05 μF condenser to the grid of V3. This has been tried and works without pulling, provided that the lower notes are at least one octave below the lowest note produced on the instrument as designed. If there is any pulling, the only satisfactory solution will be the inclusion of a buffer stage between the pedal note generator and V3, and this may easily be arranged by making C3 a double triode.

Simplified Tuning

To simplify the work of selecting correct values for Ra to Rx variables may be used, but in view of the critical values which are needed it will be found that the best plan is to obtain a length of paxolin and punch along its edges small holes to accommodate the wire ends of resistors. For each note you would then need a 1,000-ohm variable—one of the Egen banked type components pre-set being ideal and the fixed resistors being selected as already explained, but with the slider of the variable in its central position. The resistor is then selected to be nearly correct, final adjustment being carried out on the variable. As already explained, however, this will only save time in the initial setting up and the variable factors will have no future use as they cannot be separately adjusted without upsetting the entire keyboard.

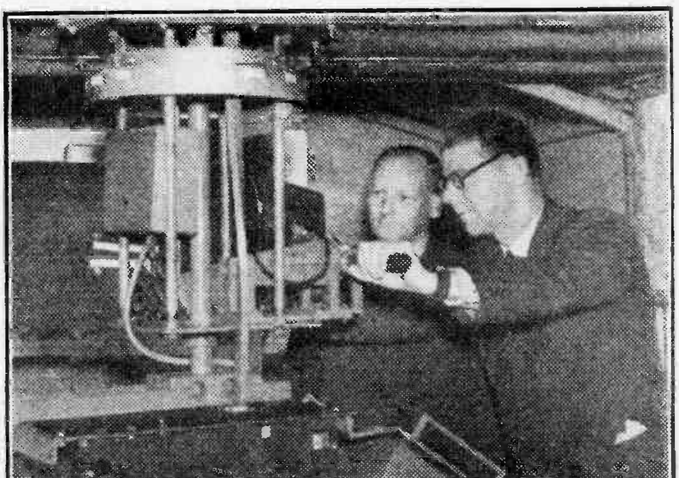
New Premises for Schools Broadcasting Department

FROM September 22nd, when the new schools broadcasts term began, programmes have been originating from the new building recently taken over by Schools Broadcasting Department, Nos. 1 and 1A, Portland Place. This is conveniently situated just across the road from Broadcasting House and replaces the temporary accommodation at Film House, Wardour Street, which the department has occupied since 1945. The new building contains, in addition to offices, five studio suites designed and constructed to meet schools broadcasts requirements. There are three general purpose studios, two talks studios, their associated control cubicles, an "echo room" for the production of artificial reverberation, and an apparatus room.

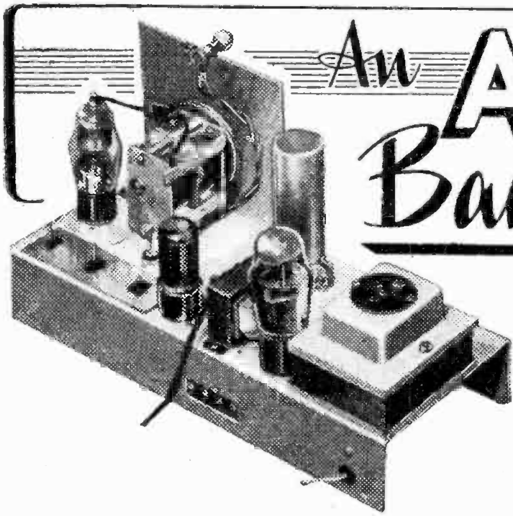
The technical equipment, built to the latest BBC design, enables each studio suite to function as a self-contained unit. Each studio has its own control cubicle containing a desk on which are mounted all the necessary operational controls. In accordance with modern practice each microphone has its own amplifier. The outputs of these amplifiers are fed first to a mixer unit on the control desk where they can be selected individually, or combined, as required, and then to a main amplifier, which is also controlled on the desk, so that the general level of the programme can be maintained within the appropriate limits. Provision is made for adding artificial echo in varying amounts to any of the microphone or gramophone points.

Means are also provided to link the outputs of three of the other studios to the control desk in the cubicle of Studio 5, which then acts as a master control position, and has its talk-back, cue light controls, and similar facilities extended to them. Such linking arrangements augment the usefulness of the studios and permit of more ambitious productions.

The installation is of special interest in that once the studio equipment has been set up ready for use it can be switched on and off as required from the main control room in Broadcasting House.



Mr. Bernard Collins, manager of Southend Airport, who is to demonstrate the Ekco airfield radar approach aid in America, is seen with the equipment watched by Mr. A. W. Martin, technical director of E. K. Cole, Ltd., who was responsible for developing the approach aid.



An A.C. Band-Pass 3

A DETECTOR-L.F. CIRCUIT WITH VALVE RECTIFIER AND HIGHLY SELECTIVE TUNING. AN R.F. STAGE WILL BE DESCRIBED LATER

SOME constructors who have built a number of battery-operated receivers seem hesitant about attempting a mains receiver, and this design should be of particular interest to them. It employs a pentode detector followed by a beam tetrode output stage, the third valve being the rectifier, which is of full-wave type. This type of circuit is very much less complicated than the usual superhet circuit, but can, nevertheless, give good results. Reaction is provided, and this considerably increases sensitivity to weak transmissions. For listening to the local stations, under average conditions, this control need not be used, and a volume control, combined with the on/off switch, is provided. In order to achieve a good degree of selectivity, two tuned circuits are employed, with top-capacity coupling. This avoids the flat tuning which can be so troublesome with simple "straight" receivers.

Such a circuit provides good volume and range, but selectivity and sensitivity equal to that obtained with a larger receiver using more valves must not, of course, be expected. Nevertheless, very powerful reception of local stations is possible, and quite a number of more distant transmitters can be picked up at good volume. Accordingly, the receiver should prove of real utility, and quality of reproduction is fully up to the general standard of ordinary receivers.

A fairly large chassis is used so that wiring and components are not unduly cramped, and this allows space for either a 6in. or 8in. speaker to be mounted

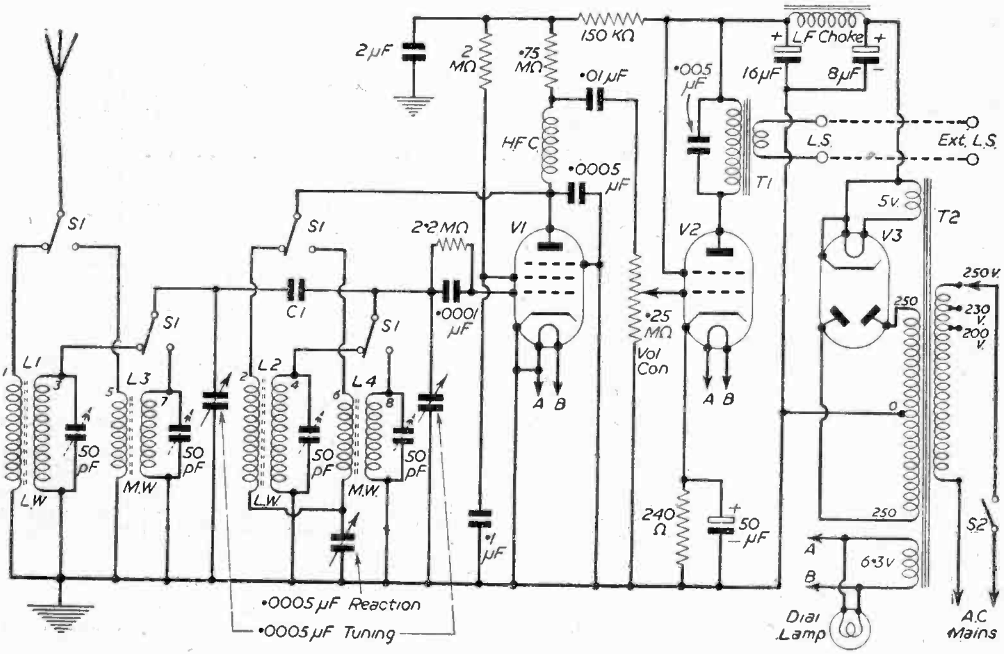


Fig. 1.—Theoretical circuit of the A.C. Band-Pass 3.

opposite to the tuning dial. The size of speaker fitted can depend upon personal preference. The larger type of speaker does give slightly improved reproduction, especially at the lower frequencies, but the improvement is not very significant. With the smaller speaker, the overall size of the receiver is reduced.

Tuning System

Four separate dust-cored coils are used, two for medium waves and two for long waves. The pairs of coils are quite separate, and are selected by a 2-way 4-pole rotary switch. The primary windings of the aerial coils are used for aerial coupling, to avoid excessive damping which would otherwise be imposed by the aerial. Coupling between the two circuits is provided by C1, and this condenser can be adjusted between quite wide limits. When the capacity is very small, selectivity (sharpness of tuning) will be high, but volume will be reduced. As the capacity is increased volume increases but selectivity is to some extent reduced. Because of this, it is best to adjust the capacity of C1 by trial, initially, as will be explained.

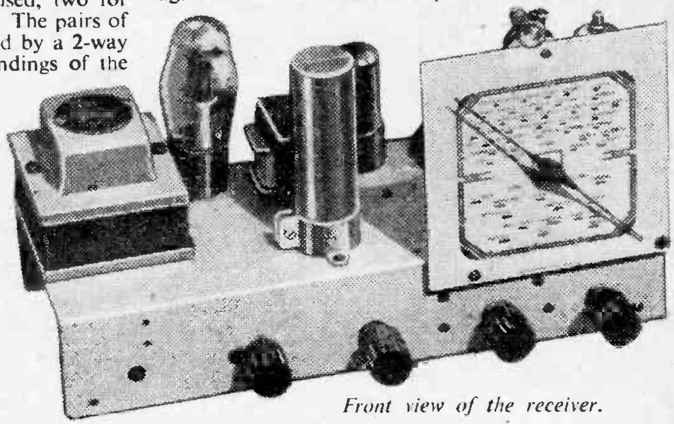
In addition to the adjustable cores of the coils, a small pre-set condenser is wired in parallel with each tuned winding. These enable correct alignment to be obtained, and the initial adjustment of them is very simple.

An illuminated tuning dial with stations and wavelengths indicated is specified, the gang condenser being driven by a cord reduction arrangement from the outer, right-hand control knob. The adjacent knob is for wave-changing, and the next for reaction. The left-hand knob provides on/off switching and volume control.

Practical Construction Details

The positions of all the components will be seen from the diagrams. The valveholders may be secured either above or below the chassis, the key-ways being positioned as illustrated. It is most convenient to leave the speaker and tuning dial to be fitted later, otherwise it will be difficult to work with the chassis in an inverted position.

The heaters may be wired first with advantage, using twin flex. One length of flex is taken from the 6.3 v. secondary of the mains transformer to tags 2 and 7 on the 6V6 holder. A further length goes to tags 2 and 7 on the 6J7 holder, from which additional



Front view of the receiver.

leads pass up to the dial lampholder. The 5 v. secondary feeds the rectifier heater, the heater tags being 2 and 8, in this case. Tag 8 is also the cathode, and goes to the 8μF section of the smoothing condenser, and smoothing choke.

The smoothing condenser consists of 8μF and 16μF values in a common tubular can, the negative connection being obtained by bolting the retaining clip to the chassis. In the

LIST OF C

2-gang .0005μF conde
dial. (Osmor.)
H.F. choke, Type QC1
4-pole 2-way rotary sw
"K" type coils No.
(T. G. Howell.)
Four .00005 μF pre-
Electronics.)
20 henry, 250 ohm,
(Osmor.)
8 plus 16 μF smoot
(Osmor.)
.0005 μF reaction con
.25 megohm volume co
Radio.)
250-0-250, 5 v., 6.3 v.
former. (Osmor.)
Four 1¼in. dia. control
etc.)
13½in. by 5½in. by 2½in
(Osmor.)
Three McMurdo octal
2.2 MΩ ½ watt resistor
2 MΩ ditto.
.75 MΩ ditto.
150,000 MΩ ditto.
240 MΩ 1 watt resisto
.0001 μF fixed condens
.1 μF ditto.
.0005 μF ditto.
2 μF ditto.
.01 μF ditto (mica).
.005 μF ditto.
50 μF bias condenser
6J7, 6V6 and 5Z4 valv
6.3 v. .3 a. dial light a
6in. to 8in. P.M. speal
6 B.A. nuts, bolts, con

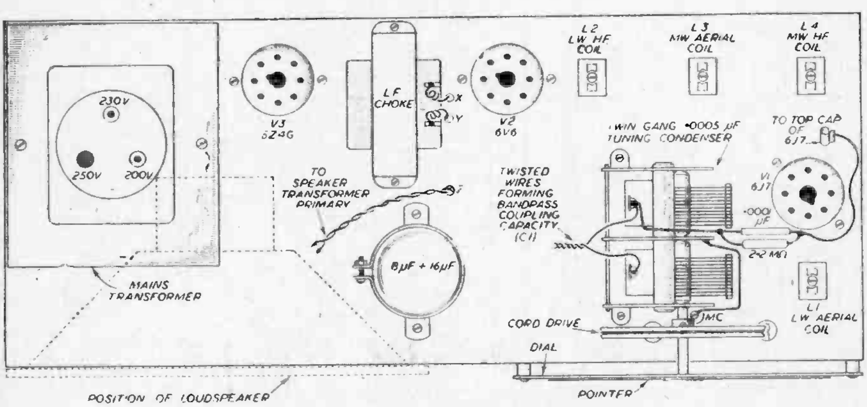
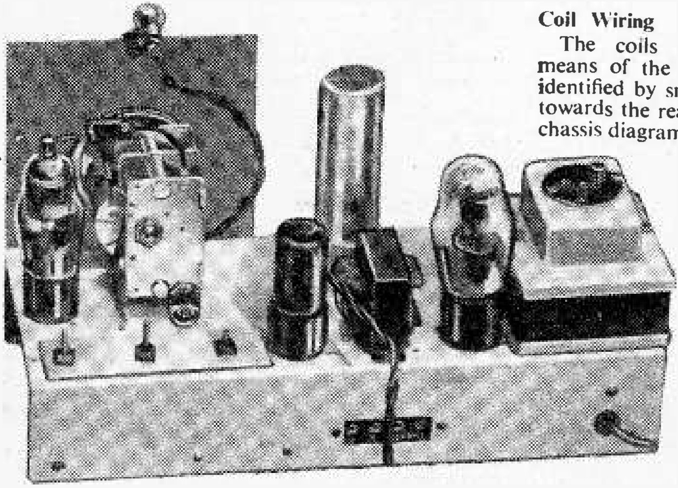


Fig. 2.—Above chassis view showing wiring.

specified type the 8μF tag is marked red.

The mains input leads pass through a rubber grommet in the back runner of the chassis, and are soldered to a small 2-way tag board. If this is not done these leads should be otherwise made secure to withstand any pulling which may arise.



Rear view of the receiver.

All leads should be reasonably short and direct, and kept clear of each other. A number of points are marked " M.C." and these are wired to the chassis. A lead from the moving plates tag of the tuning condenser to chassis is necessary, as the condenser specified has rubber-bushed feet. Two flexible leads pass up through the chassis from tags 3 and 4 of the output valve ; these are subsequently connected to the primary of the speaker transformer. The second pair of sockets at the rear of the chassis provide extension speaker connections. Two leads from these are taken to the secondary of the speaker transformer.

Coil Wiring

The coils are secured in ¾in. dia. holes by means of the spring clips provided. The tags are identified by small notches, and these are positioned towards the rear of the chassis, as shown in the sub-chassis diagram. Both primary and secondary of both aerial coils are connected to the chassis ; so are the secondaries of the two H.F. type coils. The two reaction windings are returned to the reaction condenser. This leaves eight tags to be connected, and these are numbered to show how the wave change switch is wired to them. When the switch is in one position, both medium-wave coils are connected. In the second position, both long-wave coils are switched in. The receiver will operate correctly on one waveband before the coils for the other band are added, and this should be remembered if any confusion in the coil wiring arises.

The four pre-sets are bolted directly to the chassis. In each case the tag bolted to the chassis should be that adjacent to the head of the adjusting screw. It should be noted that the 50μF condenser must be connected in the correct polarity as shown.

Drive and Dial

The large drum is placed on the condenser spindle and the cord passed through the small slot on its rim, and hooked by the spring which maintains tension. The cord is then taken down through one hole in the chassis, round the tuning knob drive, up through the second hole, and given a complete turn round the drum. Both ends are then tied

1PONENTS
with drive and metal
)smor.)
. (Coventry Radio.)
1, 151, 122 and 152.
condensers. (Sussex
mA smoothing choke.
condenser with clip.
er. (Coventry Radio.)
l with switch. (Alpha
p-through mains trans-
s. (Sussex Electronics,
issis, with socket strip.
holders. (Osmor, etc.)
Dubilier T.C.C., etc.
i0 v.)
Or G/GT types.)
older.
ith 6V6 transformer.
ig wire, etc.

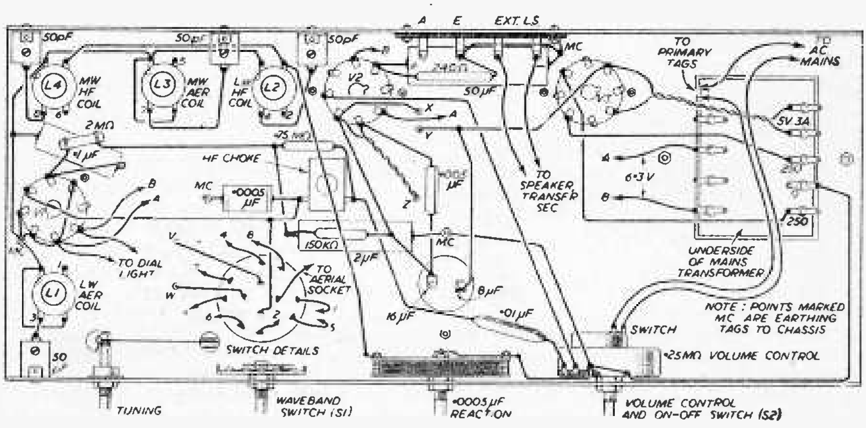


Fig. 3.—Under chassis view and wiring.

together, the cord being pulled tight to stretch the spring. The dial is bolted to the front runner of the chassis, the condenser vanes are closed, and the pointer set at a horizontal position. The dial may be spaced out slightly from the chassis to bring it near to the pointer.

The lamp-holder is bolted to the top of the dial, and fitted with a 6.3 v. .3 A. bulb. If the holder is of the type with one tag common to the fixing bracket then a single lead from tag 7 of the 6J7 holder is all that will be required.

Circuit Adjustments

The mains transformer is equipped with a screw which may be inserted in one of three holes, for 200, 230 and 250 v. mains. Where the actual voltage is not of these figures, it should be inserted into the next highest hole, and tightened down.

Only a very small capacity is required for C1, and this is provided by twisting together two *insulated* wires which have been soldered to the top tags of the condenser, as illustrated. The capacity will depend upon the thickness of the insulation and the length twisted together, in addition to the gauge of wire. Connecting wire with very thick insulation is unsuitable. In cases of doubt, a .00005μF pre-set can be used. However, the capacitance of the twisted wires can be adjusted in a few moments by actual trial.

The four pre-sets below the chassis are set approximately half open, and the coil core-screws turned until about 10 or 12 threads project above the chassis. A station of high wavelength in the medium-wave band should then be tuned in, and the BBC Third. Programme transmitter on 464 metres will probably be most convenient. The cores of the medium-wave coils are then adjusted for maximum volume, and also to obtain a correct pointer indication of the station. As the cores are unscrewed it will be necessary to close the tuning condenser slightly, to keep the station in tune, and vice versa. In this way the inductance of the coils can be adjusted to the correct value. A station of low wavelength is then tuned in, and the medium-wave trimmers are adjusted. A little further adjustment of the cores may then be required. Adjustment to the trimmers should be made at the low-wavelength end of the scale ; the cores should be adjusted only when a high-wavelength station is being tuned in.

Actually, the procedure is very straightforward, but maximum volume will only be obtained when both circuits tune accurately together. The long-wave band is then similarly treated.

Low volume and very sharp tuning will indicate that C1 is of too small a capacity. This can then be increased as explained.

Aerial, Earth and Speaker

Best range and volume will naturally be obtained with a good outdoor aerial and a sound earth. However, satisfactory results are obtainable with an indoor aerial, though range is reduced, due to the lower signal pick-up of such aerials. In the event of an *extremely* short indoor aerial being used, this may be taken directly to the fixed plates tag of the rear section of the gang condenser, if desired.

For proper reproduction the loudspeaker must be enclosed in a cabinet or secured to a baffle board. If the receiver is to be inserted into a suitable cabinet from behind, the speaker may be secured to the chassis by means of a stout bracket. When required, a 2-3 Ω extension speaker may be plugged into the extension sockets at the rear of the chassis. The receiver should not be switched on without the usual output transformer being connected to provide an anode load for the 6V6.

The Marconi/Osram U50 and Mullard GZ30 are equivalents of the 5Z4G. The Z63 and KTZ63 may be used instead of the 6J7 ; a 6K7 or equivalent type will also give quite good results here. The 6V6 will handle a little over 4 watts, with average screen grid and anode voltages of 250.

British Sound Recording Association

LECTURE details for London for the first half of the 1952/53 season, to be held at the Royal Society of Arts, John Adam Street, W.C.2, at 7 p.m.

November 21st.—" Problems of Sound Recording and Reproduction." A discussion, to be opened by a prominent engineer who will be joined by others in the " Brains Trust " which will follow the main discussion. It is hoped that members will take an active part in the " open " discussion following the opening remarks. The Brains Trust will afford an opportunity for members to submit questions on any recording or reproducing problem which they have.

December 19th.—" Equalisers, filters and tone control systems," N. H. Crowhurst, A.M.I.E.E. The lecturer will discuss the design of equaliser circuits to be used with high quality amplifiers ; between stages at high impedance ; at line impedance; the question of termination ; the significance of constant resistance types ; various configurations and equivalents ; methods of achieving desired response shaping ; factors influencing design—response, distortion, possibilities, etc.

Political Education in Malaya

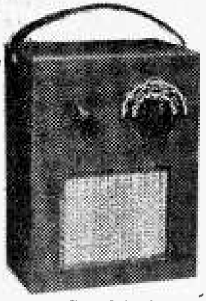
PRIVATE enterprise has played a large part in assisting the Malayan Government to bring the Community Broadcasting Service within reach of the indigenous population in the remoter parts of the country.

This programme which enables them to keep abreast of Malayan news and views was planned to meet a situation in which indvidually owned radio receivers were a rarity. Village communities gather at stated times to hear the programmes from Singapore and Kuala Lumpur—at no cost to themselves.

The General Electric Company has been given a 10-year contract to provide, install and maintain all the battery operated receivers. Since the G.E.C. started installing receivers in Malaya some 720 equipments have been put into operation, the last State to be served being Perak, which has 140, the largest number in any State.

Each radio equipment can and usually does serve a village group of from 100 to 250 people. Special listening hours have been arranged for Community Broadcasts whose programmes are put out in three languages : Chinese, Malay and Tamil. Three dialects of Chinese are used in the Chinese programmes.

DESIGNS FOR THE HOME CONSTRUCTOR



THE "MINI FOUR".—A 4-valve Battery Superhet Receiver, designed by "Practical Wireless" to receive 4 Pre-Set Stations, no tuning being necessary. The complete Receiver can be built for **£9/10/0** (plus case, **15/6**). Send **1/6** for Assembly Instructions, Layouts and Component Price List.

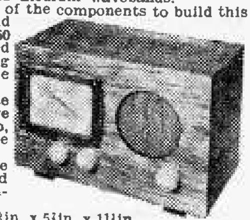
THE "MINI TWO-THREE."—Complete diagrams and layouts from which either a T.R.F. 3-valve set or a 2-valve set (afterwards easily converted to the 3-valve) can be made for **£5/3/0** or **£4/3/6** respectively (plus case, 15/6). Full Instructions, Layouts and Component Price List, 2/-.

THE "MINI TWIN."—The ideal set for the beginner ! A simple 1-valve 2-stage Battery Set covering Long and Medium Wavebands. Can be built for 37/6, plus 9/6 for attractive Plastic Case and 14/9 for suitable headphones. Complete instructions, layouts and price list 1/3.

THE "WIRELESS WORLD" 3-VALVE SET

A Midget 3-valve T.R.F. Receiver for operation on A.C. mains, covering long and medium wavebands.

We are able to supply all of the components to build this set, as designed, and specified in the Feb. 1950 issue, including the drilled chassis, valves and moving coil speaker, etc., at the following prices :—



To construct complete chassis, less dial and drive assembly, **£5/5/0.** Ditto, including dial and drive assembly, **£6.**

To construct the complete Set, including dial and drive assembly and cabinet, **£7/3/6.**

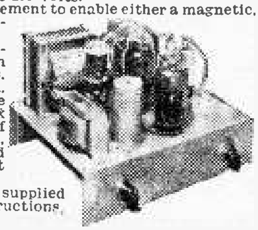
Overall size of cabinet is 7½in. x 5½in. x 11½in.

A reprint of the designer's article, giving Circuit and Assembly Instructions (this is available separately for **9d.**), together with a Practical Component Layout is included with each of above assemblies.

A QUALITY "PUSH-PULL" AMPLIFIER KIT

A Kit of Parts to build a 6-8 watt Push-Pull Amplifier for operation on A.C. mains 200-250 volts.

Incorporates a simple arrangement to enable either a magnetic, crystal, or lightweight pick-up to be used.



A 10-watt Output Transformer is designed to match from 2 to 15 ohm speakers.

Tone control is incorporated.

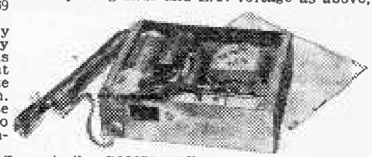
The overall size of the assembled chassis is 10in. x 8in. x 7½in. high. Price of kit complete in every detail, including drilled chassis and valves, **£6/12/6.** Component layout is supplied.

Price of assembled chassis, supplied ready for use, **£8/2/6.** Instructions, layouts and price list 1/-.

"PERSONAL SET" BATTERY ELIMINATOR

A complete kit of parts to build a Midget "Alldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts.

This Eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 69 volts.



The kit is quite easily and quickly assembled and is housed in a light aluminium case, size 4½in. x 1½in. x 3½in. Price of complete kit, with easy to follow assembly instructions, 42/6.

In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. x 2½in. x 1½in. Price 47/6.

★ Send 9d. P.O. for our STOCK LIST, showing many KITS OF PARTS for Sets and Battery Chargers and "hundreds" of Wireless Components. When ordering please include 1/6 to cover cost of postage and packing.

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GERMANIUM DIODES, 3/9.

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SELENIUM RECTIFIERS. F.W. 6 or 12v. 4 A., 26/- ; 24v. 2 A., 30/- ; 3 A., 14/6 ; ½ A., 5/6 ; 250v. 120 mA. H.W., 9/-.

TRANSFORMERS, 200-240 volts, tapped 3-4-5-6-8-9-10-12-15-18-20-24 and 30 volts at 2 A., 21/6. One year guarantee.

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PHONES, High Resistance, 12/6 ; Low, 8/6.

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NEW VALVES. 35Z4, 35L6, 25Z4, 25L6, U281, VP4B, U50, 5Y3GT, 6K7GT, 11/-.

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This unit incorporates a brand new feature which will make an immediate appeal to all tape recording enthusiasts . . .

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- ★Fast forward and rewind.
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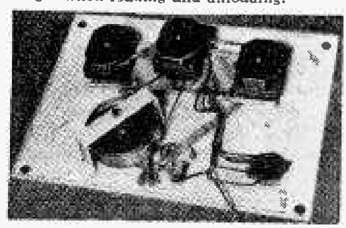
- ★Spare Tape Reel.
- ★Heavy Balanced flywheel.



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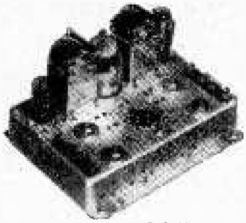

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(Less Dynamotor)

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Containing VCR97 CRT with mu-metal screen. 12 VR91's (EF50), 4 VR65's (CV118-SP61), 3 VR92's (EA50), 2 VR54's (EB34). Plus Pots., Switches, H.V. Cond., Resistors, etc., etc. Built on metal chassis to fit box size 18 x 8½ x 11½ in. All controls brought to front panel beside viewing screen.

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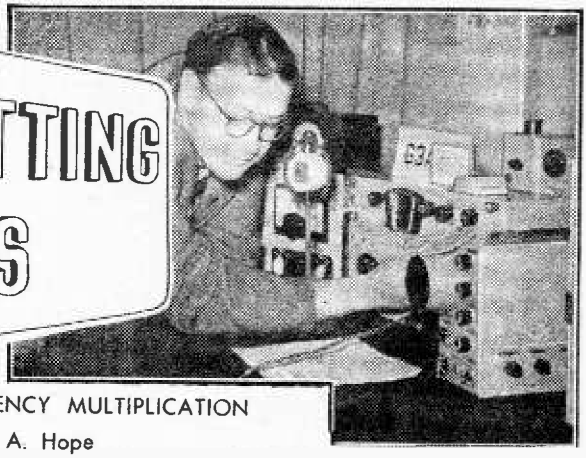

PRINCIPLES OF FREQUENCY MULTIPLICATION

By Wm. A. Hope

THERE appears to be a widespread belief that the multiple of any given frequency is obtained by the "selection" of the required "harmonic," using a rejector circuit in the anode circuitry of the multiplier valve. It all depends what one means by the word "selection."

This article was written to clear up any wrong ideas on this subject, and to give, briefly, the basic principles of the frequency multiplier.

Pendulum Analogy

This analogy makes use of the well-known pendulum/escapement system, where the escapement represents the anode current variation of the multiplier valve; whilst the pendulum represents the anode tuned circuit. Let us suppose that the escapement actuates the pendulum once in every four cycles; therefore, we can say that the frequency of oscillation of the pendulum is four times that of the escapement. If the escapement frequency is considered as the "fundamental," the frequency of oscillation of the pendulum represents the fourth "harmonic" of the "fundamental" frequency.

The normal frequency multiplier operates in roughly the same manner as the P.A. stage of a transmitter, except that the control grid is biased further beyond the valve "cut-off" point and the R.F. input to the multiplier is considerably increased. This results in increased intensity of the Ia pulses, which last for a much shorter period of time.

These short Ia pulses cause the tuned circuit (which is tuned to a multiple of the fundamental frequency) in the anode circuit of the multiplier to be driven into oscillation at its predetermined frequency. As the fundamental frequency is multiplied, the efficiency of the stage is reduced; i.e., the power output from the multiplier stage is reduced. Fig. 1 shows graphically how the Ia pulse is produced using the normal Ia/Vg characteristic of the valve in question. As will be seen, the widths of the grid swing curve (marked "A" in Fig. 1) and the Ia pulse are the same, but there are two cycles of oscillation in the anode circuit for each cycle of R.F. input to the multiplier control grid. This is shown in Fig. 2, where F1 is the fundamental frequency and F2 represents *one cycle* of the R.F. output. In this case we have

$$F1 = F2 + F2$$
$$= 2 \times F2$$

$\therefore F1 = n \times F2$, where n is the multiplying factor.

In this case, n is equal to 2, thus satisfying the conditions for frequency doubling. Lastly, a word on suitable valves. Beam power tetrodes and pentodes, of the 6V6 and the EF50 class respectively,

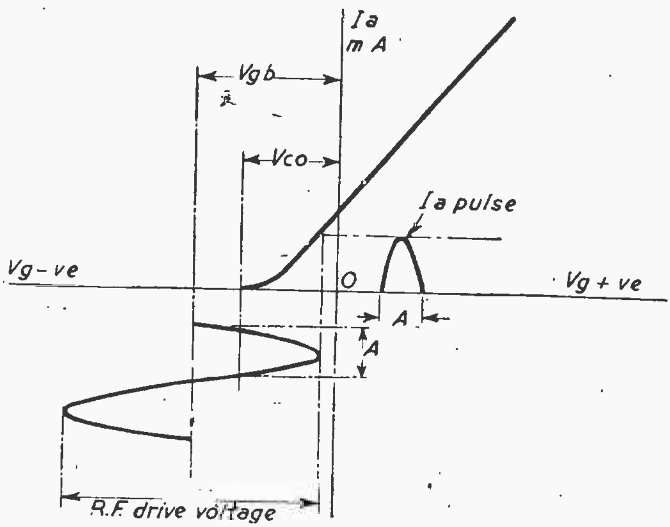

Fig. 1.—Relation between Ia pulse and drive input.

are very suitable for frequency multipliers since they have a high grid/plate amplification and provide ample R.F. output. As stated previously, however, a further stage of amplification may be necessary, bearing in mind that the higher the multiplied frequency, the lower the stage efficiency.

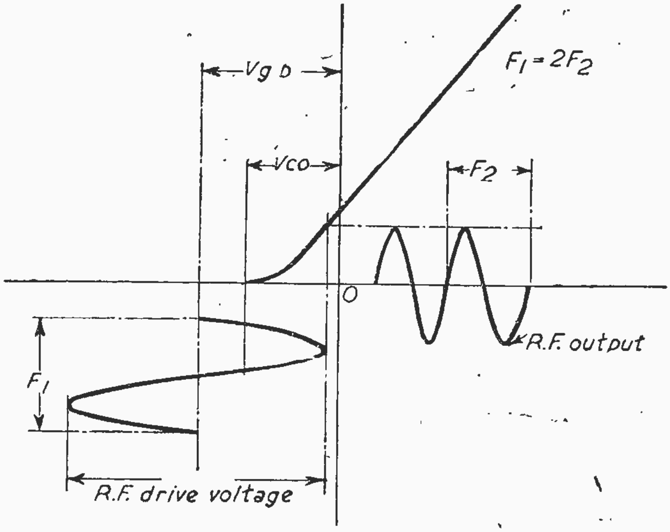

Fig. 2.—Frequency doubler operation.

Converting D.C. Sets for A.C. Mains

By H. S. Thorpe

THE Mullard PZ30, having an output of 400 mA. as a half-wave rectifier, lends itself as an ideal method of running D.C. sets from A.C. mains, especially when the speaker field is in the heater chain, or the series current of the valve heaters is such that a rectifier could not be run in series with them.

The circuit used is as shown in Fig. 1.

V is a Mullard PZ30.

The two anodes are strapped, as shown, as well as the two cathodes, for operation as a half-wave rectifier. The dropper is a normal .3 amp. type in series with the PZ30 heater and the 230v. mains, dropping the surplus voltage, in this case 178 volts, at .3 amp. The condenser is a good reliable type with a high ripple rating, such as Hunt's J42 (max. ripple, 225 mA).

The valve, dropper and condenser can be mounted on the radio chassis, taking care to isolate all components from direct contact with chassis, or they could be mounted on a small sub-chassis screwed to the side of the cabinet above the set. The condenser should be mounted away from the dropper or any source of direct heat.

The normal on-off switch in the set must be disconnected and the leads joined together and taped. The switch is then connected to the live lead going to pin 7 on the valve.

If the set fails to operate on switching on, reverse the polarity of the leads marked Set + and Set —.

The set must be treated as a universal set, as if the A.C. supply is reversed the chassis could be alive to E.

A practical layout is shown in Fig. 2.

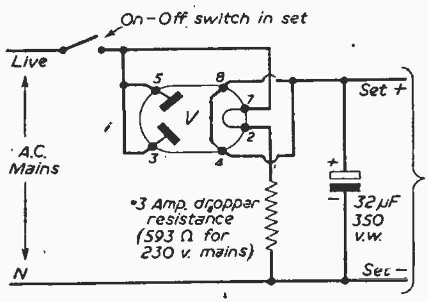

Fig. 1.—Theoretical circuit which is recommended by the author. A 30Ω 5w. resistor should be included in each anode lead.

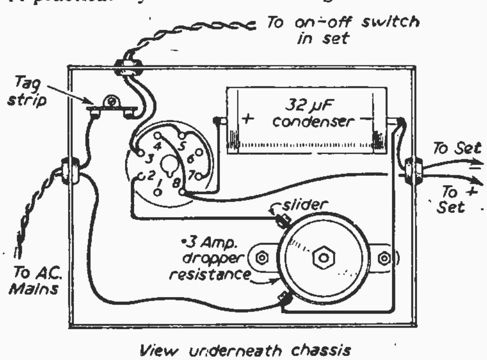

Fig. 2.—Underside view of chassis, which may be of steel or aluminium.

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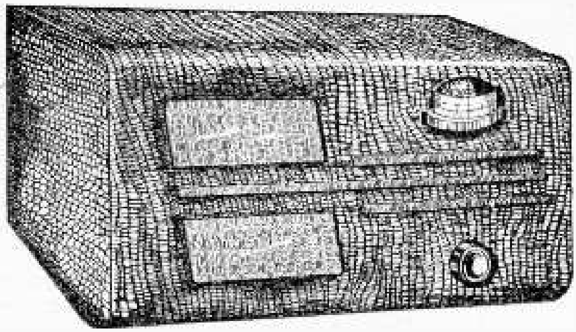

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ECC32
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ECC34
ECC35
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ECC91
ECH3
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ECH35
ECH42
ECL80
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EM1
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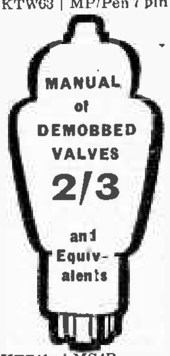
EM34
EN31
EY51
EY91
EZ35
EZ40
EZ41
FC2
FC2A
FC4
FC13
FC13C
FW4/500
FW4/800
GDT4B
GT1C
GZ32
H30
H42
H63
HD24
HL2
HL2/K
HL13
HL13C
HL21DD
HL23
HL23DD
HL41
HL41DD
HL42DD
HL133DD
HVR2
IW4/350
IW4/500
KBC32
KF35
KK32
KL35
KLL32
KT2
KT32
KT33C
KT36
KT41
KT44

KT61
KT63
KT66
KT71
KT74
KT76
KT81
KT101
KTW61
KTW63

MH4
MH41
MHD4 Cl'r
MHD4 met
MHL4
MKT4 5 pin
MKT4 7 pin
ML4
MP/Pen 5 pin
MP/Pen 7 pin



KTZ41
KTZ63
L63
L77
LN152
LP2
LSD3
LSD8
ME41
ME91

MS4B
MSP4 5 pin
MSP4 7 pin
MSP41
MS/Pen 5 pin
MS/Pen 7 pin
MS/PenB
MU14
MVS/Pen 5 pin

MVS/Pen 7 pin
MVSPenB
N16
N17
N18
N37
N78
N142
N145
N147
N148
N150
N152
OM1
OM4
OM5B
OM10
OZ4
OZ4A
P2
P41
P61
P220
PA1
Pen 4DD
Pen 4VA 5 pin
Pen 4VA 7 pin
Pen25
Pen44
Pen45
Pen45DD
Pen46
Pen220
Pen220A
Pen383
Pen428
Pen453DD
PenA4
PenB4
PenDD4020
PL33
PL38
PL38M

PL81
PL82
PL83
PM2HL Clear
PM2HL met
PM12M met
PM22A
PM22D
PM24A
PM24M
PM202
PT10
PT41
PX4
PX25
PY31
PY80
PY82
PZ30
QP21
QP22B
QP25
R2
R3
R10
R11
R12
R14
R16
S23
S130
S130P
SD6
SP2
SP4 5 pin
SP4 7 pin
SP4B
SP13
SP13C
SP41
SP42
SP61
SU25
SU61
SU2150

SU2150A
T41
TDD2A
TDD4
TDD13C
TH4B
TH21C
TH30C
TH41
TH233
TH2321
TP22
TP23
TP25
TP2620
U10
U14
U16
U18/20
U22
U24
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U151
U152
U201
U281
U282
U403
U404
U801
U4020
UAF42
UB41
UBC41
UBF80
UBL21
UBL21/N
UCH21
UCH42

UF41
UF42
UL41
UL44
UL46
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VP41
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VR75/30
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W21 4 pin
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Resistor Tolerances

THE MEANING OF TOLERANCES, AND THEIR IMPORTANCE IN MODERN CIRCUITS

IT mystifies beginners to find that many resistors which are sold as, say, 10KΩ may in fact be anything between 8KΩ and 12KΩ, and they wonder why this is and how much difference it will make to the performance of the circuit in which they are interested.

Why are not all resistors marked with their actual resistance? The reason is that manufacturers cannot make resistors all of which are exactly a predetermined value. If they try to make 10KΩ resistors some of them turn out to be 9KΩ or even 8KΩ, and others 11KΩ or 12KΩ or perhaps even further from the desired value. The salesman, on the other hand, cannot stock every conceivable value of resistor—10KΩ, 10.1KΩ, 10.2KΩ, 10.3KΩ, 10.4KΩ, etc., not to mention 10.01KΩ, 10.02KΩ, etc., so they compromise by classifying groups of values together and putting one label on them all. These groups must be so arranged that any value of resistance falls into one or another of them. The obvious starting point is a group centred about a number beginning with 1, such as 10KΩ, and for simplicity there must be groups centred round 1KΩ and 100KΩ as well. The next point to be considered is how large these groups shall be. Obviously the larger the range of values each group takes in the smaller will be the number of groups needed. The largest and most common size of group used in practice is the 20 per cent. tolerance group in which any resistor will be within 20 per cent., or one part in five, of the marked value. Thus resistors marked 10KΩ may be between (10−2)KΩ and (10+2)KΩ, i.e. between 8KΩ and 12KΩ. The lower limit of the next group must be 12KΩ so as to leave no gap, and its centre value is therefore 15KΩ, with 18KΩ as its top limit. At this point trouble starts, as if the lower limit of the next group is made 18KΩ its mean value becomes 22.5 KΩ, which is inconvenient. Also, if this process continues the seventh group centres on 110.6KΩ, whereas it is convenient that the series should repeat with the seventh term 100KΩ and the 13th 1MΩ. So we see that a slight overlap between groups is in fact desirable. The centre of the third group is therefore made 22KΩ, the fourth group is centred on 33KΩ, the fifth on 47KΩ and the sixth on 68KΩ. In this way every actual resistor may be put in one of the groups and there is very little overlap. If ± 10 per cent. groups are used each group is smaller and other nominal values are put between the ± 20 per cent. ones. Thus the 10KΩ±10 per cent. group covers up to 11KΩ and a new group centred on 12KΩ has to be introduced to bridge the gap between this and the lower limit of the 15KΩ±10 per cent. group. Actually a very small gap is left between 13.2KΩ, the upper limit of the 12KΩ group, and 13.5KΩ, the lower limit of the 15KΩ group, but this may be ignored in practice. This halving process is repeated for the ± 5 per cent. groups.

Importance

We now come to the second question: how much does this matter? It is obviously important to know the answer to this as ± 20 per cent. resistors are cheaper than the more accurate ones and so must be used wherever possible. The first point to be realised in considering this question is the very large variation of characteristics between one valve and another of the same type. As a typical example the anode current of a certain type of R.F. pentode may vary between 6mA. and 15mA. from one valve to another under identical conditions, and the mutual conductance from 6mA/V. to 9mA/V. If a pentode is being used as an audio voltage amplifier its gain is given by G=gm.R1, where R1 is the anode load and gm the mutual conductance. Thus if R1 is 20 per cent. low, the outside limit, and in practice it will probably be less than this, the gain G will also be 20 per cent. low. This corresponds to a reduction in output of less than 2 dB, which will be undetectable by ear and even with a perfectly accurate resistor the gain may vary more than this from one valve to another. Thus in this application a ± 20 per cent. resistor is quite accurate enough. If a triode is used as a voltage amplifier with an anode resistor equal to or greater than its anode impedance the variation in gain will be even less. If the resistor is used as the cathode resistor in an automatic bias circuit the anode current will only increase by about 10 per cent. if the resistor is 20 per cent. low, and this is again no bigger than the variation from one valve to another. Thus in almost all valve circuits the variation in gain due to using ± 20 per cent. resistors is smaller than that due to changing valves.

If, however, two equal output voltages are required, as in a phase splitter such as that shown in Fig. 1, it is important that Ra and Rc should be equal although their actual value is not very important. If the constructor has no way of matching the resistors himself then his only way of getting them equal may be to buy high accuracy ones.

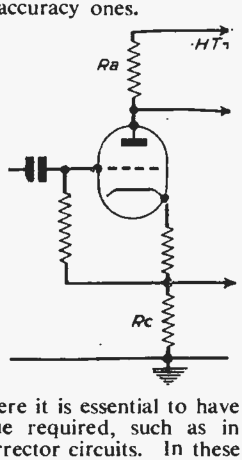

Fig. 1.—A typical phase-splitter circuit to illustrate the effect of resistor tolerances.

There are a few cases where it is essential to have resistors of the exact value required, such as in carefully calculated tone corrector circuits. In these the product of a resistance and a capacity must be accurately a predetermined value, and it is quite common to use ±1 per cent. resistors and capacitors. Another example where it is specially important to have the resistors right is in bridge circuits and voltmeters where they must act as standards.

Accuracy

We will now consider arrangements for getting an accurate resistor of a non-standard value. This is important as high stability ± 1 per cent. resistors are only made of a few values and not in overlapping ranges as ± 5 per cent. resistors are. Consider the case of two resistors connected in series. If the combination is to be ± 1 per cent. and one resistor is ± 1 per cent. the other must be ± 1 per cent. also; but if it is permissible for the combination to be 1.1 per cent. out then the second may be less accurate. Consider a typical case. It is desired to connect a 100KΩ and a 5KΩ in series to make a 105KΩ resistor and 1.1 per cent. tolerance is permissible. In this case a 100KΩ ± 1 per cent. must be used and at the worst will only be 1KΩ out. But a total error of 1.155KΩ is allowed so we see that the 5KΩ may be up to 155Ω out. This is over 3 per cent. and if a ± 5 per cent. resistor is used the total value will still be within 1.2 per cent. of the desired amount, which for most purposes is good enough. Thus as long as the larger resistor is accurate a cheap lower accuracy resistor may be used for the second.

The same thing happens if resistors are connected in parallel. Thus if a 100KΩ and a 2MΩ are so connected to give a resistance of 95KΩ and the 100KΩ is a ± 1 per cent. resistor the 2MΩ can be ± 5 per cent. without making the total resistance more than 1.2 per cent. out at the most. In calculating this case it is easiest to work in conductance, that is the reciprocal of resistance. The conductance of a 100KΩ resistor is 1/100,000mhos or 10μmho, while that of a 2MΩ resistor is 0.5μmho, and the problem is the same as before with new units. Of course the errors in the two resistors may cancel each other out and it is unlikely that they will both be at the limit of their tolerance, but this is possible and must be considered as it is the worst case.

Exactly the same reasoning applies to capacitors. A 100pF ± 1 per cent. capacitor may be connected, in parallel this time, with a 5pF ± 5 per cent. one and the combination will be within 1.2 per cent. of its nominal value, or a 2,000pF 5 per cent. may be connected in series with the 100pF ± 1 per cent. with the same accuracy.

The method outlined above should enable constructors to calculate the effect of connecting two resistors of different tolerances in series or parallel with each other.

The Tuned Circuit

FURTHER TO THE ARTICLE ON THIS SUBJECT IN LAST MONTH'S ISSUE, THE FOLLOWING NOTES MAY PROVE OF INTEREST

Applications of the Tuned Circuit

AS applied to a radio receiver, the tuned circuit is fundamentally employed for the selection of a desired transmission. The resonant frequency of which is adjustable, usually by a variable tuning capacitor. Although some receivers incorporate a mechanical method of traversing the axis of the tuning coil with an iron dust core, thereby altering the inductance of the coil.

Whether L or C be rendered variable the result is the same: a means is created by which the resonant frequency of the circuit may be adjusted from the cabinet front. The "rejector circuit" is normally employed for this function, since it has the ability to develop across it a large signal potential and acts as a short circuit to unwanted carrier voltages. The (full line) curve of Fig. 8 (a) shows a typical response curve which may be expected from a rejector circuit of fairly high Q, while the broken line curve illustrates the effect of heavy damping, producing low Q characteristic. The curves at (b) indicate similar conditions in conjunction with the "acceptor circuit."

Owing to the present overloaded state of the medium and short wave bands, the tuned circuit should be as selective as possible, thereby attenuating the possibilities of adjacent channel interference. Unfortunately a single tuned circuit of high selectivity gives rise to poor quality reception owing to its restricted pass-band. However, by employing a combination of two or more tune circuits in a bandpass arrangement the sides of the overall response curve are made fairly vertical, while the top is flat within its pass-line limits.

Numerous and varied are the applications presented for the tuned circuit, not only on the R.F. side of the receiver, but also in connection with the A.F. side. Whistle filters, scratch filters, tone compensator circuits, to mention just a few. All of these take the form of either the "acceptor" or "rejector circuit," according to the mode of application.

In conclusion it should be mentioned that the subject of tuned circuits is indeed a vast one, but it is hoped that this brief account will be of assistance to constructors and servicemen, and will enable them to understand more clearly the function of this important circuit.

Book Received

"**Electronic Measurements,**" by Terman and Pettit. 707 pages. Second Edition. Price 72s. 6d. From McGraw-Hill Publishing Co., Ltd.

THIS is an important contribution to electronics, and published at a time when electronics is penetrating almost every known activity. It is exhaustive in its content, very completely illustrated, and very adequately covers the whole field from Voltage and Current, Power, Circuit Constants, Frequency Measurements, Waveform Measurements, Characteristics of Valves, Amplifier Measurements, Receiver Measurements, Aerials, Radio-waves, Oscillators, Generators, to Reactance and Resistance Standards and Devices, and Attenuators and Signal Generators.

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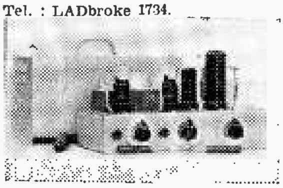

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MODEL AC10E (as illustrated), 10-watt, 4-valve unit, neg. feedback, separate mike stage and separate mike and gram inputs, 2 faders and tone control, input volts mike .002, gram .21v., **£10-7-6.** **MODEL AC18E.** 6-valve unit with p/pull output of 18½ watts, separate mike stage and separate mike and gram inputs, 2 faders and tone control. Feedback over 3 stages. Input volts, mike .003, gram .3v., **£15-5-0.** **MODEL AC32E.** Specification as AC18E, but with a larger output stage giving 32 watts output, **£18-18-0.** **MODEL U10E.** D.C./A.C. mains, p/pull output of 10 watts. Spec. as AC18E, **£12-19-6.** All the above amplifiers are complete with metal case, chrome handles and outputs to match 3, 8, 15 ohm speakers. All have H.T. and L.T. connectors for supplying power to tuning units (as have AC8C and AC4C, but not U10E and U4C). See tuning units below. **MODEL AC8C.** 5-valve chassis with p/pull output of 10 watts. Feedback over 3 stages. For record or radio reproduction. Output to 3, 8 or 15 ohms, inputs for radio/LP/standard records **£10-10-0.** **MODEL AC4C** (A.C.) or **MODEL U4C** (A.C./D.C.). 3-valve 4-watt amplifier chassis for radio/records. Output to 3 ohms, **£5-15-0.** All prices include inland carriage. Remember that College amplifiers have been in production since 1945 and used by hundreds of domestic and commercial operators throughout the world. Demonstrations daily 8.30 to 6.0 p.m., on both microphone and records.

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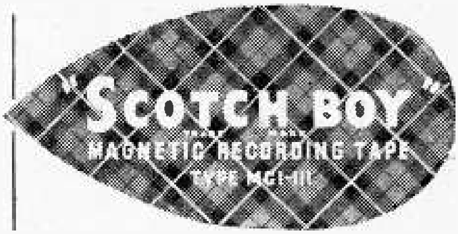

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Surplus Cathode-ray Tubes

DETAILS OF TUBES SUITABLE FOR OSCILLOSCOPES

By E. G. Bulley

THE availability of cathode-ray tubes on the surplus market has provided the experimenter and amateur with the means by which he can construct a piece of measuring equipment at reasonable cost.

Prior to the war, the construction of such gear was in most cases out of reach of one's pocket, the main reason being that the price of the tube was quite high. However, many constructional articles have in the past appeared in PRACTICAL WIRELESS, and will no doubt continue to do so.

This article is therefore written so as to provide the reader with data appertaining to the smaller diameter tubes that are available, and which are considered suitable for the construction of small bench type oscilloscopes.

Function

The cathode-ray tube is perhaps described best as a device whereby two dimensions can be plotted, one dimension as a function of the other. However, the basic construction of such tubes does not differ from one manufacturer to another, so to enable the new reader to appreciate their action the following description is included.

The description deals only with those available upon the surplus market, namely those of the electrostatic types which are tabulated in the table. The tube itself consists of a heater element assembled within an oxide coated cathode sleeve, thus, as in radio valve practice, the heater raises the temperature of the cathode to a specific temperature resulting in electron emission. Now this emission is drawn into a narrow beam from the cathode by the action of what may be termed an electric field which is created by such electrodes as the grid and anode number one.

As this beam, which is fairly small in cross-sectional area, leaves anode number one, it has a tendency to spread or diverge. This diverging beam, however, is immediately corrected by the electric field created by anode number two. In other words, the beam converges after leaving anode number two and thus reaches the fluorescent screen as a small spot.

It is as well to mention, however, that the second anode also increases the kinetic energy of the beam, and it is this potential that causes the beam to strike the screen with sufficient force to cause the spot to fluoresce and so give a visible indication of what is happening.

Several Anodes

The reader will notice by referring to the table that some of the tubes have three or four anodes. This need not in any way confuse the issue, because their purpose is to create additional kinetic energy to the beam of electrons, either before or after deflection. Nevertheless, it may be as well to mention that in some tubes these anodes consist of an aquadag coating upon the interior walls of the glass envelope. If the coating is located after the deflector plates its purpose is to increase the kinetic energy of the beam, after it has been deflected. This enables the spot on the screen to be more intense and much sharper, which is essential in making some observations.

The deflector plates do not really require much description because as their name indicates, they are

TABLE OF EX-SERVICE TUBES

Surplus No.	Comm. No.	VF	IF	VA1	VA2	VA3	VA4	Beam Current	Screen Diameter
CV279... ...	—	4	1.1	1,500	250	1,500	—	—	70m/m
NC16	—	4	1.1	1,500	250	1,500	—	—	70m/m
CV320... ...	4053A ...	4	1.1	800	135	800	—	3μA	38m/m
VCR155. ...	4053A ...	4	1.1	800	135	800	—	3μA	38m/m
CV967... ...	4053A ...	4	1.1	800	135	800	—	3μA	38m/m
NC19	4053A ...	4	1.1	800	135	800	—	3μA	38m/m
CV389... ...	—	4	1.1	3,500	75	1,700	3,500	40μA	40m/m
VCR521 ...	—	4	1.1	1,800	700	4,000	—	50μA	90m/m
VCR522 ...	—	4	1.1	800	135	800	—	4μA	38m/m
VCR221 ...	—	4	1.1	2,000	340	2,000	4,000	4μA	90m/m
*2AP1... ...	2AP1 ...	6.3	0.6	250	1,000	—	—	—	2in.
*2BP1	2BP1 ...	6.3	0.6	500	2,000	—	—	—	2in.
*CV602 ...	3AP1 ...	2.5	2.1	1,000	1,500	—	—	—	3in.
*3AP4... ...	3AP4 ...	2.5	2.1	1,000	1,500	—	—	—	3in.
*3BP1	3BP1 ...	6.3	0.6	575	2,000	—	—	—	3in.
*3EP1	3EP1 ...	6.3	0.6	430	1,500	—	—	—	3in.
*3JP1	3JP1 ...	6.3	0.6	500	2,000	4,000	—	—	3in.
*3KP1... ...	3KP1 ...	6.3	0.6	320 appx.	2,000	—	—	—	3in.
*3MP1... ...	3MP1 ...	6.3	0.6	500	2,000	—	—	—	3in.
*3RP1... ...	3RP1 ...	6.3	0.6	600	2,000	—	—	—	3in.

* American manufacture.

there to deflect the beam. They consist of two pairs of parallel plates, each pair located so that they are 90 deg. to each other. One pair is used for horizontal deflection, whereas the other pair is for vertical deflection.

It can therefore be said that the field created between these plates will deflect the beam accordingly and so reproduce a visible result upon the screen of the tube. The anodes and focusing arrangement of any tube, plus that of the emitter, is commonly known as the electron gun and is the means by which the beam can be controlled, focused and accelerated at will.

The potential applied to the final anode is much higher than that of the preceding anode, that is to say in the case of a tube having three anodes, anode number three is operated at a much higher potential than that of number two, but in many cases anode number one has applied to it the same potential as that of anode number three. Furthermore, some oscilloscope circuits have anode number two at earth potential ; this naturally depends upon circuit design and requirements.

To-day, the C.R.O. is an essential piece of equipment and enables the experimenter to investigate waveforms, valve characteristics, electrical and mechanical equipment as well as a host of others which are too numerous to mention.

Layout and Screening

In the design of any oscilloscope special attention should be paid to the design and layout of the power pack, because the presence of any ripple voltages will undoubtedly cause modulation of the electron beam. One must, therefore, give plenty of thought to the filter section of such a pack.

Another important factor is that of screening, because the tube is extremely sensitive to magnetic or electric fields. Ample screening must therefore be provided, not only for the tube, but if possible to such components as transformers and chokes. Suitable screens for these surplus tubes can still be obtained from various dealers who have in the past broken down equipments for their components. It is of importance not to forget to earth the screens, otherwise the screening effect will be lost and interference to the beam will still prevail.

To conclude, it is not out of place to mention to the reader, whether new or old, that cathode-ray tubes are usually operated at high potentials and great care must therefore be taken when using them.

From Our American Correspondent

First Records on Tape

THE first full-range recorded tapes for commercial sale featuring major orchestras with noted conductors and soloists were introduced by MaVo-Tape, Incorporated, at the October 29th-November 1st Audio Fair, in New York City. Distribution of the recordings, to be sold as " Magnecordings by Vox," is to follow the New York introduction.

The " Magnecordings " will be recorded on half tracks of standard recording tape at 7½ in. per second tape speed, presenting a full hour programme on a professional 7 in. reel. Special equalisation in recording will give high-fidelity reproduction up to 15,000 c.p.s.

The " Magnecordings " will be made by Magnecord, the world's oldest and largest manufacturer of professional magnetic tape recording equipment for MaVoTape, Inc., from the " master " tapes of the Vox Productions, Inc., library, and will be distributed initially through Magnecord distributors. " Magnecordings by Vox " will offer all the advantages of tape recording ; no surface noise, no loss of quality through wear, and the accurate liveness and range of full frequency reproduction, 50 to 15,000 c.p.s.

" Magnecordings " will be sold by " time segments " ; the length of the selection will determine the price of the tape. An hour programme, 7 in. reel of 1,200 ft. (2,400 ft. of recorded programme), will sell for $9.95.

Plans call for six releases per month. Initial releases will include *Shostakovich*—Fifth Symphony by the Vienna Symphony Orchestra, Jascha Horenstein conductor ; *Mahler*—Symphony No. 2 in C Minor, " The Resurrection," by the Vienna Symphony Orchestra, Otto Klemperer conductor, with Ilona Steingruber soprano ; and, *Tchaikovsky*—Piano Concerto in B Flat by Monique de la Bruchollerie and the Vienna Symphony Orchestra.

Distribution of " Magnecordings by Vox," throughout Latin America will be handled by Magnecord Western Hemisphere, Inc., 89, Broad St., New York, 4, N.Y., and to all other countries by Magnecord International, Ltd., of the same address.

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EICOR, Inc., announces a newly-styled model of their famous tape recorder which retains the same basic trouble-free mechanism with the following improvements :

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The amplifier is equipped with an equalisation switch for the frequency change between the low and high speeds.

Self-aligning plug-in recording heads are provided as standard equipment. This gives a quick change from single- to dual-track recording and enables a new head to be installed without servicing.

A locking system is built into the record-listen switch to guard against accidental erasure.

A more easily operated system of mechanical and electrical switching makes the recorder extra easy to operate.

A red indicating light for " record " and a green light for " play " give extra-visible indication of the position of the record-play switch.

Four standard type gramophone jacks—two for input and two for output—have been provided. The outputs have cut-out switches.

The case has been re-styled and strengthened, and the lid will close on the unit while loaded with 7 in. reels, ready for operation. Storage of the microphone and A.C. supply cord, which plugs into the unit, is in the lid of the case.

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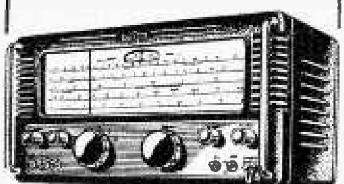

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THE DECIBEL

• THE APPLICATION OF THIS UNIT, WITH WORKED EXAMPLES

ONE of the most useful and most abused units in communications calculations is the decibel, or db as it is known for short. It is a logarithmic quantity and is a ratio of two powers. To get an idea of the unit, it is essential to have an idea of the function of logarithms. There are two types of these in general use, the log to the base *e* or natural log and the log to the base 10; the latter is used in most calculations. A log (the abbreviation of logarithm) is defined as the power to which one number must be raised to produce another number. For example, 1,000 is 10 multiplied by itself three times, and is often written as 10^3. Now if $\log_{10}$ is used, then $\log_{10}$ 1,000 would equal three, i.e., the power to which 10 had to be raised to produce 1,000. This looks simple, so we must look for a catch. Take, then, 3.16. This is the square root of 10; then how many times must 10 be multiplied by itself to produce this number? Obviously less than 1, but in algebra from the law of indices, a square root can be written as $X^{\frac{1}{2}}$ so then root ten can be written as $10^{\frac{1}{2}}$ or to keep the log as a decimal number, $10^{0.5}$. No snag there. Another example: 316 is equal to 100 multiplied by root 10. The logs of the numbers are added, i.e., $10\times10\times3.16$ would give a $\log_{10}$ of $1+1+0.5$, so log to the base 10 316 would be 2.5. How about 316×316? The answer on working out by arithmetic comes very near to 100,000, and the log of this number is five. The log of 316 is 2.5, so that log 316×316 would be $2.5+2.5$, which equals 5. The answer is, then, the same whether we work forward or backwards.

In communications work, the ratio of two powers to the base 10 is called the Bell, but as this involves the use of decimals, the decibel is used. This is one-tenth the ratio of the Bell, and is obtained by multiplying the ratio to the $\log_{10}$ by 10; this then gives a number in which the unit represents the log of a number, whilst the tens and hundreds figures represent the number of 0s. The formula for the number of db is given as 10 $\log_{10}$ P1/P2, where P1 is the larger power and P2 the smaller. If the power put in is larger than that got out, then there is a loss or negative gain, i.e., if there is a loss on calculation of 5db it can also be regarded as a gain of -5db; alternatively, a gain is a negative loss. Again the term so many db up is a gain whilst so many db down is a loss.

Very often in calculations it is a ratio of voltages that have to be dealt with. Now these cannot be converted to db ratios, unless the resistance is known, as the formula E^2/R gives the power dissipated by a voltage in a resistance.

The number of db will be $10 \ \text{Log}_{10} \dfrac{E^2/R}{e^2/r}$.

Only if the input resistance is equal to the output resistance can the formula 20 Log_{10} E1/e2 be used, as the two Rs cancel out.

There is also another formula for calculating the db from resistance and current. The power dissipated by a current in a resistance is I^2R, so the formula 10 Log_{10} I^2R/i^2r can be used. But if R and r are of the same value, the formula can be simplified to 20 Log_{10} I/i.

Examples

One or two examples of the use of these calculations will be of use. A certain aerial gives into a transmission line of 80 ohms, an output of 10 mV. at a certain frequency, and another gives 20 mV. into the same load. The power delivered is thus four times. Applying the formula 20 Log_{10} E/e, we get 20 Log_{10} 20/10. Log_{10} 2 is from our tables 0.3; this multiplied by 20 gives 6 db. On the other hand, if two aerials gave the same voltage output, but one delivered it to a 100 ohm load and the other to a 50 ohm lead, the second would have an output that was 6 db. higher than the other. Another example. An amplifier requires an input of 1 volt to give an output of 5W. With an input of 1M this would give a gain of 10 Log_{10} 5/.000,000,1, equals 10 Log_{10} 5,000,000, equals 10×6.7 or 67 db, but if the input resistance was 1,000 ohms the gain in db would only be 37 although the input voltage had not altered.

Another use of the db is in calculating the frequency response of amplifiers. In this case the response is given at a certain power at a certain frequency, say, 5 watts at 1,000 cycles for a certain input voltage. If the output power is measured at another frequency, the ratio of the powers is given in db, i.e., if there is only half the power at 300 cycles the response would be said to be 3 db down at this frequency. It is usual to plot the response on graph paper that has a straight law on the vertical and logarithmetic on the horizontal.

A Table of Log_{10} of Useful Numbers

Log 1 is 0.00	Log 10 is 1.0
Log 2 is 0.30	Log 100 is 2.0
Log 3 is 0.48	Log 1,000 is 3.0
Log 4 is 0.60	Log 10,000 is 4.0
Log 5 is 0.70	Log 100,000 is 5.0
Log 6 is 0.78	
Log 7 is 0.85	
Log 8 is 0.90	
Log 9 is 0.95	

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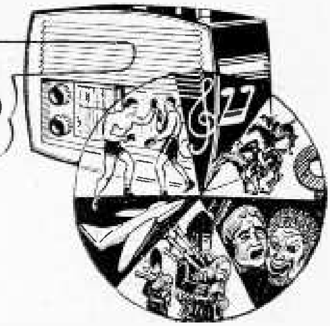

By MAURICE REEVE

Attack on BBC

DURING September the *Daily Telegraph*—and doubtless other papers—quoted excerpts from a speech made to a Mothers' Union Festival, at Lowestoft, by Canon Stather Hunt, Rector of Pakefield, Lowestoft, in which the Canon roundly denounced the dramatic fare provided by the BBC and, more particularly, its selection of plays for " the popular feature, 'Saturday Night Theatre'." " Ninety per cent. of these plays," the Canon said, " hinge on the adulteries or would-be adulteries of the characters."

Other points from Canon Hunt's address were that the plays " were a menace to the moral health of the country " ; " Sexual sin is apparently regarded as not being merely normal but sometimes almost glorious . . . " and " Why not portray pure love and the happiness of married life."

With all due respect, it is difficult to imagine a more ridiculous or inaccurate condemnation. I have often felt obliged, on this page, to pass my own strictures on " Saturday Night Theatre " choices, but invariably from the exactly opposite avenue of approach to the Canon's. To me they more often fail for the very want of those elements which, had they been present, would have enhanced them both as dramatic vehicles and pictures of real life. " Rupert of Hentzau " and " Quiet Week-end " are much more typical than, say, " Autumn Crocus."

Coast erosion in East Anglia has made sad havoc of Pakefield in recent years, and parts of it that were a respectable distance from the coast, when I was on holiday there as a child, are now no more. As the mothers of those fast-departing acres listened to the " Voice on Sinai " the other night, they must have wondered whether they were going to be allowed to listen at 9.15 on the following Saturday. It is utterly absurd to say that 90 per cent. of these plays are hinged on the adulteries, or would-be adulteries, of the characters, and I would recall to Canon Hunt the ever-true words of Dean Inge that " the soul is dyed the colour of its leisure thoughts."

" Saturday Night Theatre "

Of the two " Saturday Night Theatres " I " attended " this month one, " Autumn Crocus," would certainly justify the Canon's moral strictures. But the other, " The Heiress," has not the slightest elements of adultery or sex in it. Both were huge West End successes, the former before the war and the latter very recently.

Dodie Smith's beautiful play deals with an idyllic story of an English school-teacher, on holiday in Switzerland, having her first love affair with the proprietor of the hotel where she and her friend are staying—a married man with a family. But as virtue is triumphant and the young lady returns home to her duties and the path of duty, Canon Hunt should not be too squeamish over it. Martyn C. Webster's production captured the essential spirit of the piece which, as the part of Fanny—excellently played by Marjorie Westbury—was idealized love ; and Albert Leiven, as the hotel proprietor, caught the more mundane and material side of the affair to a T.

" The Heiress," based on Henry James' novel of the same name, by Ruth and Augustus Goetz, is a most delicate and enthralling story. Catherine is the daughter of a Boston doctor. Her mother, apparently a beautiful and gracious woman, died when she was a child. Because her father believes her to have grown up without any of her mother's beauty and charm—rather like himself, presumably ! he visits her with a cold and cynical brutality and makes of her life little better than hell on earth. To complete her wretched lot, she falls in love with a young scoundrel who, after proposing to her for her prospects, deserts her for learning that those prospects are not likely to be as much as was hoped. Returning a complete failure, from the Californian gold rush and renewing his base suit, the heroic girl rises to her full stature and tells both her worthless father and lover just where they get off.

Although Cecil Trouncer as Dr. Soper and Patricia Hilliard as Catherine didn't quite rise to the heights of their prototypes at the Haymarket, they gave a completely satisfactory performance, as did Peter Cotes, Gladys Young and the rest. Frederick Bradnum's production was equally satisfactory.

" The Lady from the Sea "

In spite of these two first-class shows, I think Ibsen's " The Lady from the Sea " in the Monday World Theatre series was even better. The old master at his favourite theme, of releasing woman from her age-old shackles and giving her a chance to breathe the air of " freedom " and " liberty," writes a most moving play, even though it is not quite the masterpiece that " Ghosts " and some of the others are. Peter Watts's production and translation were powerful and William Fox, Marie Ney, Heron Curvic, Valentine Dyall, etc., formed an excellent cast.

Piano Concerto

E. Sackville West gave another of his absorbing and erudite analyses of piano concertos, this time with the great Brahms B flat. It may have " claims" to being the greatest, as Mr. West said, but it definitely is not. Of all the records used as illustrations, no mention was made of easily the finest, and probably the finest of all discs, that of Horowitz and Toscanini.

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THIS MONTH'S BARGAIN OFFER.—RECEIVERS TYPE R.1155.—These popular communications receivers in "used" condition, complete with their seven valves. They are in working order although this might not be perfect. "W.W." data leaflet and circ. diagram supplied. (Separately 1/3.) Price £6.17.6, carriage 7/6, plus £1 for transit case which we refund when this is returned.

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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).

Importance of Layout

SIR,—I have been interested in the comments about Mr. Kemsey-Bourne's amplifier circuit. Last term at school one of my pupils (Elementary Radio) constructed his circuit and was very disappointed in it. After spending much time with it at his home, he brought it to a practical session of the class. The amplifier was duly put through its paces. The first thing noticed was that the grid of the output valve was getting very hot; a grid stopper was applied with some measure of success. Various measurements were made and they were hay-wire! Having had considerable experience with amplifiers, I suspected that the very bad layout that the student had used was at fault. This entailed long leads to the valve electrodes put in to keep the valves well spaced—to keep things stable and reduce feed-back. These long leads were, in fact, acting as tuned circuits, and oscillations were occurring at very high frequencies. The chassis layout was revised and the grid leads were made as short as possible. The amplifier was then rebuilt and worked perfectly, with the circuit exactly as the writer had specified. I mention this because very often good circuits get a bad name because the constructor makes—not deliberately—a mess of the layout.—JAMES S. KENDALL (Birmingham).

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

Modifying MCRI

SIR,—Readers who own ex-Service receiver MCRI may be interested in obtaining sufficient output to work a small speaker.

This can be done by substituting a 3V4 for the final valve. No alteration in wiring is needed, since the 3V4 has a tapped filament; one half only being in use; nevertheless, output is ample for a small speaker.

The screen should be fed at 90 volts instead of 67 volts which it will receive, but no ill effects have been noted using 67 volts.—A. ASHCROFT (Ormskirk).

Re 6-volt Circuits

SIR,—I am a regular reader and am very keen on 6-volt battery-operated circuits of receivers and audio-amplifiers. I have tried to build some of the circuits in PRACTICAL WIRELESS with a vibra-power-pack, but found their drain on my 6-volt battery far in excess of the commercial receivers.

I am sure there are many like me who would be very grateful if you could include a discussion on 6-volt circuits.

Our nearest A.C. power is 34 miles away, and so we must rely on our 6-volt wind chargers for power.—G. JOHANNES (Darling, S. Africa).

Recording Results

SIR,—May I reply to the letter in your October issue of PRACTICAL WIRELESS, of Mr. L. C. Phillipps, who is experiencing great trouble in recording the violin. As he states that his tape recorder will record this instrument when played over his radio set, but not when he is recording a "live" solo, the trouble is most certainly an acoustic one.

I suggest that he stands with his back to the microphone when playing a violin solo. For my part, when recording music, I place a bowler hat over the rear part of the mike to dampen echo.

Has your correspondent tried a ribbon mike? This, with its directional properties, in a damped room (heavy curtains, etc.), should rid him of those unwanted echoes.—KEITH H. YOUNG (Alklington).

D.C. Supplies

SIR,—I have made up the A.C. H.T. eliminator and trickle charger described and circuited in PRACTICAL WIRELESS, November, 1951, pp. 501-502. As I applied to the "junk box" for spares, the unit differs a little in some respects.

It is housed in the tuning deck of a former R1196, the four tuning capacitor holes providing for a mains "on-off" switch, a DPDT switch for the 6 volt 2.5 amp. side and the 12 volt 1.5 amp. side of the composite mains transformer to be switched in and out of the charging circuit, the mains lead access, and the charging lead exit.

I have seven wander plugs arranged on a bakelite panel (Woolworth wander plugs), so that I have the following combinations:

6.3 volt heaters } For Mains set.
12 volt heaters }
H.T. 30-90 (3 watt 50 K. pot. through 15 K. resistor.
H.T. 120 volt }
H.T. 150 volt } For battery set.
H.T. 180 volt }
H.T. 240 volt (for mains set).
+ leads to charge 2-volt accumulators at 1 amp.

I have two large metal rectifiers 280 volt 60 m/a in circuit for FW rectification smoothed by 2 chokes in series with 32 μF. + 16 μF. 350 volt working electrolytics—absolutely no hum.

Instead of a wander plug to various tappings via resistor chain, I have used one side of a two-pole, six-way wafer switch.

L.T. rectifier 6 volt 1 amp. ex Premier radio.

L.T. dropping resistor as per your diagram, etc.

Earthing via ½ μF. condenser through third pin of mains socket plug, i.e., three-core cable.

On battery work (1935 Mullard MB3) this unit is simply grand. (The mains trans. ex Radio Supply Co., Leeds, 10/9) (260-0-260 60 m/a. 6.3 volt 2.5 amp. and 12 volt 1.5 amp.)

You will see that I have left myself the opportunity of using the unit as a mains RX power pack as well when need arises. I hope to try this soon.—J. RODGER (Old Meldrum).

An Electrolytic Tester

SIR,—There seems to be several points that do not appear to be clear in my article on the electrolytic tester. (1) The polarity of the test lead. This is negative and should be taken to the negative end of the condenser under test. (2) The positive connection is that marked 50 in the diagram and is situated at the rectifier cathode. (3) The total resistance of the chain of resistors should be 60,000 ohms, and for this particular circuit, should, starting from the positive end, be 10,000, 15,000, 10,000, 5,000, 10,000 and 10,000. (4) The centre tap of the mains transformer should not, on any account, be connected to anything. (5) The "fail" lamp is just a 6-volt dial bulb. (6) The use of the 2-way switch is to measure the ratio of the voltage drops for the calculation of the capacity of the condensers. (7) The contacts A1 and A2 are contacts mounted on the top of the relay. (8) The resistance in series with the meter can be any value between 200 and 500 ohms —200 is best for a large reading on the meter whilst a higher value gives a better protection.—JAMES S. KENDALL (Birmingham).

Balanced Speakers

SIR,—May I once again crave space in order to amplify my previous letter? First, let me tell our friend Mr. Waterworth that I am not concerned with tone controls. I suppose in my long experience I have dealt with every form of tone control ever devised, "his," by the way, was described in another journal very fully, some three years ago. Too often tone control circuits cause more troubles than they cure. Next, crossover networks, to be really efficient, are too costly and cumbersome for the ordinary amateur. I am not concerned with these either.

A simple frequency discriminating network from the volume control of the feeder, or gram. pre-amplifier, feed three distinct circuits, each through another volume control. Each circuit is designed for its job, High, mid and low, and each output feeds a speaker designed for its job, too. One does not want cinema output in a room 16 ft. by 18 ft., where three one watt outputs are plenty, so pressure units are superfluous. The top speaker can be a 5 in., or even a 3 in., it should be mounted high in one corner of the room, sloping slightly downward; a small flare will give better distribution. The middle and low speakers may be mounted in a corner cabinet, with a division between them. The low should be within 1ft. of the floor. The middle may be an ordinary 8 in., the low can also be an 8 in., but must have a flexible spider and surround; for the latter I prefer "chamois" leather. The speakers should be situated in opposite corners of the same wall, i.e., at an angle of about 90 deg. Single ended outputs are sufficient for domestic purposes and the whole equipment will not be as costly as most modern amplifiers alone. With this arrangement one can build up high and low at will, and also retain as much low as desired at very low volume.

In conclusion, I regret I have neither the time nor facilities to provide circuit diagrams for the many readers who have written to me, but perhaps P.W. will allow me the space to publish details of the equipment at some future date. Further, I have developed an entirely new single ended output which is particularly suitable for this type of amplifier. I will describe this when opportunity permits.—R. H. COWTAN (Rickmansworth).

Organ Details

SIR,—In the October, 1952, issue "Thermion" draws attention to the patent law and refers particularly to your current articles on the construction of a simple electronic organ. This has prompted several readers to inquire if this company had raised any objection.

As manufacturers of the "Clavioline," which was the forerunner of various simple electronic organs developed during the past two or three years, we would like your readers to know that, far from objecting, we welcome any such article which stimulates an interest in this absorbing field of electronics.—B. DAVIS (Managing Director, Henri Selmer and Co., Ltd.).

The Radio Show

SIR,—I have read with great interest the article which appeared in the November issue of PRACTICAL WIRELESS, by the Marquis of Donegall, concerning a visit to the Radio Show. Due probably to an oversight, the reference at the end of the first column on page 513 to the assembly of television cameras on our stand should not, of course, refer to the Electrical Trades Union. This Union had a small stand on the first floor and was in no way connected with the activities which were undertaken jointly on our stand by Pye, Ltd., and ourselves.—H. F. GILLARD (Multicore Solders Ltd.).

News from the Trade

A New Solder Company

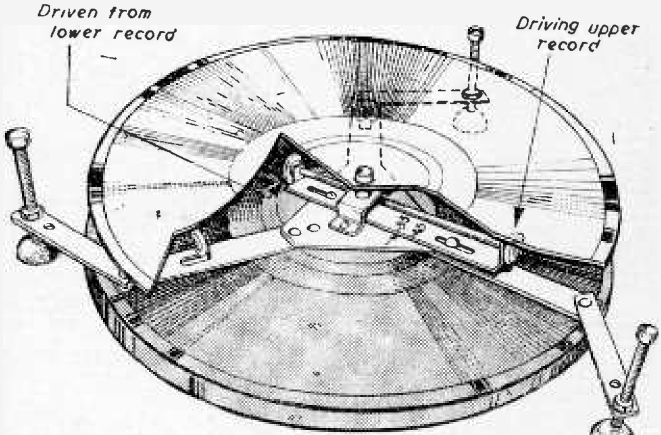
H. J. ENTHOVEN & SONS LTD., 89, Upper Thames Street, London, E.C.4, have formed a new company which was operative as from the 15th October of this year.

The new company will be known as "Enthoven Solders Ltd." who will have their head office at Upper Thames Street. It will be divided, for ease of administration and customer service, into two divisions.

One of the divisions, concerned with marketing of solid solders, is to be under the control of Mr. W. J. Myers, who is appointed to the board of the new company. The other is under the direction of Mr. F. C. Thompson, a comparative newcomer to Enthovens, but an executive with great experience in marketing and one having a fine general business background.

Enfield Speed Changer

A NOVEL instrument to enable a standard (78 r.p.m.) motor to be used for playing $33\frac{1}{3}$ and 45 r.p.m. discs is illustrated on the right and is marketed by the British Distributing Company. Three hinged limbs are provided with rubber feet and it may thus be placed firmly upon the motor-board of any size of turntable. The limbs are threaded and the main mechanism may be raised so that it just clears the turntable, with the spindle end of the motor fitting into a hole in the centre of the changer. Indications show the setting for either $33\frac{1}{3}$ or 45 discs, and loosening a screw enables the setting to be found very simply. Three rubber rollers then come into operation, one being driven by a record placed on the turntable to act as a driver and the other two rotating the slow-speed disc which rests upon them and is centred by a short projecting spindle as in a normal motor. Friction is adequate for all normal discs which are, of course, played with lightweight pick-ups and the device works very well indeed. It is sold upon a large card carrying stroboscopes for the three speeds and the price is 13/6 plus P.T.
British Distributing Co., 591, Green Lanes, London, N.8.



The "Enfield" speed changer.

"Emidicta" Portables

SINCE its inception in 1950 the "Emidicta" system has been adopted on an increasingly large scale by all manner of industrial organisations and commercial undertakings, including banks, insurance companies and Government departments.

Now the system has been made completely comprehensive by the introduction of two "Emidicta" portable machines specially designed for use by travellers or by executives on prolonged business trips.

One of the new "Emidicta" portables (Model 2401) is for A.C. mains operation, the other (Model 2402) works from internal dry batteries and caters for circumstances where no mains supply is available.

Recordings made on either of the portable machines may be used on the office type "Emidicta" and vice-versa and thus a complete "Emidicta" link is formed between the traveller and his headquarters.
E.M.I. Sales and Service, Hayes, Middlesex.

Plessey "E" Series I.F. Transformer Type 19

A RESULT of improved techniques in winding and assembly, the new E/19 I.F. transformer introduced by The Plessey Company, Ltd., is an all-purpose unit of inexpensive construction.

Permeability tuned in the normal manner, the "E" type transformer has a Q factor of 85 and an overall bandwidth for two stages of 7.7. Kc/s at 6 db, and 15.4 Kc/s at 20 db. The standard coils are tuned by 100 pF capacitors, and both stages are identical. Other values of tuning capacity, coupling, etc., can be supplied to meet manufacturers' special bandwidth requirements.

A further advantage offered by this unit, for use in portable receivers, is a 50 per cent. reduction in weight over previous designs of iron pot cored miniature I.F. transformers. The Plessey Co., Ltd., Ilford, Essex.

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BOOKS

I.P.R.E. TECHNICAL PUBLICATIONS: 5.500 Alignment Peaks for Superheterodynes, 5/9, post free. Data for constructing TV Aerial Strength Meter, 7/6. Sample copy The Practical Radio Engineer, quarterly publication of the Institute, 2/-; membership and examination data 1/-. Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8.

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

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AL ALLOY PANELS, 16 gauge, for radio and television construction. Send S.A.E. WILTON RADIO, 30, Giants Grave Rd., Neath.

954, 2/6; Mike. Tone Transf., **9d.;** 25K Potm., **8d.;** UX5, Æ, **2d.** S.A.E. list. ANNAKIN, 25, Ashfield Place, Otley, Yorks.

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EDE'S STUDIO, 274, Haydons Road, Wimbledon, S.W.19. Please note new address. Offer good used Radio Spares stripped from Ekco chassis, all compents are tested before despatch. Mains Transformers, 350-0-350v 80ma 4v 4 amp 4v 2 amp, usual prims with voltage tap, 9/6 ea. Rola Energised Speakers with pentode trans, 2,000 ohm field, 8in., 9/6. 3-gang 0005 Tuning Condensers with trims, round dial SM drive and large knob, 2/6. Aerial Coil, osc. coil, wave change switch, padder, and IF trans 110 K/cs, 5/- the lot (regret no diagram). Mains Droppers—2 amp 800 ohm with fixing rod, 2/-. Chassis mounting HF Chokes in neat ali can, 1/6 ea. Pentode output Trans., standard size, 2/-. Volume Controls, ¼ meg. with switch, 1/6 ea. Twin mains input Hum Suppressor Chokes, 2/-. Condensers: mica, tubular, and electrolytic, 2/6 per doz. (our selection). Resistors, 1/6 doz., ½ and 1 watt (our selection). Please add enough for post on above items. DC Chassis complete with all components and speaker, only 15/-. AC Chassis complete with mains trans., etc., and 8in. Speaker, only **£1,** post and packing on the above chassis 5/-. Traders please send for our new trade list of new components at very competitive prices. EDE'S STUDIOS, 274, Haydons Rd., Wimbledon, London, S.W.19.

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HANNEY OF BATH offers:—Eddystone 740 Receivers, now available again at **£38/15/-,** send for free illustrated folder. The New Collaro Pickups (prices inc. tax), magnetic for std. records only, **40/-;** G.P.29 Turnover Crystal with sapphire needles for std. and L.P. records, **80/8;** Orthodynamic with alloy needles and transformer, for std. and L.P. records, **77/8.** ACOS G.P.20 Pickups, std. or L.P. **71/5,** heads only **43/4.** Autochangers: Collaro RC521 with magnetic P.U. (std.), **£12;** Collaro 3RC521, 3-speed unmixed with 2 GP 27 Hi-Fi crystal heads, **£17/18/5;** Type 3RC522 as 3RC521 but mixed, **£20/8/4.** B.S.R. Monarch, 3-speed with Hi-Fi turnover crystal pickup with 2 permanent sapphire styli, **£17/17/-.** Gram-motors: B.S.R. MU 10 2-speed motor, **74/4;** B.S.R. M.U. 14 3-speed motor, **£6/8/6.** Taylor Montrose Multimeter, **50/-** (see Taylors advert. in Nov. issue of "P.W."). Q-Max Chassis Cutters, with key, ⅝ and ¾ **12/4;** ⅞ **13/3;** 1, 1⅛ and 1¼ **16/-;** 1½ **17/9.** Rectifiers: Brimar RM1, **5/-;** RM2, **6/-;** RM3, **7/-;** RM4, **21/-;** S.T. & C. K3/45 1ma, 2kV, **8/2;** K3/100 (5kV), **14/8.** Westinghouse WX3 and WX6, **3/9** each; 14D36, **11/7;** 14A86, **20/4;** 36EHT45, **23/8;** 36EHT50, **26/1;** 36EHT100, **29/5.** Viewmaster, Stage One, **61/-;** Two, **42/9;** Three, **£5/1/8;** Four, **9/10;** Five, **£10/4/-;** Six, **£7/5/9;** Seven, **53/-.** Coils with L9, London, **21/-;** Wenvoe, **28/-;** B'ham, H'Moss and K-O-S, **30/-;** Pre-amp, 4/- pair. Bulgin Kit, **15/-;** W.B.100, **18/6;** WB101, **6/-;** WB102, **18/6;** WB103, **42/-;** WB103A, **52/6;** WB104, **15/6;** WB105, **32/6;** WB106, **25/6;** WB107, **32/6;** WB108, **33/6;** WB109, **22/6** (state tube type); WB110, **10/-;** WB111, **5/9;** WB112/12in., **21/6;** WB112/9in., **21/-;** WB300 pre-amp Chassis, **17/6;** W.B. Double Deck Chassis Conversion Kit, **35/-.** Viewmaster Wide Angle Components: Allen, FO.305, **21/-;** DC.300, **42/-;** GL.18, **10/-;** GL.16, **10/-;** LO.308, **50/-;** FC.302, **35/-.** Elac P.M. Focus Rings, W25 Mk.11, **57/6;** W22 Mk.11, **52/6.** Sundries: New H.R. Headphones, **14/9** pr.; 6.3v 1.5amp Fil. Trans., **7/6;** Polystyrene Varnish, **1/10;** Osmor HO Packs, **52/-;** Osmor Q Coils, **4/-;** Weymouth H Coils, **3/9;** Wearite P Coils, **3/-;** Denco C TRF Coils, **8/-** pr.; R.M. TRF Coils, **15/-** pr.; TRF Coils with reaction, **4/3;** G.E.C. Xstal Diodes, **4/-.** Send 6d. stamp for our comprehensive lists now, containing details of P.W. 3-speed Autogram, Tapedeck Amplifier, Modern 1 and 2 Valver, High Speed Fault Finder, Williamson Amplifier, Viewmaster, Teleking and General Components. Please add 9d. postage on orders under £2 and 2/- is added to C.O.D. orders under £5. "You are safe in dealing with us." L. F. HANNEY, 77, Lower Bristol Road, Bath. (Tel. 3811.)

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PRACTICAL WIRELESS, Dec., 1952

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