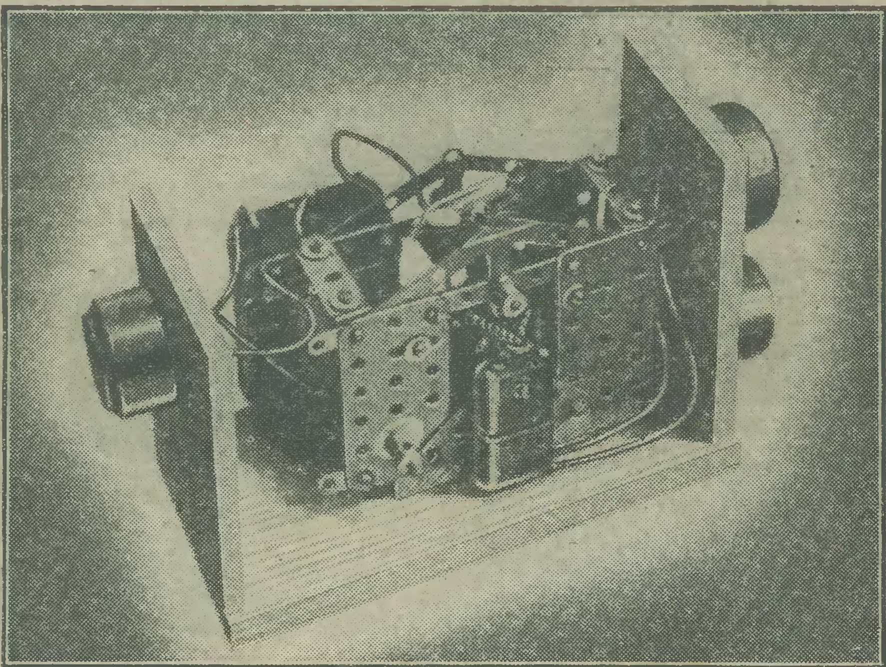
RECEIVER REMOTE CONTROL

Practical Wireless

9D. EVERY MONTH

Vol. 24. No. 507. || Editor: F. J. CAMM || OCTOBER, 1948



See Page 415

PRINCIPAL CONTENTS

Practical Wireless

and PRACTICAL TELEVISION

16th YEAR OF ISSUE

EVERY MONTH
VOL. XXIV. No. 507 OCTOBER, 1948

Editor F. J. CAMM

COMMENTS OF THE MONTH — *BY THE EDITOR*

Better Listening

OUR leader last month on the Campaign for Better Listening has brought a number of illuminating letters indicating that the B.B.C. is not really in touch with the listening public. We are aware that it has its own research bureau which purports to analyse public reactions to programmes and to estimate public taste. If the bureau had operated as intended, many of the programmes which we are told by the B.B.C. are popular would be abolished; for example, none of our readers who has written concerning the campaign likes "Twenty Questions," less than 2 per cent. like crooners and none of them likes the talks on gardening. One of our readers suggests that every listener should compile a black list of programmes and radio personalities he does not like and, as soon as the programme or name is announced, switch over to another programme or switch off.

There seems to be lack of co-ordination within the B.B.C. itself. It consists of a number of small cells containing a producer and the artistes working in entire ignorance of, and without a care for, what is happening in other studios.

A number of readers feel that the campaign will fail purely because it is being launched at the wrong time. There is not the money about that there was two years ago. The sellers' market has gone and the listeners are hanging on to their old receivers waiting for prices to come down. The reduction in purchase tax has not encouraged sales, and we suggest that the campaign should be accompanied by the additional encouragement of a reduction in the prices of all radio and television receivers, and particularly in the latter. This would have the strongest appeal and be far more productive in results than a campaign based on slogans.

There is a general feeling among listeners that the B.B.C. does not exist to provide them with what they want, that it has become a bureaucratic caucus, dictatorial in its attitude and enjoying a form of self-government with powers transcending those of Parliament itself.

There could be a considerable reduction in the number of programmes. It is on tap all day long, every day in the year, and there can be little wonder that people are sated with radio and are not anxious to spend a considerable sum of money on a new receiver. These are the days when we are told to economise, not to buy things unless they are really essential, and to save more. The purchase tax, indeed, was designed to destroy home sales and force manufacturers to export a high percentage of their productions. The Government campaign to destroy sales has succeeded and, having succeeded, it attempts to recant by reducing the purchase tax. The trade should press for the abolition of the purchase tax altogether, and it should carefully examine its costings to see whether price reductions at this stage are possible.

The bicycle trade some years ago was confronted with a similar slump. It organised a National Bicycle Week and a considerable amount of money was spent in the national press drawing attention to the pleasures of cycling and the beneficial results of cycling upon the health of its devotees. The campaign, however, did not improve sales. The manufacturers then turned to the alternative of reducing prices, and sales enormously increased as a result. Thus, it was proved that the slump was due to the high prices then prevailing. We suggest that the radio trade might follow the example.

One other point; we hope manufacturers will discontinue their practice of employing "stylists," so called, to produce streamlined cabinets with futuristic streaks of chromium plate, in an attempt to emulate the absurd styles common in America.

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

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

Contributions

We welcome contributions from readers and particularly articles of a practical nature, describing receivers and components which the reader has built himself. Articles should be accompanied by theoretical and practical wiring diagrams (drawings need only be in pencil), list of components and, where possible, photographs. Articles must, of course, be the original work of the contributor. We especially require descriptions of mains receivers and short-wave receivers. Intending contributors should, in the first place, submit a precis of the proposed article for consideration.

ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ending June 30, 1948.

Region	Number
London Postal	2,100,000
Home Counties	1,475,000
Midland	1,601,000
North Eastern	1,737,000
North Western	1,471,000
South Western	979,000
Welsh and Border	652,000
Total England and Wales	10,015,000
Scotland	1,059,000
Northern Ireland	186,000
Grand Total	11,260,000

The above number includes 54,850 television licences, an increase of 2,350 over the previous month.

Eight hundred and thirty-nine successful prosecutions for operating wireless receiving sets without licences were undertaken during June—a record number for any single month.

The British Institution of Radio Engineers

MR. W. E. MILLER has been nominated for election as a vice-president of the British Institution of Radio Engineers.

In approving this nomination at a recent council meeting, Admiral Mountbatten referred to Mr. Miller's 20 years' membership of the Institution and the fact that Mr. Miller was one of the signatories to the incorporation of the Institution in 1932.

Mr. Miller qualified for membership shortly after graduating from Cambridge University, and in addition to having served on all the Institution's committees, has also several times been elected a member of the General Council.

Mr. Miller is well known as the editor of "The Wireless and Electrical Trader" and the author of several books.

General Sikorski Memorial Fund

RECENTLY £3,500 worth of Philips X-ray and electro-medical apparatus was officially handed over to the Children's Clinic of Poznan University, Poland, by the General Sikorski Memorial Hospital Fund.

The presentation took the form of a ceremony held at Century House, Shaftesbury Avenue, the headquarters of Philips Electrical, Ltd., makers of the equipment.

His Excellency, the Polish Ambassador, representing Poznan University, received an illuminated scroll commemorating the event, presented to him jointly by Mrs. E. d'A. Willis, and Major Rowland Sanders, Trustees of the General Sikorski Memorial Hospital Fund.

Phototelegraph Service by Wire Reopened

THE public phototelegraph service by wire to Belgium, France, Denmark, Italy, Norway and Sweden was reopened recently.

The service can be used for the transmission of photographs, drawings, manuscripts or printed matter and particulars of the charges, hours of service, etc., may be obtained from the following post offices in London.

London Chief Office, King Edward Street, E.C.1.

Fleet Street Branch Office, E.C.4.

Leicester Square Branch Office, Charing Cross Road, W.C.2.

South Western District Office, Howick Place, S.W.1.

Western District Office, Wimpole Street, W.1, and from the head post offices in Manchester, Liverpool, Birmingham, Edinburgh, Glasgow and Newcastle-on-Tyne.

Radar Patent

THE original Radar Patent, filed on September 17th, 1935, and until now on the secret list, is now released. It is number 593,017 and may be obtained from the Sales Branch, The Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s.

Mr. P. B. Whiteley (Director of the well-known W/B establishment) and his bride.

Whiteley Electrical Wedding Bells

THE marriage recently took place of Mr. P. B. Whiteley (a new director of the makers of the well-known W/B speakers and other components), and Miss O. M. Marchant, daughter of Mr. R. P. Marchant, a well-known solicitor in the Midlands.

The bells of St. Peter's Church, Mansfield, where they were married, had to be dismantled some time ago, but before this happened a recording of them was made, and by the use of amplifiers in the church tower a most realistic effect of the original bells was obtained.

Sir Clifford Paterson, O.B.E., D.Sc., F.R.S.

THE General Electric Co., Ltd., deeply regrets to announce the death, on Monday, July 26th, after a short illness, of Sir Clifford Paterson, O.B.E., D.Sc., F.R.S., at the age of 68.

Clifford Copeland Paterson was born on October 17th, 1879, at Stamford Hill, and was educated at Mill Hill School.

He joined the G.E.C. in 1919 to establish and direct the G.E.C. Research Laboratories. Under his guidance, these laboratories, which began with a staff of 29, have developed into the largest of their kind in the country with a present staff of 1,750. He was appointed to the board of the G.E.C. in 1941 and received his knighthood in the Birthday Honours List of 1946.

Radar for Tilbury-Gravesend Ferry Service

BRITISH Railways (London Midland Region) are installing radar at Tilbury so that a better ferry service can be provided in foggy weather.

The apparatus is being fitted in Riverside Station, where a picture of the river and its shipping, gathered by a revolving scanner above the clock tower, will be recorded on an indicator screen situated in a darkened control room.

An operator watching the screen will use a wireless telephone to advise the Masters of the ferry steamers where they are in relation to other vessels and, of course, how they are placed in relation to the ferry landings.

Mr. A. W. Welton, Financial Controller of Mullard Electronic Products Ltd.

International Short-wave Club

A VERY special broadcast for short-wave listeners from Radio Leopoldville in the Belgian Congo is to take place on Wednesday, September 15th, at 19.00 G.M.T. and also on Thursday, September 16th, at 02.00 G.M.T. Frequency 9.768 Mc/s (30.71 metres).

New Amateur Band

THE Postmaster-General announces that, as from September 1st, 1948, holders of Amateur Wireless Station licenses may use telegraphy and telephony on any frequency between 145 and 146 mc/s, with power not exceeding 25 watts, subject to the general conditions of their licences and subject to no interference being caused with the working of other services.

Vital wireless services are operating in the 144 to 145 mc/s and 146 to 148 mc/s bands; and amateurs must ensure that no transmissions are made by them in these adjacent bands, outside the authorised limits 145 to 146 mc/s.

Miscellaneous Goods Amendment Order

THE Board of Trade, in consultation with the Central Price Regulation Committee, have made the Miscellaneous Goods (Maximum Prices) (Amendment No. 2) Order, 1948, which came into operation on Tuesday, August 17th. This Order makes minor amendments to the Miscellaneous Goods (Maximum Prices) (Amendment) Order, 1948; S.I. 1948, No. 776. It varies the scope of that Order by including hard haberdashery and excluding thermal storage water heaters and certain types of wireless sets; and it alters the definition of excluded iron and steel articles in the Second Schedule.

Brazilian Transmitters

THE new Marconi-equipped broadcasting station at Recife, Brazil, was recently inaugurated. It includes a medium-wave transmitter rated at 20 kW and two short-wave transmitters of 25 kW each.

Station WRUL

PERMISSION is being sought for an increase in power to 250,000 watts for station WRUL at Boston, Mass. If sanctioned, this increase will make the transmitter the most powerful broadcaster in the Western hemisphere.

Aircraft Interference

INTERFERENCE was recently experienced with aircraft radio from Oregon to Puerto Rico and far east into the Atlantic. This was eventually traced to an electronic heater in a Johnstown (Penn.) chair manufacturing plant.

Ahmedabad Station

WE understand that the proposed capital of Maha Gujerat will soon have an up-to-date radio station. It is learned that the details of the whole project are complete and the necessary arrangements will soon be completed to instal the studio temporarily in a private building until a permanent home is available.

A High-fidelity Amplifier

Contrast Expansion and Tone Controls are Included in This Design

By P. E. TOOKE

BEING a lover of music, and possessing quite a collection of records, I started work some months ago on designing and building a really high-fidelity amplifier that would leave hardly anything to be desired.

Consequently, this circuit I am about to describe is the outcome of six previous circuits, incorporating all their good points and, I hope, not many bad.

It is, I am the first to admit, elaborate, but to achieve the perfection I wanted I was prepared to go to extreme lengths. If any reader is not so critically inclined, several of the stages can be cut out, such as the contrast and tone-control circuits, so bringing down the cost of construction.

To proceed, I intend to give a brief description of the line-up, and then take the whole apparatus stage by stage, giving the faults and any hints as I found them.

To make it easier to follow I have broken the diagram into three units: first, "the contrast and tone-control stages"; second, "voltage amplifier, phase splitter and output"; and thirdly, "the power pack."

The first two units mentioned were on a chassis 20in. by 9in., and well spaced out. The power unit, which includes rectifiers and smoothing networks, etc., was built on a chassis 10in. by 6in.

The valve line-up is: EF39, side amplifier for contrast expansion; 6H6, expansion rectifier; 6C5, tone-control stage; 6K7, controlled voltage amplifier; 6C5, phase splitter; and 6V6s in parallel, push-pull output. Two 6V6s in normal push-pull run very well, but I needed plenty of output to play with, and the quality is improved by using four. The power-pack uses an FW4/500 for supplying the output tubes only, and a 5Z4G for the rest.

Also, it will be noticed that a 6X5 is used as a half-wave rectifier for the speaker field, which is a Magnavox Duode.

General Construction

All the main components were obtained and laid out as balanced as possible, being consistent with good wiring practice. The stages ran straight up the centre of the chassis so that the first stage was at one end and the output valves at the other. Wiring was carried out with heavy gauge wire

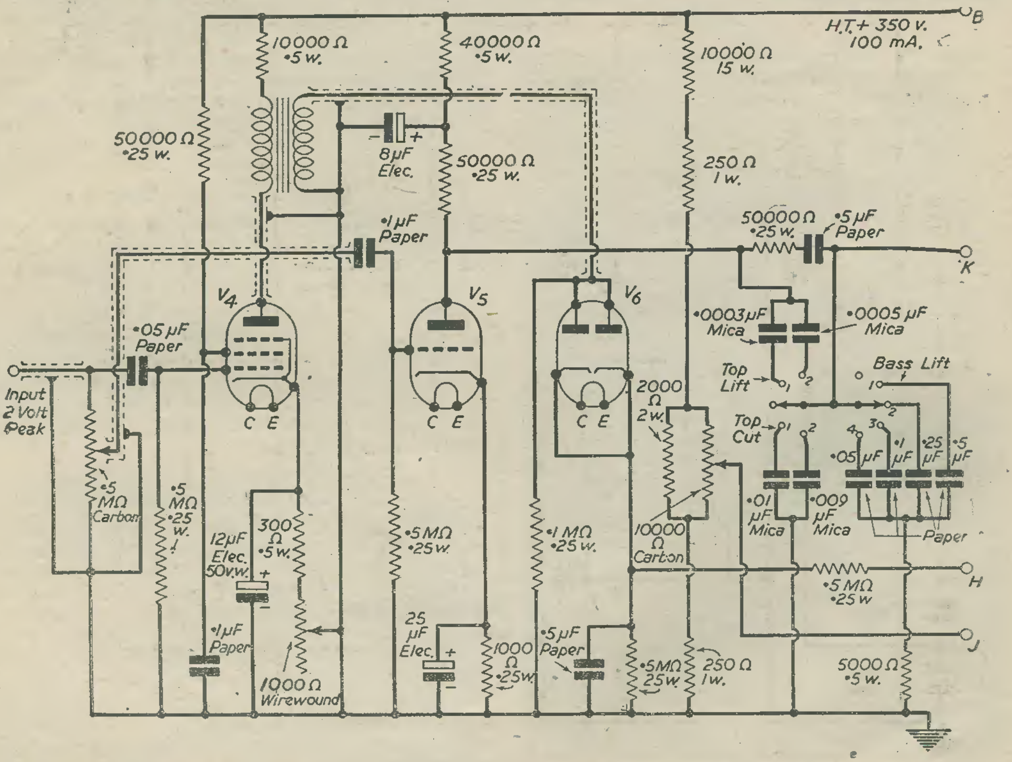


Fig. 1.—The contrast and tone control stages. Recommended valves are: V4 EF39, V5 6C5G, and V6 6H6G.

throughout, and all small items such as resistors, condensers, etc., were tagged down to group boards.

The first stage is split. It is fed direct into the side amplifier and controlled by a .5 megohm potentiometer into the main channel. Take first the side amplifier. Its sole object is to amplify the signal to feed the diode so that the resulting D.C. voltage can be used to control the main voltage amplifier and produce an expansion in volume when the input peaks. The 1,000 ohms biasing potentiometer on the EF39 is for adjusting the amplification and, therefore, the amount of contrast given ; this should be preset. To adjust the ratio of contrast as compared with the input another potentiometer is used to bias back the controlled valve from a "bleeder" network, so by using this control you can set it for no contrast or practically all contrast.

Transformer feed is used to couple the amplifier EF39 to the diode. I did not get enough gain by R.C. coupling, so as it was not critical as to frequency response, an old 7 : 1 ratio transformer was used.

This gave quite a high D.C. voltage from the diode, and with a good filter it swings the bias of the 6K7 very well.

The input, as can be seen, is fed via a .5 megohm potentiometer into the 6C5. The .5 megohm potentiometer is, of course, the main volume-control, and a blocking condenser and grid-leak is used before being fed into the 6C5. Owing to the long input lead, I found it necessary to have this condenser in, but there is no reason why it should be included as long as the lead is short and no stray hum is picked up. The 6C5 is used as a tone-control stage.

Plenty of decoupling is used on the plate, as hum pick-up at this stage, by the time it reaches the speaker, is unbearable.

Two single-pole five-way switches are used for the tone settings—not ganged, but separate. One gives bass lift and the other top lift and top cut. The circuits are the normal resistor-condenser networks and are self-explanatory from the diagram (Fig. 1). It is worth noting, however, that only first-class condensers should be used here, as an inferior one gives rise to very bad crackling.

The next stage, which is the main voltage amplifier, is shown in Fig. 2.

As it is also the valve controlled by the contrast expansion diode, the bias network is worth mention.

In Fig. 1 it will be seen that a "bleeder" network is connected from H.T. to earth, and the cathode of V7 is joined some way up from the earthy end via a potentiometer, the use of which has been explained. This means that the cathode has a delay voltage which the input from the diode has to exceed before the gain in volume can take place. This gives very good results if care is taken to decouple the cathode and diode output, otherwise stray pick-up and breakthrough of audio gives some very queer effects.

It will be noticed that the voltage amplifier is transformer-coupled to V8, the phase-splitter. I

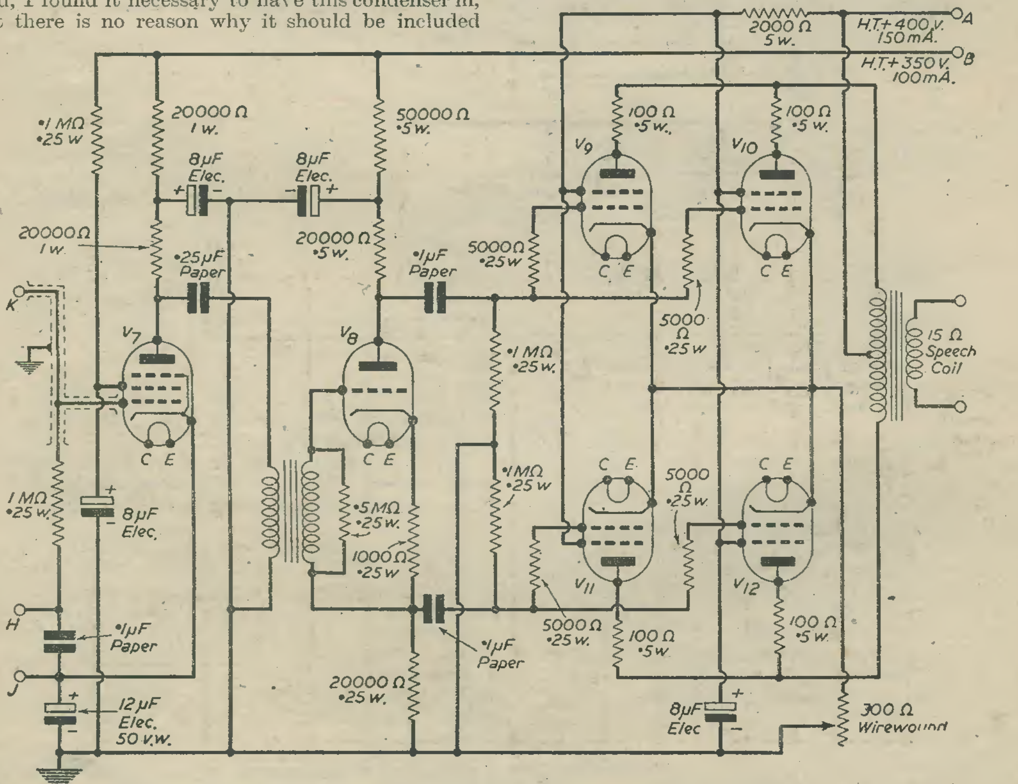


Fig. 2.—The voltage amplifier, phase splitter and output stage. Recommended valves are : 6K7G for V7, 6C5G for V8 and 6V6Gs for V9, V10, V11 and V12.

found that by choosing a good transformer and para-feeding it with a large condenser, results were just as good, if not better, than with R.C. coupling, also you got more stage-gain and therefore a second audio stage was done away with.

The phase-splitting stage V8 is a normal circuit, and apart from measuring up the resistors to make sure they are matched, care is all that matters in the layout. The output (four 6V6s) are all supplied with grid and plate stoppers. The original design omitted these and the output stage howled. By fitting the stoppers right on the valve-pin, this is cured instantly. A preset potentiometer was fitted for bias. This is not strictly necessary, as a fixed resistor can be used just as well. The bias voltage was adjusted to 13 or 14 volts, which seemed to suit the valves admirably.

The output transformer is a "Premier Matchmaker" working a Magnavox Duode speaker at present. The baffle is a piece of ¾in. wood 5ft. by 4ft., and seems ample for the speaker.

The Power Pack

This is shown in Fig. 3, and, as I have mentioned, is built on a separate chassis.

Two transformers are used—one 450-0-450 at 150 mA. for the output valves; the other, 350-0-350 at 100 mA. for all the rest of the gear. The smaller transformer supplies all the heaters, and a 200 ohms relay is fitted in the H.T. line of this transformer, so when the heaters of the 6V6s are hot, the relay switches on the mains to the large transformer, as the FW4/500 is directly heated; this saves the high voltage building up across the condensers and blowing them.

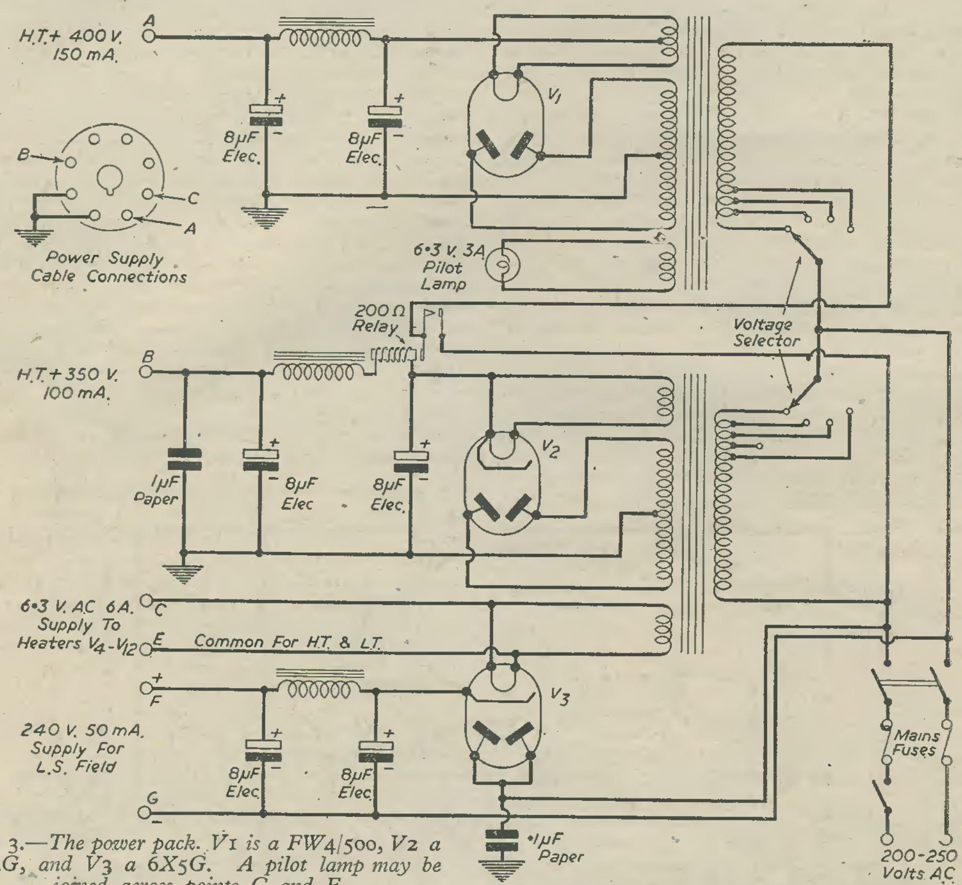


Fig. 3.—The power pack. V1 is a FW4/500, V2 a 5Z4G, and V3 a 6X5G. A pilot lamp may be joined across points C and E.

The rest of the power unit is general and I do not think needs further explanation.

If the reader builds this amplifier for gramophone reproduction, for which it was designed in the first place, a word or two here on the pick-up would not be out of place.

I used a crystal pick-up, which suits this circuit very well. If it seems a little peaky on top frequencies, the tone-control stage looks after that. Against my better judgment, but owing to the high cost of records, I have used thorn needles, and top notes and transients are faithfully reproduced.

So far I have not had the chance to try a moving-coil pick-up on this amplifier, but it should, with proper matching, give a better performance than a crystal.

MINISTRY APPEALS TO HOUSEWIVES
Keep Waste Paper separate, dry and clean for salvage.

Crystal-grinding Technique

How to Adjust ex-Government Crystals for Your Own Frequencies

By J. N. MALONEY (ZL3DE)

MANY amateurs during or since the end of the war have, by many and devious means, acquired quartz crystals somewhere in the range 2,000-7,000 kc/s. Owing to the widespread use of crystals for radio communication during the war, particularly in aircraft H.F. and V.H.F. transmitters, large quantities have been declared surplus by the many Allied Governments. These have been selling at very reasonable prices. However, it is reasonable to assume also that many crystals have come into possession of "hams" as souvenirs.

As most of these "rocks" are outside the present amateur bands, they have either been regarded as useless or thrown into the junk box after several abortive attempts at grinding them to a desired frequency.

The purpose of this article, which is reproduced by courtesy of the New Zealand amateur magazine, "Break-in," is to enlighten those who have obtained disappointing results, either through inexperience or lack of sufficient data on this subject.

For the information of those interested in this subject, crystals coming into the above category are usually divided into two types of cuts, notably the AT and the BT cut. It is not intended in this article to enter into a discussion on the derivation of these cuts, as the information is readily available on this matter in most copies of the "Radio Amateurs' Handbook." However, it will be found that almost without exception crystal blanks in the range between 2 and 4.5 Mc/s are AT cut, and those between 4.5 and 7 Mc/s are BT cut. Mention of these cuts will be made later in the article.

Apparatus Required

Before commencing the grinding process it will be necessary to have on hand the following equipment:

(1) A sheet of plate glass approximately 6in. by 6in. (an old piece of window pane will do). This must be perfectly flat and free from any scratches, cracks and abrasions.

(2) A basin of clean water (warm).

(3) A quantity of clean, lintless cloth (an old handkerchief is ideal).

(4) An ordinary lead pencil.

(5) The grinding compound.

(6) Not absolutely essential but of great help, a 1in. micrometer, reading in tenths of a thousandth of an inch.

(7) A test oscillator (the rig's crystal oscillator will do).

(8) A heterodyne type frequency meter or calibrated receiver.

Now, the first procedure is to test the blank (in its original holder, if possible) for frequency and activity as indicated by a good minimum dip in the oscillator plate milliammeter, or maximum grid current in the following stage if the transmitter is being used as a test oscillator. The magnitude to be expected in these readings may easily be determined by first noting the readings obtained when a good 3.5 Mc/s or 7 Mc/s crystal, known to be active, is placed in the test oscillator.

Having satisfied yourself on this requirement, dissemble the crystal unit, exercising extreme caution as quartz blanks are very susceptible to damage such as chipping of corners or edges, and even complete or partial fracture when being removed from or placed in a holder. Place the blank in a safe position and prepare the plate of glass for the grinding or lapping operation. The choice of the grinding compound will depend on how close to the desired frequency the blank oscillates. For blanks within approximately 300 kc/s of the frequency wanted, Grade No. 900 carborundum powder or standard jewellers' rouge will be necessary. Incidentally, jewellers' rouge in powder form is readily obtainable from any optician at a very moderate price. For blanks more than 300 kc/s lower than the required frequency, a rougher grade of compound is first required, and the No. 500 grade carborundum powder is recommended, finishing with No. 900 grade or jewellers' rouge.

After determining the grade of compound necessary for the particular blank in hand, shake sufficient of the powder on to the plate of glass so that when water is added to the mixture a creamy paste is formed over most of the plate. In subsequent grinding it may be necessary to add a little water to maintain this consistency.

Now, take up the crystal blank. Mark one side carefully with the pencil, either writing on the present frequency or the letter R, meaning that this side will be the reference side of the blank. Note carefully that *all* grinding must be performed on the opposite face of the blank. Failure to observe this precaution will result in certain trouble owing to the fact that the crystal will not have its faces parallel to one another.

Grinding

If the blank is the ½in. by ½in. size, grinding is best performed by placing the ball of the second finger on the centre of the blank, remembering, of course, to keep the reference side uppermost at all times. Commence grinding slowly with a figure eight motion, covering an area of 9 to 16 square ins. After about eight or 10 evolutions give the blank a quarter turn and repeat as above until the crystal has been turned around each quarter. Repeat the complete cycle of operations once more. Due to the fact that the weight of the finger has been on the centre of the blank it will tend to grind thinner there than on the edges. Therefore, after each two lapping operations as above, it is wise to place the edge of the first finger on each corner of the blank in turn and make about eight figure-of-eights on each one. This technique, if carefully and conscientiously carried out, will result in the blank being kept perfectly flat during the whole grinding process. Consequently, little or no trouble will be experienced in making the blank oscillate each time it is tested. Those possessing a micrometer will find that instrument invaluable in checking for the above after each sequence of operations.

The next step is to lift the crystal very carefully from the plate, rinse it thoroughly and cautiously in the bowl of warm water, then dry same with cloth, holding the blank by its edges so that no grease or perspiration is allowed on its surface. Ensure that the pencil marking has not been erased during the grinding or rinsing process. Replace in its holder and check for frequency and activity.

With the larger blanks a similar procedure is adopted with two exceptions. First being that the first and second fingers are placed on the crystal and the same motions carried out. Secondly, when grinding the corners the first and second fingers are placed diagonally across the corners, turning the blank four times to complete the operation. Because of the larger area of the blank, this procedure is essential, as the quartz has a certain amount of spring in it when subjected to even relatively light pressure during grinding.

Governing Factors

The following factors govern the increase in frequency after each cycle of operations. Grade of abrasive, finger pressure, consistency of paste, area covered in each stroke, size of blank, and type of cut. Only with practice can the frequency increase be judged, taking into account the above factors. Therefore, it is wise to observe extreme caution when grinding a blank for the first time, and use only light pressure on each stroke.

When the desired frequency is being approached add more water to the paste, lighten the pressure, make fewer evolutions or cover a smaller area on each figure eight motion. With practice, a crystal can be ground to within a few cycles plus or minus that intended.

For the benefit of those amateurs who have a micrometer on hand, the thickness for the two most common types of cut are given. Whilst grinding, this will obviate the necessity of having to check the crystal for oscillation after each cycle of operation, providing, of course, that the blank is kept flat over each face. An AT cut crystal at 3,500 kc/s is approximately .019in. in thickness, while at 7,000 kc/s it will be near .0095in. ($t=66.2/f$). The BT cut crystal at 3,500 kc/s is about .0288in. and at 7,000 kc/s it is around .0144in. ($t=100.8/f$). By frequent checking with the micrometer, grinding may be carried out with confidence until the blank is within .0005in. of the final thickness over its entire area, when it should be inserted in its holder and checked in the oscillator after each grinding operation until the required frequency is arrived at.

During the process of grinding it may be found that the crystal will cease to oscillate. This is a fairly common occurrence, particularly in the case of higher frequency crystals. Several factors exercise their influence over this condition, the most common being that the blank has not been ground evenly and the face being ground may either be concave or convex with respect to the reference side. Chipped edges or corners are also likely to cause a crystal to be inactive or to oscillate very weakly only.

A crystal will often refuse to oscillate, even if both sides are perfectly flat and parallel and the edges are free from chips or cracks, because an oscillating quartz crystal has a definite relationship between its linear dimensions, and it is possible that if it has been ground down to any great extent it will have to have its dimensions reduced in proportion. This may be done by holding the blank between the thumb and forefinger, and grinding two adjacent, or all, edges until normal activity is restored.

Frequent trouble may be encountered with faulty electrodes. By the simple expedient of changing electrodes an otherwise dead crystal may be made to oscillate beautifully.

The height of the lands or raised corners on an electrode have a very marked effect on the performance of a crystal, and, to a certain degree, on the frequency. The frequency at 7 Mc/s may be increased by as much as 1 to 2 kc/s when a pair of electrodes having high lands are substituted for the original set.

Crystals having cracked or chipped edges or corners may be made to oscillate much better if the edges are cleaned up by edge grinding, and the corners rounded where cracked or broken. This operation will have a negligible effect on the crystal frequency and improve activity considerably.

Dirty crystals are a bad cause of trouble. They are best cleaned in warm, soapy water with a toothbrush, exercising due care in doing so, and rinsing in clean warm water before thoroughly drying and replacing in the holder.

Bevelling the edges of a crystal by holding it at an angle between 30 deg. and 60 deg. to the grinding plate will help in restoring activity if other methods fail, but will make the edges much more susceptible to chipping when replacing the crystal in its holder or when removing it.

Last, but not least, electrode pressure has also a somewhat critical effect on crystal operation, not only in regard to activity but also to the frequency. This point, therefore, must not be overlooked when attempting to make a crystal oscillate.

In conclusion, the writer hopes that this article may be of some practical value to those who lack sufficient knowledge of the art of crystal grinding and maintenance. These points have been learned through several years of grinding crystals for service and amateur application. There is no reason why any amateur cannot achieve results almost equal in quality to those commercially employed in the art, although this will only be possible with patience and practice.

An Insulation Tester

How to Make a Useful Accessory for Use at 500 to 7 Volts.

By J. G. PICOT

A FEW months ago the writer decided to devise some method of measuring insulation at different voltages met with in ordinary domestic receivers and to measure the insulations of everyday domestic electrical appliances.

The voltages decided upon were: 500v., 400v., 300v., 200v., 100v., 50v., 25v., 7v.

The indication is a 100 microamp F.S.D. meter and the max. resistance that can be measured at 500v., is 245 megohms (this gives a reading of two microamps)—after this, infinity.

The leakage current across switches, etc., is one microamp at 500 volts.

The Circuit

The power is obtained from 230 volt 50 c. mains and is fed via one amp. fuses into a 230v. to 250v. transformer (the writer used one half of a 250-0-250 the second half being O/C), feeding a metal rectifier in a voltage doubler circuit, the voltage doubler condensers being 1μF. 450 volt working.

The D.C. output is selected by means of one section of a double-bank, 10-way uniselector switch, Fig. 1 (Sw 1), and is then fed through a one-megohm variable resistor R., to the series resistor, which is again selected by a uniselector switch (Sw 2), ganged to the chain potentiometer switch. From here it passes through the meter, through the external load, back to the negative side of the supply.

The switch shown in Fig. 1 (Sw 4), is across the output terminals, and is closed to balance the meter with the variable resistor at F.S.D.

The selector switch is fitted with an aluminium disc, cut as shown in Fig. 2, so that the power toggle switch Sw 3 must be put in the *off* position before rotating the selector switch. This is a safeguard against arcing at switch contacts.

The writer successfully ganged together two 10-way uniselector switches by coupling the spindles and using longer bolts to lock the units together.

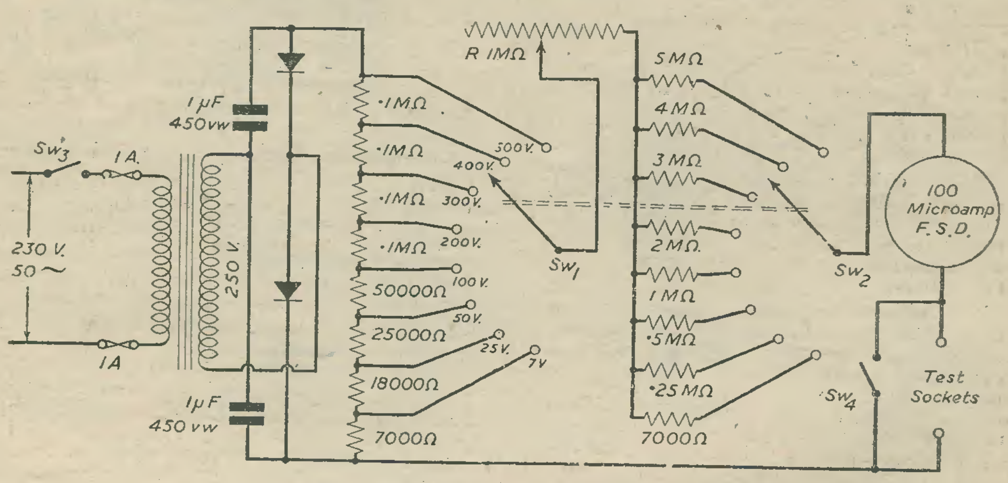


Fig 1.—Theoretical circuit of the tester.

A word of warning may be given here. Some constructors might be tempted to omit the transformer and feed straight from the line. This practice would work, and is sometimes used, but as one lead is in direct connection with the line via the bottom doubler condenser, there is the possibility of shock to the operator. Also, if one test lead is earthed, it is possible to blow the fuses.

The D.C. output is fed through a chain potentiometer tapped at each junction, and made up of the following resistors:

Four 100k., one 50k., one 25k., one 18k., one 7k., all ½ watt, making a total of 500k. This network passes 1 mA at 500 volts.

Series Resistors

The series resistors were found to be rather critical and were made up in the following manner:

Eight pieces of heavy cardboard 1¼in. long by ⅝in. wide, drilled each end to take No. 6 B.A. bolts.

Coat one side of former ½in. from each end (see A, Fig. 3), using a soft graphite pencil, then cut 32 strips of aluminium ¼in. wide ⅝in. long (electrical cable clips are ideal for this), drill these to take No. 6 B.A. bolts and bolt them on to the formers as tightly as possible. Next cramp the clips each side of the bolts in a vice to make sure of the graphite-to-metal connection.

Ohm's law will give the value needed and as high resistances cannot be measured accurately on the normal universal meters, it is better to get a high approximation of the value needed and then make the final adjustment in the instrument, for example,

$$R = \frac{E}{I} = \frac{500 \text{ volts}}{100 \text{ microamps}} = 5 \text{ megohms}$$

Connect each one in circuit and fill-in with graphite pencil till the meter reads F.S.D. (see Fig. 3).

Using the Instrument

To use the instrument turn the variable resistor till maximum resistance is in circuit; select voltage required; place Sw 4 in closed position; switch on power Sw 3, and adjust meter to F.S.D. by varying the variable resistor.

Switch off power; return Sw 4 to O/C position; connect output leads to component to be measured, and switch on power. The meter will read X microamps, and by using Ohm's law the resistance in megohms can be found.

The operator must remember to subtract the series resistor from the answer, as this is in series with the external load:

$$R = \frac{E}{I} = \frac{500 \text{ volts}}{10 \text{ microamps}} = 50 \text{ megohms} - 5 \text{ megohms}$$

Answer = 45 megohms.

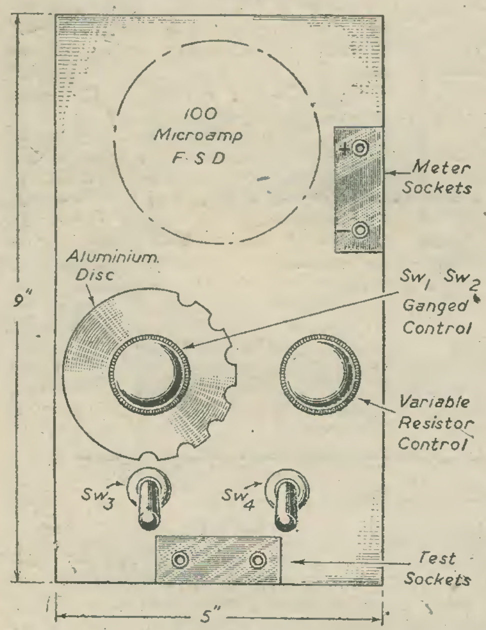


Fig. 2.—Constructional details of the tester.

The instrument is housed in a ply box 9in. long 5in. wide and 3in. deep.

The writer is using the 100 microamp range of a Western Analyser for the meter, plugging it into the circuit as shown in Fig. 2, but if one wishes to include a meter in the unit itself the modification would be quite easy.

Allowances would have to be made for the physical size of the meter in the construction (see Fig. 2).

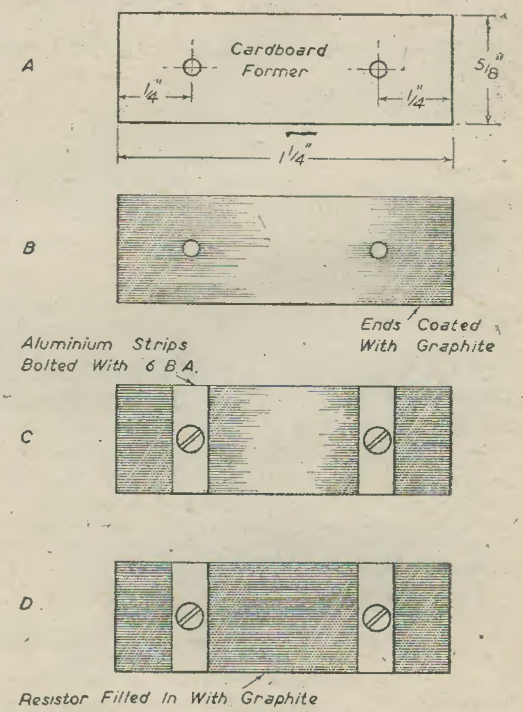


Fig. 3.—Method of making up the series resistors.

It is advisable before using the instrument to let it warm up for a minute or two with Sw 4 closed.

Condenser insulation with the working voltage applied should be 100 megohms per microfarad for mica types and 50 megohms per microfarad for paper types.

Long Distance Radio Communication

A BOOKLET issued to the Services during the war interpreted the results of observations of conditions in the ionosphere into instructions for procedure in operating the many and complex radio services required during the war. It has now been made more generally available to radio technical workers and students as "Radio Research Special Report No. 17—Fundamental Principles of Ionospheric Transmission," published for the D.S.I.R. by H.M.S.O., price 1s. 6d. (U.S.A. 55 cents.), by post 1s. 8d.

Throughout, the text is of a descriptive theoretical nature, but the use of mathematics has been kept to a minimum so that the treatment can be followed by as wide a circle as possible of those interested in this subject.

ON YOUR WAVELENGTH

By THERMION

Television Tie

A COLLEAGUE of mine, a keen television enthusiast, who has built his own television receiver, which is equal in performance to the best on the market, tells me that the visual programme has one drawback—you cannot turn your back on it, otherwise you have lost the continuity of the programme. With radio so many people carry on their conversation whilst the programme is in progress that I should have thought that the rapt attention necessary with television was a definite advantage. It has been the complaint of critics for years that so many people use a radio as a mere background and that they are not really paying attention to what is being said over the air. I checked this the other evening by asking two people carrying on a lively discussion on the advantages and disadvantages of Socialism in our time what programme they had been listening to and whether they could name any of the items or artists. They could not, and I pointed out that it was a sheer waste of electrical power.

A television programme is tantamount to a play at the theatre. When you go to a theatre you do not carry on an animated conversation with your companion. You listen to the show. I cannot understand, therefore, why people cannot do the same when watching the end of a television tube. It is the counterpart of the home cinematograph. You would be shown the door at a theatre or a cinema if you wished to converse during the run of the show.

My colleague tells me that the programmes have greatly improved in quality. There are fewer breakdowns, although interference from passing cars is still a source of annoyance in spite of the efforts which are being made to persuade motorists to fit suppressors. This problem will never be solved until suppression is made compulsory, and that time is not far distant.

Radio and the M.E. Exhibition

AS a model engineer myself, I take a keen interest in the Model Engineering Exhibitions held annually at the Horticultural Hall. I was present at the preview this year and, whilst I was, as always, impressed by the high quality of the models displayed and the ingenuity of the exhibitors, I was astonished to find so little there of a radio or electronic interest. I wonder why. A model of a transmitter, for example, should provide plenty of interest for the model engineer, and so would a model of a television receiver. It would seem that model engineers confine their interest entirely to mechanical matters and that electricity and electronics remain mysteries to them.

The Better Listening Campaign

THE article which appeared in the previous issue of this journal on the Better Listening Campaign has produced a batch of interesting letters of which those I quote are typical. Mr. S. Tyser, of Acomb writes, "I was very interested in your Editorial in the current issue of 'P.W.' and the campaign for selling more sets. I think it is apparent that there is not the money about that there was 12 months ago, which suggests that the cost of current models is far too great to warrant a second set. Most makers produce a three wave-band job, and in the experience of my friends and myself rarely touch the S.W. band. For the ordinary person S.W. tuning is too critical and the 'ham' prefers a S.W. set. An examination of wavelengths shows that the medium band gives 'Home' and 'National' programmes together with a few useful foreigners. I therefore seriously suggest that sets with only the M.W. band (thus cutting costs) are likely to be suitable for sale as a second set. I refrain from making technical suggestions. From an interest point of view I may mention that I have one communication set (home designed), one domestic set (commercial), one portable and two others on the way. My first thought on reading your Editorial was to suggest the equivalent of the German People's set." And here is another letter from W. Watts of Watford: "I think we may call ourselves average listeners. I took out an experimental licence in 1921 and have bought many wireless sets in my time and made an even greater number. I think every licence holder should be given an opportunity, say, once every three years, to tell the B.B.C. his likes and dislikes. We have in our home a black list and, as their names are announced, we carefully switch off or over. (List of names enclosed.) A friend of ours who happened to observe our list a while ago said they quite agreed with it. I dislike dance bands and crooners, also announcers, talks, 'Twenty Questions' and plays connected with the war. There *is* room for another receiver in the home and in every bedroom, as you suggest."

The idea of a black list of radio bores is good, and I must instal one. Much better however to write to the B.B.C. and tell them the items you do not like. My reader's suggestion that the B.B.C. should conduct a plebiscite of its listeners every three years is also good, notwithstanding the fact that it has its own Listeners Research Bureau. I should like to know how that Bureau works. No one has ever asked me, nor any of my friends, questions concerning B.B.C. programmes.

WATCH YOUR DUSTBIN
Waste Paper, Cartons, Cardboard, should be kept separate, dry and clean for salvage.

Television Topics

How to Make Use of the B.B.C. Test Card "C" and Set Up New Receivers or Check Existing Ones

By W. J. DELANEY (G2FMY)

JUDGING from our correspondence quite a number of readers have built satisfactory television receivers, but cannot adjust them for the best results. Queries are often asked by readers who cannot gain access to commercial receivers—how to judge, for instance, whether the synch. separator is working satisfactorily. Every part of the modern television receiver can, however, be checked to a very high standard by means of the special test card which is radiated by the television transmitter every morning (except Sundays) from 10 to 11 a.m. The new card now in use is known as Test Card "C," and this transmission is stationary for the whole hour period. It is extremely difficult, of course, to try and make adjustments on a normal picture transmission, as not only are the figures and scenery moving, but light and shade are changing, and as soon as some adjustment is made to the equipment the scene may change, and it is not easy to see whether the desired effect has been obtained. On the other hand, the stationary geometrical pattern is constant and quite a lot can be done in one hour by way of adjustments or in making experiments.

Aspect Ratio

The first and most important part of the adjustment is the proportion between width and height. As most readers know this is called the "aspect ratio" and bears the relation 5 to 4; that is, for 5 units in a horizontal direction the height is 4 units. When, therefore, the "picture width" and "picture height" controls are correctly adjusted to the ratio 5 : 4, the concentric black and white circles in the centre of the pattern will appear truly circular. There is, of course, a circle in the centre of the standard tuning signal, but this is somewhat smaller and it may be possible to get a true circle here and find that the outsides are not correct. When making all adjustments on the test card, the height and width controls should be set so that the black and white border just fills the tube mask or viewing area. When the adjustments are correctly made it may be found desirable in some cases to readjust these two controls so that the mask is just outside the mask area.

Resolution and Band Width

To obtain ideal results, the band width accepted by the vision receiver and the effect of any high-note filters or similar circuit accessories should be such that every shade of detail in a white dress, stitch lines on a gentleman's black evening-dress, etc., are visible. To assist in ascertaining what width is obtained on the receiver there are two groups of frequency gratings inside the two circles just mentioned. These gratings have black and white alternating stripes (similar to those in the centre of the circle in the tuning signal, which, incidentally, represents 2.5 Mc/s).

The fundamental frequencies shown by the gratings on the test card are 1.0, 1.5, 2.0, 2.5 and 3.0 Mc/s. On the left-hand side the 1.0 Mc/s grating is at the top and on the right-hand side the order is reversed. To receive an ideal picture with the existing transmission response should be uniform up to 2.7 Mc/s and therefore it should be possible to separate the 3.0 Mc/s grating bars. Every endeavour should be made to receive the 2.5 Mc/s, and nothing less than this should be tolerated in a home-built receiver. When adjusting a receiver to separate these lines, make sure that no fictitious result is obtained due to "black after white," a form of misadjustment which gives all black objects a white outline. The two concentric circles will assist in seeing that this is not taking place.

Contrast

The full range of tones from black to white are covered by a five-step wedge, which is in the centre of the card. The top square is white, corresponding to 100 per cent. modulation, and the lowest square is black, corresponding to 30 per cent. The three intermediate squares should range through pale, middle and dark grey.

Linearity

The background of the card is a middle grey and is ruled into squares. The vertical and horizontal lines should be equally spaced so that in every part of the picture the background is divided into equal squares. Line and frame linearity controls should be adjusted and modified, if necessary, to obtain this effect.

Synch. Separator

In some cases readers have wondered if picture impulses are getting into the time bases. The synch. separator is a tricky circuit and various schemes are used. The efficacy of the circuit may be judged by the black and white squared border and the two vertical lines at each side of the central circles. The border should not be jagged, and the two vertical lines should be without any kinks. These two lines are also an indication of the reception of reflected signals. There should be no positive or negative images at the right-hand side of the lines.

L.F. Response

The white rectangle, with a black rectangle inside it should, in an ideal system, be exactly reproduced as just described. There are, however, imperfections in the system as at present transmitted, and it will not be found possible to obtain a clear-cut black rectangle inside the white one. On the right-hand side of the black will be a slight streaking or shadow, so do not waste too much time trying

(Continued at foot of next page)

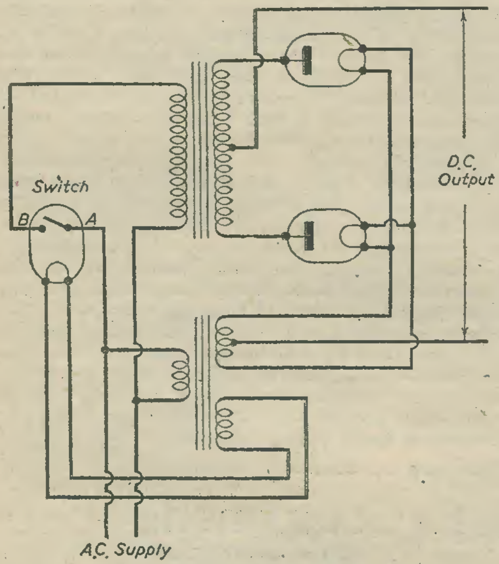
Mercury Vapour Rectifiers

The Care and Maintenance of ex-Service Valves

By E. G. BULLEY

WHEN hostilities ceased, surplus Government valves were released, at controlled rates, on the commercial market. Among these valves were mercury vapour rectifiers, and many of these valves have been purchased by radio amateurs who are not fully aware of the care and maintenance that they require.

Mercury vapour rectifiers, unlike the vacuum type, depend entirely upon the current being carried by mercury ions which are produced by the electrons colliding with the molecules of mercury vapour that are present in the bulb. In actual operation, however, the bulb is filled with a blue glow which is in effect "created ionisation"; this is a characteristic of all mercury vapour rectifiers. This ionisation neutralises the space charge and so reduces the internal resistance of the valve.



Rectifier Circuit with the inclusion of a Thermal Delay Switch.

Mercury vapour rectifiers have the characteristic of being able to carry fairly large currents, which is the result of the neutralisation of the space charge and also of the voltage drop being constant when the valve is operated up to maximum ratings.

The voltage drop across the rectifier should be carefully checked at frequent intervals, and so long as the low voltage drop is maintained (usually 15 volts), there is little danger of positive ion bombardment of the filament. However, if this bombardment does occur, the emissive properties of the filament will be damaged and the valve eventually destroyed.

Anticipation of the life of the rectifier can therefore be determined, if, when measuring the voltage drop, one finds that the voltage drop has increased. To avoid this increase, which will shorten the life of the valve, it is essential that the maximum peak anode current is not at any time exceeded.

Maximum Peak Anode Current

The maximum peak anode current is the highest instantaneous current that the rectifier can stand in the direction in which it is designed to pass current. It can be stated that it is also a function of the electron emission available.

To limit this, a protective fuse of suitable rating should be included in the rectifier anode circuit. The presence of this will not only safeguard the rectifier but also the power pack in which it is incorporated.

The filament potential in any mercury vapour rectifier is also an important factor, because, should the filament voltage be below normal, flashback or arcing will occur. This phenomenon is due to the breakdown of the mercury vapour, which results in conduction in the opposite direction to that which the rectifier is designed to pass current. It is essential, therefore, that when first installing mercury vapour rectifiers the filament voltage should be carefully checked to ensure that the correct voltage is being applied.

Another important point to remember is that the anode potential must always be delayed so as to enable the filament to reach its correct operating temperature and thus enable it to supply full emission. Failure to delay the anode voltage will result in the voltage drop becoming excessive, which in turn will cause ionic bombardment of the filament. This bombardment will, as mentioned previously in this article, destroy the emissive properties of the filament and result in the ultimate destruction of the valve.

Delay of the anode potential can be accomplished by automatic means, and this method is advised; by making a reference to the illustration the reader will appreciate the operation of such a circuit.

The delaying of the anode voltage can be effected by means of a vacuum delay switch type DLS10 incorporated in the primary side of the transformer. However, to appreciate the principle, it is necessary

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(*Concluded from page* 410)

to obtain a clean white background. The shading is not very bad, but is definitely noticeable, and experience will show whether or not the low-frequency response of the receiver is normal.

Focus

Finally, to assist in ascertaining whether the focus coil is correctly positioned and the tube electrode structure in order, there are four diagonal areas of black and white in each corner. These correspond in frequency detail to 1.5 Mc/s and should, therefore, all be resolved uniformly with better clarity than the middle squares of the frequency gratings referred to earlier.

to give a brief description of the actual switch and the method by which it delays the anode voltage.

Vacuum Delay Switch

The switch consists of a small filament mounted upon a glass stem, and adjacent to a bimetal strip. Attached to this bimetal is a contact (A), which in turn is spaced a short distance from another fixed contact (B). When the filament has been alight for a specified period, the bimetal expands and in so doing it forces over contact A to "make" with contact B. This contact remains so long as the filament of the delay switch remains alight.

In the illustration, the reader will notice that the filament of the switch is switched on simultaneously with the filaments of the rectifier valves. Thus, when the bimetal strip is heated sufficiently by the radiated heat from the filament, it expands and thereby allows the H.T. to be applied to the rectifier anodes. The delay period is equal to the time the filament takes to heat the bimetal and so cause it to expand.

In the actual operation of this type of valve, it is essential that the valve be worked within the specified peak inverse voltage. Failure to do so will result in arcing back and will have a similar effect upon the valve as if the filament were operated at a lower voltage than that specified.

The maximum peak inverse voltage is the highest peak voltage that the rectifier will stand in the direction opposite to that in which it is designed to pass current.

Arcback can also result from the valve being operated within the specified peak inverse voltage but at a much higher ambient temperature. To prevent this, if the valve is to be operated at a higher ambient temperature, the peak inverse voltage rating must be greatly reduced. This can be clarified by remembering that high condensed mercury temperatures reduce the voltage required for striking and at the same time reduce the peak inverse voltage rating, whereas low condensed mercury temperatures increase the striking voltage and cause cathodic sputtering. However, both these conditions are not favourable to filament life.

Avoiding Leakage

When first installing mercury vapour rectifiers, it is advisable to wipe the bulb clean of all dust or dirt; this will avoid any electrical leakage and so prevent local heating.

The next consideration is to run the rectifier with only the filament potential being applied; this should be of the order of 15 minutes, and by so doing, the mercury evaporates from any of the electrodes to which it had adhered. This will prevent excessive pressure being concentrated at the place at which it had adhered and thus avoid flashovers between the electrode structure.

By giving the filament a preheating period, it also removes the mercury that may have got splashed on to the interior of the bulb, which in turn would cause excessive heating of the bulb and so result in a higher ambient temperature.

Mercury vapour rectifiers should always be mounted vertically and in a well-ventilated position. They should be screened from any source of R.F. energy otherwise the life of the valve will be affected. It is as well to mention, however, that electrostatic and electromagnetic fields are detrimental to the mercury vapour rectifier, and if screening is adopted to protect the valve, adequate ventilation must also be provided.

New Standard S.H.F. Components

THE ever-widening use of the S.H.F. (Super High Frequency) section of the radio spectrum has created a demand for a range of standard components suitable for wavebands between 100 Mc/s (3 metres) and 10,000 Mc/s (3 cms.).

To meet this demand the Plessey Company, Ltd., Ilford, who have carried out considerable research in the S.H.F. region have introduced a range of connectors to cover a wide field of application. Although designed primarily for S.H.F. equipment, these connectors are ideally suited for use in frequency bands down to the V.H.F. region.

Standardisation of the design has been achieved in the company's own range, and by the incorporation of special mating features, no confusion can arise in interconnection between various S.H.F. devices; a problem ever present in previous designs.

The connections have been designed for 70-80 ohm coaxial lines and give very low reflection losses up to the highest frequencies; the limit being set by higher modes and discontinuity reflection. Female types have been designed for power outlets and male types for power inlets.

Two series of connectors, major and minor, are available, with each series consisting of four types. These are: free straight, free right angle, bulkhead mounting and panel mounting. Each type is produced in both male and female versions. This, of course, ensures complete control of the matching of all S.H.F. devices. Facilities are provided for any type of coaxial waveguide transformation.

Male and female types are interchangeable, and to avoid confusion both inner and outer conductors of a particular connector assembly are both male or both female. To ensure correct mating and therefore matching continuity, all female connectors are provided with locking rings. These have a coarse diamond knurl, coloured black, to distinguish them from the finer knurl of actual connector assemblies.

Intercoupling between minor and major components is achieved by the introduction of major or minor adaptors, so designed to maintain the correct impedance of 70-80 ohms.

All connectors and adaptors are precision machined from brass and to ensure high conductivity have a burnish silver finish. Spacing dielectrics are made from Distrene.

The cable types of connector have a compression cone anchorage from the cable-conducting braiding while the inner conductor is arranged for solder connection. To avoid damage to the spacing dielectric the plug on the centre pin is readily removable and the spacers, being split and cone wedged, can if damaged be easily replaced.

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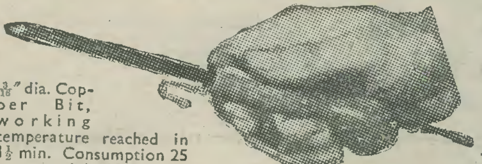

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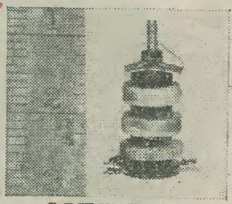

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Receiver Remote Control

A Simple Mechanical Multi-point Switching Arrangement

By F. F. TOWNDROW (Assoc.I.E.E.)

THE use of an extension speaker or speakers is now more or less an accepted convenience in many homes to-day, but the problem so often arises how to operate easily and cheaply the switching on and off of the set from these extension positions.

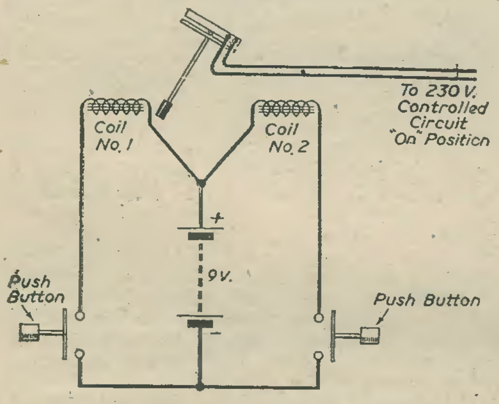


Fig. 1.—Basic Circuit of the relay.

The relay and circuit, etc., described, has been in operation for several years, during which time the writer has only had to renew the two 4.5 volt standard flat torch cells every 12 months.

These renewals of cells could be obviated by the use of a small capacity 230-9 volt transformer of the bell type, but, taking into consideration the very intermittent demand of 100 mA during the operation of the on-and-off pushes, it does not appear to warrant the continual use of the energising current of the transformer.

The Circuit

The simple circuit of the relay is shown in Fig. 1, which is the wiring for energising of the two horizontally opposed ex-bell indicator coils on the low-voltage side (9v.), and the gravity operated mercury switch on the high-voltage side (230v.).

The relay which is adjacent to the set can be operated from any number of selected positions in the house (in the case of the writer this is the kitchen, dining-room, lounge and two bedrooms, which comprise a circuit length of approximately 40ft. from the relay to the most distant push-button position).

To prevent excessive voltage drop, standard two-core with earth 3/029 C.T.S. house wiring cable was used, utilising the earth wire for the common return conductor, this cable being taken to the end push-button position with the remaining push-buttons connected from it at various room positions. The relay was constructed from the remaining retailers' stock of Meccano parts in the early war years, and the enclosed mercury switch (to control up to three amps) was obtained from one of the makers of this

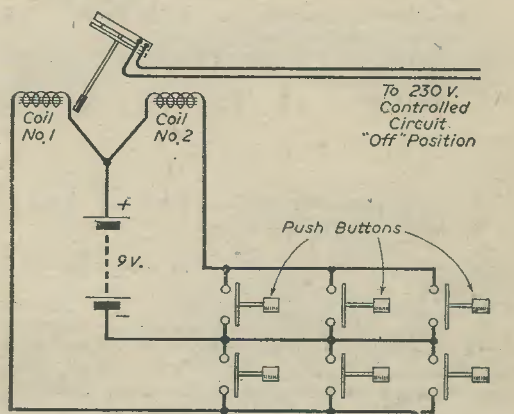


Fig. 2.—Actual Circuit showing the method of including additional push-buttons.

type of switch, the coils being obtained from an early pattern type of bell indicator, connectors, terminals, etc., obtained from usual workshop oddments box.

Operation

The operation of the relay is as follows: on the pressing of the "on" push-button (red) No. 1 coil is energised and attracts the armature attached to the mercury switch, this tilting the switch to a position where the mercury covers the two internal contacts. It is held in this position by weight of the mercury. On pressing the "off" button (black) the armature is attracted to No. 2 coil, when the

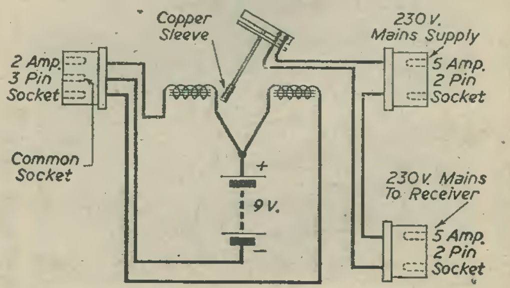


Fig. 3.—Wiring with interconnecting power plugs.

switch will be returned to its original position. It was found advisable to fit a copper sleeve over the lower part of the armature to prevent residual magnetism and sticking to the iron core of the coils.

The whole of the relay, etc., is enclosed in a small wooden case with a sliding lid for inspection and renewal of cells, all H.V. connections being connected to five-amp two-pin sockets and L.V. connections to three-pin two-amp sockets. An additional refinement was made in the form of a small double-push control, connected with light-class flexible wire to a three-pin two-amp plug, which could be plugged into sockets to enable the relay to be operated from either the dining-room table or the armchair in the lounge.

Note : The volume control on the set is always left in the " full-on " position, the speakers being adjusted for their respective volume by their independent resistance controls.

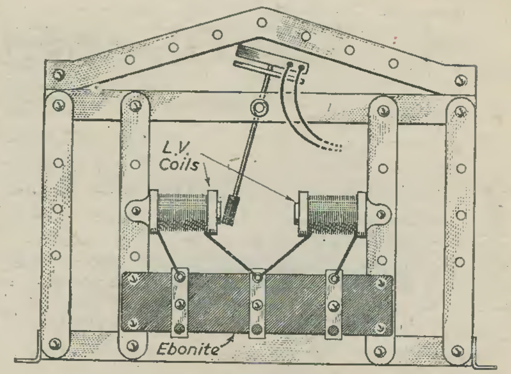
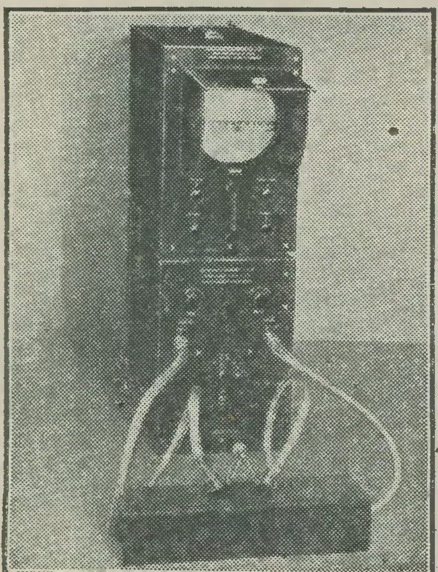


Fig. 4.—Relay (Showing L.V. Coils and connections)

Supersonic Detection of Flaws

A New Device Using the C.R. Tube

THE detection of flaws in metals—without having to destroy the work during testing—has long been a subject of both interest and importance. In this sphere the use of X-rays has played a prominent part. Recently, however, compact and portable equipment has been evolved which makes use of a cathode-ray tube. An example of equipment making use of a cathode-ray tube for the detection of faults in metals is the supersonic flaw detector evolved by Henry Hughes and Son, Ltd., their model 2B being seen below. In this apparatus two small searching units, or probes—which are connected to the equipment by flexible screened and armoured leads—are applied by hand, and usually in close proximity to each other, to the surface of the material under test. Across the C.R. tube screen appears a luminous straight line, along the length of which can be observed certain sharp deflections. From these deflections and their relative positions the presence and depth of a flaw in the area of the material under examination can be deduced. Probes have a contact surface of about 1in. in diameter and, provided the surface explored is reasonably smooth, it need not be machined or otherwise specially prepared. Oil is commonly used to improve surface contact. Surfaces having a radius of curvature of less than 5in. require to be explored with special curved probes.


The Hughes Supersonic Detector.

Principle of Operation

In operation, one of the two probes acts as a transmitter and, when applied to the surface it is required to explore, directs into the material a narrow beam of supersonic energy. The other probe acts as the receiver for energy reflected from any flaws in the path of the beam and from the opposite boundary of the material. The sharp deflections of the luminous image on the screen of the cathode-ray tube correspond to the point of entry of the beam into the material. This point is called the transmission mark. The point of reflection of part of the beam from a flaw is the flaw mark, while the point of reflection of the beam from the boundary of the material is the bottom mark. The magnitude of the flaw can be gauged from the size of the deflection of the flaw mark, whilst its location can be deduced from the position of the probes on the surface and from the depth of the flaw below the surface. This depth is accurately determined by the relative distances between the transmission mark, the flaw mark and the bottom mark, as measured on the scale attached to the screen.

Practical Hints

Bandset Selector Switch

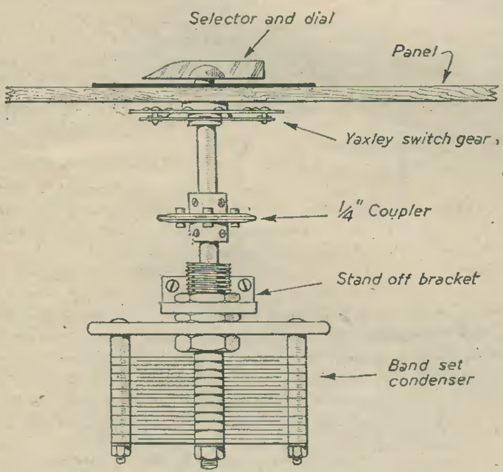
THE accompanying diagram more or less is self-explanatory, but a couple of points are worthy of note.

First, the Yaxley switchgear is the type that uses a standard ¼in. spindle instead of the flat bar type.

The one I have in use was obtained from Government surplus gear, and after stripping off the switch wafers, etc., was ideal for the job, giving nine bandset positions to 180 deg. track of condenser vanes.

The second point covers choice of bandspread condenser, one with a capacity suitable to give complete coverage between bandset positions is an advantage.

Adjustments for any band can easily be made by loosening off the coupler and setting the bandset to required band. When this has been done the bandset can be relocked to the switchgear by tightening up the coupler.—J. ENTWISTLE (Darwen, Lancs).



A novel bandset idea.

THAT DODGE OF YOURS!

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

SPECIAL NOTICE

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

Useful Pendant Suspension

LIKE many others, I suspend my electric pendants on wires over the work bench.

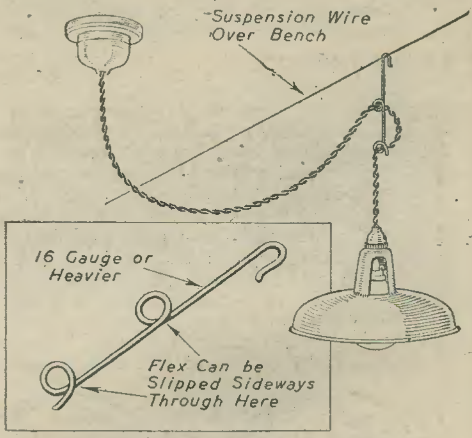
It became necessary to find a method whereby these could be raised and lowered and left to "stay put" without elaborate balance weights or expensive fittings.

I accordingly bent a piece of 16-gauge copper wire as shown, threaded the flex through without removing shade or holder by sliding it sideways into the loops and then squeezing the latter together.

A gentle pull on loop will allow the flex to be slid up or down and the greater the weight at the lamp end the more firmly it is retained at whatever height one leaves it.—JAMES D. BURGE (Birkenhead).

Improved Test Meter

AT times it is found that a suitable test meter is not available, and it should be pointed out that certain makeshift tests can be carried out, and the following ideas will give an idea of the lines which may be adopted. A standard voltmeter of the pocket-watch type may be used as a continuity or current tester if connected in series with a circuit. The exact range to be used (in the case of a dual-range or similar meter) will have to be carefully chosen. It may be possible to calibrate a meter used under such conditions. Similarly, a standard meter reading, say, up to 1 mA may be used with a 1.5 volt cell in series to check circuit continuity, bearing in mind that if the circuit resistance is likely to be very low a resistance of about 1,000 ohms should also be included in series to avoid damaging the meter. Once the main idea has been grasped quite a number of improvisations of this type may be made.—G. WALDE (N.W.9).



A useful device for the workshop.

Using the Osc

The Cathode Ray Instrument

By H. R. McDE

To commence an article with the adjoined title may seem rather ambitious when we consider that the C.R.O. can be applied to any problem that can be made to provide a voltage in relation to some other axis, which may be time, frequency, etc. These problems may vary from hum tracing in a radio receiver to the tracing of algebraic curves on the C.R.O. screen.

To clarify the meaning of the heading, let us look into the uses of the C.R.O. with regard to problems relating to the practical radio engineer and the amateur transmitter. This narrows down the field a little, but even so the possibilities are tremendous, depending for the most part on the ingenuity of the user.

At the present day, due for the most part to the low cost of ex-Service gear, there is a considerable amount of information in the technical press regarding the construction of basic oscilloscopes, suitable amplifiers, time bases and "wobbly" oscillators for visual alignment. This is all very well in its way, but the average user of such equipment does not always know exactly what is being observed, even if the connections to the gear under test and the C.R.O. are correct. The result is that if a fault is present it always shows up on the oscillograph screen, and the user is at a loss to diagnose the cause. The old adage, "A little knowledge is a dangerous thing," applies here, as the user may think he is observing one phenomena when other conditions are present which completely alter the trace. The result is disillusionment and, eventually, chaos.

This article will try to remedy this, and at the same time provide food for thought on how to obtain a solution to your own particular problem.

Equipment Necessary

Assuming a basic C.R.O., i.e., tube and power supply, a time base which is linear from about 10 c.p.s. to 10,000 c.p.s. will be needed, together with an amplifier linear from at least 10 cycles to 10,000 cycles and preferably extending to 500 kc/s or even 2 Mc/s. A single stage amplifier will be sufficient for most observations, but if possible both X and Y plates should be push-pull fed so as to minimise distortion. It should be noted that a well-known manufacturer produces a 4½in. C.R. tube that is free from nearly all forms of distortion, and in addition it has a double beam. The advantage of this cannot be stressed too highly, as it enables the user to observe with accuracy two independent effects that occur simultaneously. Also P-P deflection is not required for good results. The go-ahead experimenter should purchase one; he will never regret it!

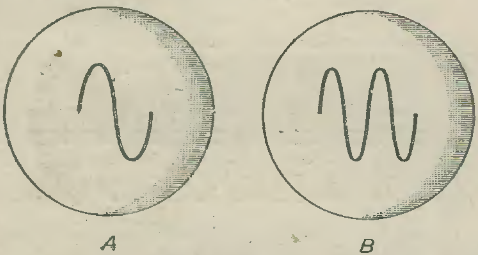


Fig. 2.—A, single cycle, and at B the result of halving the frequency.

Fundamental Operation

To gain proficiency in the operating procedure used for the oscillograph, connect up the circuit shown in Fig. 1, this supplying about 40 v. A.C. to the vertical plates—no amplifier being needed. If a suitable mains isolating transformer is available, the condensers may be dispensed with and the circuit will not be alive with regard to the mains—a good point! With the time base switched off, a vertical line will appear on the screen. The focus and brilliance controls are then adjusted to suitable positions.

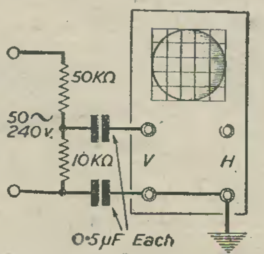


Fig. 1.—An elementary hook-up to give an idea of the operating procedure of the 'scope.

This vertical line is directly proportional to the applied E.M.F., i.e., if it is 4 cms. long and the voltage applied is 40 v., then 1 cm. represents 10 volts. Similarly, a trace of 6 cms. length indicates 60 volts. It should be noted here that the results are almost independent of frequency, R.F. potentials being measured just as easily as audio and supply voltages. From the previous few lines it will have been noted that a ruled transparent scale placed in front of the tube screen is a distinct advantage for quick reading of voltages.

If we now switch on the time base and set its frequency at 50 cycles, the vertical line is drawn out to the single trace as Fig. 2A. Suppose we now lower the T.B. frequency to 25 cycles, the trace then consists of two complete waves similar to Fig. 2B. If the T.B. frequency is lowered further still, three whole waves will appear, the frequency being 50/3 cycles, which is 16.67 cycles per second. If the frequency of the wave being examined was 400 cycles, a T.B. frequency of 100 c.p.s. would produce 400/100, i.e., four whole waves on the screen. The pattern will be stationary if the synchronising terminal is connected to the vertical input. A little experimenting with the mains and/or an audio oscillator will soon enable the user to proceed to more serious investigations.

Oscilloscope—1

ment and Its Applications.

McDERMOTT

Signal Source

In many of the operations to be described a pure source of audio energy is required. A fixed frequency is not objectionable as long as it is a pure sine wave, free from any trace of distortion. It is obvious that if we are to attempt to trace distortion by normal methods then it is essential that the input potential be free from such distortion. Very few of the normal servicing signal generators with provision for an audio output will be found to have a pure sine wave modulating tone. Because of this, it has been thought necessary to give a

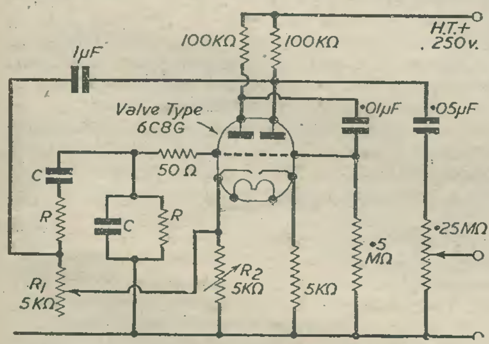


Fig. 3.—A Wien oscillator circuit.

brief description of a suitable oscillator. It will, in any case, prove of great use in the amateur shack.

The circuit consists of a Wien bridge oscillator using a double triode with feed back. The ex-Government valve 6SN7 could be used, but care should be taken in the values of the bias resistors chosen, as the performance may suffer. If satisfactory results are not obtained, measure the bias resistors as they are often well away from their stated value. Below are given two sets of R-C values for frequencies of 400 and 1,000 cycles.

400 c.p.s.	R-200,000	C-0.002
1,000 c.p.s.	R-160,000	C-0.001

The C.R.O. now makes itself useful in the calibration of the oscillator. We will consider the frequency of the latter to be nearly 400 cycles. The oscillator is switched on and allowed a few minutes to attain working temperature. During this period the time base is set to 100 c.p.s. This may be done by using the A.C. mains as previously described and adjusting the time base control until the pattern of Fig. 4A appears on the screen. The T.B. is then operating at 100 c.p.s.

The next step is to feed the oscillator into the vertical input of the C.R.O., apply synch., and vary R1 until a stationary pattern consisting of four whole waves, similar to Fig. 4B, is seen on the tube screen.

To achieve this it may be necessary to vary R2 slightly. It should, however, be kept as near maximum resistance as possible, for if it is lowered too far the valve will be overloaded and a far from pure output will result. If, even after adjusting R2, it is found impossible to obtain the required pattern on the screen, the values of R and C in the bridge circuit should be examined; it is probable that they are not quite correct. To assist this, a small trimmer may be placed in parallel with each of the bridge condensers or the resistors may be changed. When these adjustments are completed, i.e., four waves appear on the screen, the oscillator is working at 400 c.p.s. Although the setting up of the oscillator may appear to be rather complicated, in practice it is very simple and at the same time accurate.

In this series of articles it is proposed to cover some very interesting practical applications of the C.R.O. in the radio field, nearly all of which can be performed by the amateur. A list of the main subjects follows:

(a) Frequency Calibration.
(b) Depth of Modulation in Transmitter.
(c) Depth of Modulation Monitor.
(d) Viewing valve characteristic curves.
(e) The C.R.O. as a Bridge Null Indicator.
(f) Wave Propagation.
(g) Amplifier Characteristics.
(h) Receiver Characteristics.
(i) Alignment of Straight and Superhet receivers.

Frequency Calibration

(a) Frequency calibration, of which an example has already been given, i.e., the calibration of the fixed frequency oscillator, is probably the best way really to get to know your 'scope and "get the feel" of the controls. The main thing, at first, is to get to know approximately where to find certain much-used frequencies of the time base, such as 25, 50 and 100 cycles. An idea would be to incorporate a small transformer in the C.R.O. to provide about 50 peak volts A.C. to a terminal on the panel so as to have to hand a means of ensuring that the time base is actually working at the desired multiple or sub-multiple of the mains when such operation is desired. *(To be continued)*

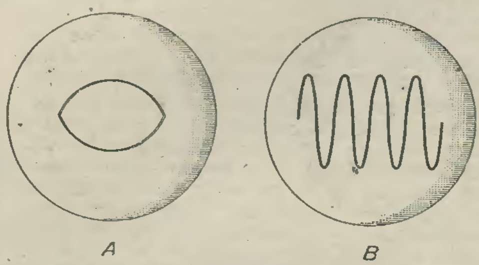


Fig. 4.—Two traces developed from the oscillator as described above.

Recording Technique—4

This Month the Question of Volume Levels is Discussed.

By K. KEMSEY-BOURNE

PREVIOUS articles in this series have dealt with monitors and volume indicators, both devices that help the recordist to operate his equipment in the best way. Before we start to consider the other end of the recording chain and such topics as studio acoustics, microphone placing and recording from broadcasts it may be well to mention a type of occupational disease not listed in medical works of reference and known as "Mixer's Itch" or "Knob Twitch." This malady affects recordists, and in particular those whose apparatus does not include volume-compression devices.

The suffering recordist feels compelled to make sudden or ill-advised changes of the gain controls during cutting, and these changes lead to wide and obvious variations in the level of reproduction. The affliction is brought on by two main causes—lack of experience of the material being recorded (usually music) and the desire to record quiet sounds at too high a level.

Imagine that the operator is recording a song or other piece of music that contains a climax following a quiet passage, which is commonly the case. He comes to the conclusion that the quiet passage is being cut at too low a level; although he can hear it on his monitor the V.I. seems barely to be moving and the needle flickers feebly at about 15 dB. down, or 20 per cent. full modulation. Accordingly, he brings up the gain until the needle averages 5 dB to 7 dB down, about 50 per cent. modulation. When the peak or climax comes to take him by surprise the V.I. flicks hard over, well above the 100 per cent. level for good cutting. The unhappy fellow turns down the control in something of a panic; perhaps he overshoots to the other extreme, and then has to bring the gain up again to reach the correct level. On playback the disc sounds as though gremlins have done their worst.

The cure for this sort of trouble is clearly to set up the controls so that the peaks will be comfortably handled; this is roughly analogous to the photographic maxim, "Expose for the shadows." If it is necessary to fade up very quiet passages or to diminish loud noises of abnormal intensity then the controls must be moved smoothly and evenly at the right moment and returned to their normal setting equally smoothly at the first possible opportunity.

The recordist must know the minimum and maximum handling capacities of his gear if he is to interpret correctly the indications of his V.I. His satisfactory recording range is limited to about 20 dB. Since the difference between a faint whisper and a loud shout can be 60 dB, and the range of orchestral music is estimated as 70 to 80 dB, it becomes evident that some control (or compression) is necessary. In the studio it is not difficult to rehearse an item several times to ensure that the relative levels of different sections are known, and adjustments can be made accordingly. On the contrary, radio or "off-the-air" recording must be handled satisfactorily first time; there is no possibility of going back for another trial.

Variations in Level

Singers are notorious for exceeding during the final recorded performance the levels at which they sang during rehearsals. Recognise this as a natural artistic desire to put out their best for the recording, and allow for it where possible. Soprano voices in particular will indicate wide V.I. differences on different notes, even when the singer is trying to maintain a constant level, and even expert singers have notes on which they tend to peak.

All these various types of peaks, including the rise in power at the conclusion of a piece, must be made to lie within the 100 per cent. modulation level unless they are of very short duration.

Ordinary speech presents no range difficulties, since the average range for the fundamental speech sounds over the band 250 to 6,500 cycles is 20 dB.

Instrumental Ranges

The peak pressures of sound waves generated by playing various instruments vary with the instrument and cover a considerable range of values. Recordists must know something of these peak pressures because they determine the amplitudes that microphones and amplifiers must handle. This aspect of the subject has a bearing also on microphone placing, although as we shall see it is not possible to position microphones entirely by rules or calculations.

Let us consider the average and peak pressures set up by various instruments or combinations. Certain figures are set out in the table overleaf. A violin played at the lowest level normally usable produces an average pressure of about 0.5 dynes/sq. cm.; that is the average over its full frequency range, measured at a distance of 3ft. away. At the same distance a bass drum, which is the most powerful single instrument and can dissipate up to 25 watts of power, can have peaks as high as 1,260 dynes/sq. cm. Thus the ratio of pressures between these two cases is 2,520 : 1, which corresponds to a difference of approximately 68 dB. It stands to reason that to record these two instruments, playing at the same intensities as above, inside a 20 dB. range the level of the drum must be reduced relatively to that of the violin, and the simplest way to do this is—place the drum farther from the microphone than the violin, and so decrease the pressure at the microphone due to the drum. Extending this further, it follows that the order of distances of the different instruments from the microphone will be directly proportional to their individual pressures.

The table represents six instruments separately, a small orchestra (15 players) and a symphony orchestra. With the exception of the piano all the single instruments were at a distance of 3ft.; the piano pressure was measured at 10ft. The figures for the orchestras are not directly comparable with those of the separate instruments, since these pressures are at 6ft. and 15ft. respectively from the nearest instrument.

What the table shows is the relation between the average and the peak pressures for each case, and this has been expressed as a decibel range. Where the dB. range is greater than that of the recording equipment then such peaks as occur in the material recorded will have to be diminished.

Studio Acoustics

The reverberation, "liveness" or "deadness," of a studio affects the apparent loudness of any sound, especially since the reverberation is not constant for all frequencies, and this has a notable effect on the quality of recording. Recording up to 4,000 cycles in a "live" studio may sound better than working up to 8,000 cycles in a "dead" or lifeless one.

The following table shows the relation between average and peak pressures for various instruments. Pressures are in dynes/sq. cm.

Instrument	Average Pressure	Peak Pressure	Peak Average	Decibel Ratio
Bass drum ..	40	1260	31.5	30
Snare drum	15	365	24.4	28
Trombone ..	6.5	230	35.5	31
Trumpet ..	8.5	55	6.5	16
Clarinet ..	3.5	26	7.4	17
Piano ..	2.5	24	9.6	20
Orchestra ..	8	120	15	23
Symphony Orchestra	5	130	26	29

Noises in Radio Receivers

Aerial Design, Noise Limiters and Other Aids Described.

By J. CARTWRIGHT, A.M.I.R.E.

WITH the availability of surplus ex-Service equipment, many amateurs are constructing or modifying superhet receivers for short-wave operation. It may be of interest, therefore, to consider the factors affecting the signal-to-noise ratio obtainable. It is of no use having a really high gain receiver, if the noise level is so high that it swamps all but the strongest signal. An analysis of the various sources of noise will show what may be done to reduce the noise level to the lowest possible value in any particular case.

For our purpose all random signals may be classified as noise and they may be considered under the following headings:

(A) Noise external to the receiver.
- (1) Radiated.
- (2) Mains-borne.

(B) Noise inherent in the receiver.
- (3) Faulty components.
- (4) Circuit or thermal noise.
- (5) Valve noise.

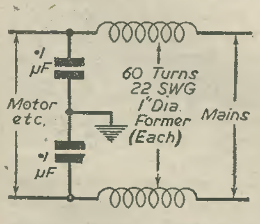


Fig. 1.—Circuit details of a simple mains interference suppressor.

Radiated noise, that is noise picked up by the receiver aerial, may be due to natural or man-made causes. Of the natural causes, the thunderstorm is the most usual. A bad storm as far as 1,000 miles away may produce the familiar crackle on a sensitive receiver. The effect of these discharges of natural electricity produce most interference at low frequencies and the effect decreases as the frequency increases, becoming negligible at 20-25 Mc/s. At V.H.F. "cosmic noise" is encountered. It is believed that this is due to disturbances of the sun's surface, probably associated with some form of particle emission. It is noticeable as an increase in "hiss," noise level.

Radiated man-made noise is most commonly due to car ignition systems, diathermy or induction heating apparatus. The radiation may take place

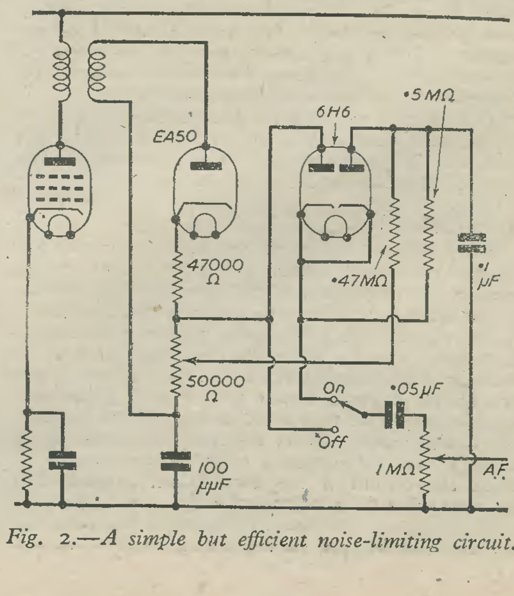


Fig. 2.—A simple but efficient noise-limiting circuit.

directly from the source or by reradiation from overhead telephone or power lines. The interference field decreases sharply with distance from the source, so that the aerial should be as high as possible and far away from overhead wires. If the aerial must of necessity be near overhead lines, then the main direction of the aerial pick-up should be at right-angles to them. A screened or balanced feeder should be used in order to eliminate pick-up on the feeder where it passes through the interference field. A high aerial is in any case advantageous in increasing the signal voltage induced in the aerial.

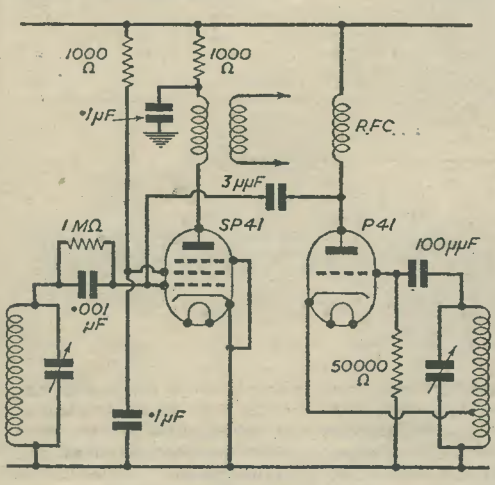


Fig. 3.—A frequency-changing stage with grid leak bias.

Of mains-borne interference, that is interference voltages present on the house mains wiring, the most common source is probably the household vacuum cleaner. Suppression of the interference at the source is, of course, the ideal solution, but so often impossible, because the source happens to belong to someone else. A simple filter of the type shown in Fig. 1 will usually provide the cure. If the trouble lies in sparking at the brushes of a motor, a couple of .1μF condensers from brushes to frame will often be a useful addition. If the matter has to be tackled from the receiver end, a filter of the type shown should be inserted in the mains lead close to the mains transformer.

Noise Limiter

Many of the types of noise so far mentioned consist of sharp pulses of voltage very much greater in amplitude than the required signal. By limiting the receiver response to the amplitude of the signal, the noise output is reduced to the same level, thereby rendering the signal more easily readable. The circuit shown in Fig. 2 is a simple but highly efficient audio limiter and is actually a modification of that used in the AR88 receiver. The circuit automatically adjusts itself to the signal amplitude and the diodes come into operation to block the circuit if the modulation exceeds 100 per cent. due to a noise pulse.

Dealing now with noise inherent in the receiver, the method of preventing noise due to faulty components is obvious. Dry joints, dirty connections to the moving vanes of a condenser or a resistance which is being overheated may all contribute their quota of hiss and crackles.

On the other hand, every circuit component produces a small noise which cannot be eliminated. The electrons in, say, the copper wire of a tuning coil are in constant motion and although the average effect is zero, over a short period of time this random movement does represent the generation of a voltage. This voltage has components covering an exceedingly wide frequency range, but due to the response of the receiver and the human ear it is audible as a hiss. This is commonly called thermal agitation noise. The value of the thermal noise voltage is proportional to the square root of the impedance of the source and the square root of the bandwidth of the circuit. It is sufficiently small to be of importance only for the first tuned circuit in any normal receiver. As an example, the approximate value for a tuned circuit with an impedance of 100,000 ohms and a bandwidth of 10 kc/s is 4μV. However, if this circuit feeds a non-linear device such as a frequency changer valve the noise voltage is effectively greater since I.F. noise components can be produced by R.F. noise components outside the nominal bandwidth, owing to interaction with oscillator harmonics, second channel effects, etc. The amplified noise plus signal voltages are so much greater than the thermal noise voltage generated in the second stage that the contribution of this stage is negligible.

Valve Noise

In much the same way, all valves produce noise in varying degrees because the anode current consists of individual electrons and there will be short period variations even though the average anode current is constant. In the case of the diode and triode, the " shot noise " voltage produced is proportional to the anode current divided by the square of the mutual conductance. For a multigrid valve, the total space current is divided between the anode and one or more screen grids, and in consequence the noise voltage as calculated on the anode current must be multiplied by a factor greater than one. To obtain the minimum noise voltage, therefore, the screen current should be small compared with the anode current and the mutual conductance should be large. Special valves having these characteristics have been produced by both British and American manufacturers, typical examples being the television pentodes EF50, SP41 and 6AC7. For the normal types of frequency changers the screen current is high and the effective mutual conductance, i.e., the conversion conductance, is low and consequently the noise level is high.

It is usual to express the " noisiness " of a valve as the " equivalent shot noise resistance." This is the value of resistance which, under standard circuit conditions, would produce the same thermal noise voltage as the actual valve noise voltage. By using this equivalence, it is possible to compare the merits of various valves and to compare the relative importance of valve and circuit noise. Typical values for various types of valves are :—

Triode—200 to 500 ohms.
Television pentode—2,000 to 4,000 ohms.
Normal pentode—20,000 to 50,000 ohms.
Frequency changer—50,000 to 150,000 ohms.

In practice the value is even higher in an actual frequency changer circuit since the oscillator contributes a certain amount of noise in addition to that produced by the hexode or heptode due to the interaction between noise voltages outside the nominal passband of the receiver with oscillator harmonics to produce components falling within the I.F. passband.

Having now briefly considered the sources of noise, we may consider how to apply these facts in a practical case. Suppose the aim is a general coverage superhet, 1.7 Mc/s to 30 Mc/s, of high sensitivity and signal/noise ratio. From the figures given above it is obvious that at least one stage of R.F. amplification must precede the frequency changer, since for optimum performance the valve noise should be less than the circuit noise. At the low frequency end of the range, one R.F. stage, using EF50 or SP41, will give satisfactory results, but at 30 Mc/s, where tuned circuits have of necessity much lower impedances two stages would be better. However, a very satisfactory compromise is to use a single high-mu R.F. stage, followed by a similar valve as a frequency changer. This type of frequency changer has a higher conversion conductance than any of the more normal circuits. An SP41 in the circuit shown in Fig. 3, has a conversion conductance of 2.7 ma/V., and a noise level little greater than that of the same valve used as an amplifier. The difficulties normally encountered with grid injection are largely overcome by using grid-leak bias for the mixer.

The R.F. circuits should have as low loss as possible, with the layout arranged to give minimum stray capacities. Plug-in coils enable a number of bands to be covered with the maximum efficiency, but switched coils in a turret form of construction can be very nearly as good. The aerial coupling circuit is of vital importance and the number of turns on the aerial coil should be adjusted to give optimum signal transfer, that is the feeder impedance should be matched. Although this adjustment does not in theory give the best signal/noise ratio, the difference is not normally detectable in practice.

Two Stages

If an I.F. of 465 kc/s is chosen, two stages using iron cored coils and normal R.F. pentodes will give adequate selectivity for 'phone reception, with maximum usable sensitivity. The overall bandwidth will be determined almost entirely by the I.F. amplifier, since the R.F. circuits will be comparatively flatly tuned, especially at the higher frequencies. This will give a bandwidth of about 5 kc/s at 30 dB. down which is a compromise giving high signal/noise ratio with reasonable audio quality. A double diode triode, as detector and L.F., feeding a power pentode such as a 6F6 completes the line-up. To deal with pulse type interference a noise limiter between the detector and audio stage will prove a very worth-while addition.

Above 30 Mc/s very much the same considerations apply, provided that it is remembered that the stage gain decreases due to the difficulty of obtaining high impedances in the tuned circuits. Above 100 Mc/s other desirable properties of the valve have to be sacrified to obtain minimum inter-electrode capacitics. The acorn valves, such as the 954, or their equivalents in the 9,000 series of the miniature range are the usual types. The latest releases for U.H.F. use the 6AK5 and the 6J6, which is a special double triode.

As a matter of interest it may be noted that the old controversy of whether the superhet or the reacting detector receiver is the more sensitive for weak signal reception cannot be settled simply by calculating the theoretical signal-to-noise ratios. The sensitivity of a reacting detector depends far more on the skill of the operator than on the circuit. The author of this article had occasion to make a series of tests on receivers of this type and a variation of 10 to one in the sensitivity figure for any particular set was found, depending on whether the operator was skilled or unskilled.

In conclusion, it may be of interest to describe an easy check on the efficiency of an R.F. stage. The aerial is removed and a condenser of .1μF connected from grid to ground. If the thermal noise due to the tuned circuit is the limiting factor, as it should be, then the noise output will decrease on connecting the condenser.

Microwave Multichannel System

THE Plessey centimetric (microwave) radio link has been developed to provide multi-channel two-way radio telephone communication in situations where the provision of landline equipment is either not possible or is undesirable. The microwave radio " beam " is extremely narrow, and is not unlike the beam produced by a searchlight. Provision has been made for eight duplex channels (speech or telegraph) of a 4 kc/s. bandwidth over one R.F. carrier in the 6 cm. waveband (i.e., a carrier frequency of about 5,000 megacycles per second).

Receiver

The receiver is a superheterodyne type with a V.M. local oscillator, which is of similar construction to that of the carrier oscillator. The mixer is of the cavity type into which is injected, by means of a loose coupling, power from the local oscillator. The receiver line from the aerial hybrid is matched into the mixer cavity. The first detector is a silicon crystal capsule, feeding directly into a 60 mc/s head amplifier.

The I.F. amplifier is designed to have a gain of 92 dB. at a mid-band frequency of 60 Mc/s with a bandwidth of 10 Mc/s., the input impedance being 75 ohms.

The detected output provides the demodulated signal in a video-frequency band with a flat characteristic from 20 c.p.s. up to 5 Mc/s. from a low internal impedance. The A.F.C. control voltage operates on the grid of the local oscillator valve.

The I.F. amplifier may be regarded as comprising two separate three-stage amplifiers connected in tandem. The wide bandwidth is obtained by means of feed-back, using special low-capacity resistors.

The video output signal from the detector passes through a video amplifier and is fed into a group pulser and separator unit in the second bay.

Modulation–3

In Concluding This Series "DYNATRON" Deals With Amplitude Modulation

TRUE amplitude modulation as generally understood is a result of adding a third carrier frequency, giving the wave of Fig. 1 (b).

We have just seen how a "simple beat" between sidebands (i.e., minus the carrier) results in Fig. 1(a). If now the carrier is reintroduced in correct frequency, magnitude and phase, the pulsating envelope, with frequency-doubling, will be transformed into the true sinusoidal envelope of Fig. 1(b).

In Fig. 8, we have two sideband vectors OA and OB, revolving relative to the carrier vector OC.

As its frequency is higher than the carrier, OA will be revolving faster than OC, therefore slowly gaining upon OC. Similarly OB will be falling behind OC at the same rate as OA is gaining.

Actually, OA, OB and OC are all revolving anti-clockwise extremely rapidly—all being "high" frequencies. But *relative to* OC, OA is revolving (gaining) anti-clockwise, whilst OB has a relative clockwise (falling behind) motion.

At all times, however, OA and OB will be symetrically placed relative to OC—will make the same angles with OC. Therefore, the vector resultant OD will always fall *in line with* OC; either in-phase as in 8(a) and 8(b), or diametrically opposite as in 8 (c).

In one case, OD will be adding to the carrier amplitude to raise the modulation to a "peak"; when the sideband vectors have positions such as in (c), OD will be of opposite phase to the carrier, subtracting therefrom to cause the "trough" in the modulation envelope.

Which explains what we mean in saying that A.M. is a "complex beat" between sidebands and a carrier.

As in simple beats, the modulation envelope is a "difference-frequency": the difference (fc+fm) −fc, or fc−(fc−fm), the answer being the modulating frequency fm in either case.

The upper sideband is (fc+fm); the lower, (fc−fm): "sum" and "difference" frequencies, but of an altogether different type to those we have been discussing in the case of beats.

As explained before, the *beat*-difference between the sidebands is, (fc+fm)−(fc−fm)=2 fm (we get frequency-doubling). With a carrier, the beat differences are, (fc+fm)−fc, or, fc−(fc−fm), as above.

Here, we get a difference between either sideband-frequency, and a *mean* frequency fc, which gives the correct modulating frequency fm.

But in speaking of "sums and differences," no one should be so foolish as to confuse sidebands with what we do to find a beat-difference. For example, the so-called "sum frequency" in beat-rectification is not a "sideband" (!), but a second harmonic of a resultant mean frequency.

Is it anything else in a modern mixer?

A Little Mathematics

How do we derive an expression for an amplitude-modulated wave?

First, an alternating current of steady amplitude (or an unmodulated carrier) is denoted by,

$A \sin 2\pi fct$, or $A \sin \omega t$,

where A stands for the constant amplitude.

Suppose, now, the amplitude, instead of being constant at the value A, is varying sinusoidally at an audio rate represented by B sin pt, Fig. 1(b).

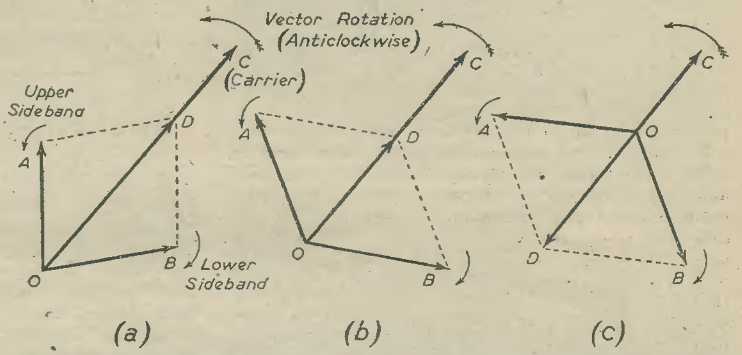


Fig. 8.—Vector picture of a "Complex Beat" between carrier and sidebands. Tailed arrows show rotation of the vector system as a whole; small arrows show relative *rotation of the sideband vectors with respect to the carrier. Resultant OD always falls in-phase, or at 180 deg. to the carrier vector OC, i.e., adding or subtracting to the amplitude.*

Then, the amplitude will rise to a maximum of (A+B). During a modulation cycle, the peaks of successive H.F. cycles will be close enough together for us to write:

Instantaneous Amplitude of a given H.F. cycle = A+B sin pt,

i.e., considering how the H.F. *amplitude* is changing over the modulation cycle.

But, next, we want a general expression of the form $A \sin \omega t$, to give the *instantaneous value at any point in any H.F. cycle, during modulation.*

It is quite simple. Instead of having the constant value A, the amplitude is now (A+B sin pt), so, therefore:

$$A \sin \omega t \text{, becomes, } (A+B \sin pt) \sin \omega t.$$
$$= A(1+B/A.\sin pt) \sin \omega t.$$
$$= A(1+m \sin pt) \sin \omega t,$$

where, m = the *modulation factor* B/A.

For example: $20(1+0.8 \sin 2\pi (1{,}000)t) \sin 2\pi 10^6 t$

states we have a wave—or an alternating current—of 20A. peak (unmodulated), and of frequency 10^6 cycles/sec. (=1.0 Mc/s); it is modulated 80 per cent. (m=0.8) by a sinusoidal current at 1,000 c/s, The "20" might equally well stand for 20 volts, or 20 kV. in transmission problems.

If simply superimposed, the expression is, A sin ωt + B sin pt.

For frequencies in the ratio of 2/1 or more, this equation says the waves remain entirely independent as explained in reference to Simple Superposition. If in a ratio less than 2 (if the frequencies are within the same "octave"), mutual interference would take place to give a simple beat, Fig. 1(a) and Fig. 7.

But in A.M., fc and fm are widely different frequencies. Simple addition, as above, would leave the waves independent, Fig. 6(a). *Modulating* A sin ωt by B sin pt implies *multiplication* of instantaneous values:

A sin $\omega t \times$ B sin pt, and not (A sin ωt + B sin pt).

A non-linear device is essential to accomplish this.

Two high-frequency sidebands are generated, when we may apply beat principles as in Fig. 8; the carrier and sidebands are all frequencies within the 2/1 ratio limit.

It may be interesting in a later article to try to understand how a non-linear device can "multiply" the instantaneous values of two (or more) sine waves.

Practical P.A. Working–4

Microphones and Loudspeakers are the Subject of This Article.

By R. SELBY

THE ribbon velocity microphone is capable of giving first-class reproduction, being free from resonances and having a very wide frequency response. It has a definite directional pickup which may or may not be an advantage. The chief difficulty lies in its very low output. Owing to the very low impedance of the ribbon, a step-up transformer must be mounted inside the microphone casing, and, unless the ratio (and therefore the output voltage) is low, a screened cable must be used for connection to the amplifier. The small mass of the ribbon means that it is not likely to be harmed by dropping, but it is liable to damage by wind or by speakers blowing into the microphone, an unpleasant habit which some users adopt for finding whether the microphone is alive or not. Taking all these factors into consideration, it may be said that the ribbon is an excellent microphone, provided it is handled considerately, and that it finds its principal application in indoor use.

Crystal microphones are of two types—the diaphragm and the sound-cell. Both have an excellent high-frequency response. The former has an output comparable with that of a moving-coil and is useful for some purposes, particularly in mobile loudspeaker vans, but it cannot be considered a high-fidelity instrument and will not be considered further. The sound cell type consists of one or more Rochelle salt crystals embedded in wax and lightly suspended inside a protective and screening case of metal gauze. Sound waves impinging directly on the crystal cause it to generate a corresponding voltage. Sound pickup is substantially non-directional and frequency response is excellent, but output is low and the high impedance of a capacitive nature presents some difficulties. The load imposed on the microphone by the grid resistor of the input valve must be not less than 2 megohms if loss of bass is to be avoided, and the connections from microphone to grid of the valve

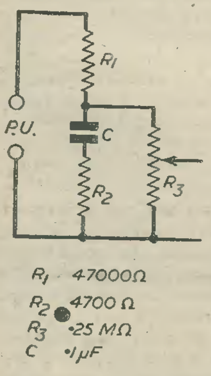


Fig. 3.—Tone-controlled input circuit.

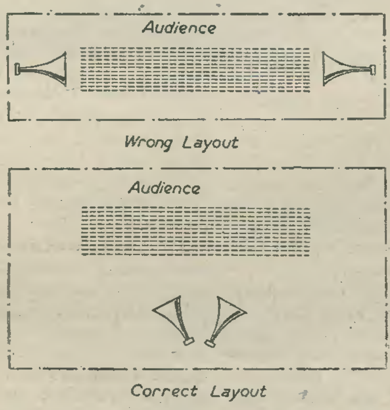


Fig. 4.—Two speakers may be arranged as shown above.

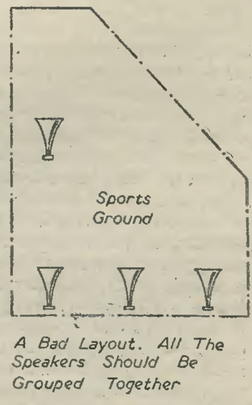


Fig. 5.—Another incorrect speaker layout.

Trade Notes

Varley Transformer

TO meet the popular demand for "Universal Output" transformers, Oliver Pell Control, Ltd., have recently put into production a new model listed as Varley D.P.61

This heavy duty model is a multi-radio output transformer, capable of handling 20 watts without distortion, and meets the needs of those who require a high-quality component. It is specially suitable for 6L6 valves or equivalents. The sectional and interleaved windings are carefully balanced to ensure a level response over a wide frequency range.

The D.P.61 transformer is enclosed in stoved enamel grey shrouds, giving a minimum loss of power. It is supplied in 11 ratios for a single valve and 11 ratios for "push-pull." Other details are as follows :—

Primary Inductance	..	45 henries
Primary Resistance	..	300 ohms each half
Primary current ..	..	100 mA. each half
Output (maximum)	..	20 watts
Ratios	..	13 : 1-100 : 1

List price, 45s.

"Bafflette" Console Model

THIS speaker is so designed that it will stand in a corner or normal floor model position. It is of highly-polished walnut, black plinth, horizontal inlays at top and bottom. Its dimensions are 26in. x 17in. x 6in.

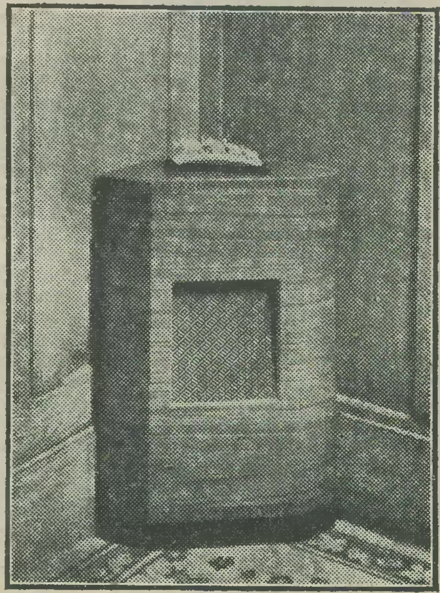
The speaker aperture is set back at an angle to prevent attenuation of the higher register; strong shallow cabinet eliminates unwanted "box" resonance. The quality of reproduction is consequently better than the average table model and comparable with a good console radio receiver.

The price is £6 15s. (8s. 6d. extra with transformer).

C.-R. Tubes with Standard Heaters

DESIGNERS of D.C./A.C. television receivers will be particularly interested in two new cathode-ray tubes which have recently been announced by Mullard Electronic Products, Ltd. These tubes, a 9in., type MW22/14C, and a 12in., type MW31/14C, have heaters rated at 6.3 volt, 0.3 amps., and may, therefore, be series run with the valves in the television receiver. Although the maximum first anode voltage has been reduced from 400 to 300, in practice this does not prevent direct interchangeability with older tubes as these are invariably operated at a first anode voltage below 300, this being usually obtained from the 300 volt line less the appropriate bias. The new tubes can thus be used as direct replacements in sets which have been using the Mullard types MW22/7 or MW31/7, according to whether a 9in. or 12in. tube has been fitted.

In addition to the MW22/14C another tube, type MW22/14, is also in production. This is similar to the MW22/14C, but has a coating of Aquadag applied externally to the flare of the tube, the purpose of which is to act as one electrode of a smoothing capacitor for the E.H.T. supply. This has the advantage that it eliminates the necessity of using a standard smoothing capacitor, thus reducing the cost of the equipment. It should be noted, however, that although the MW22/14 has identical operating conditions and characteristics to the MW22/14C, it is not directly interchangeable with this latter tube on account of the external conducting coating.



The new "Bafflette" Console Model Extension Speaker.

R.G.D., Ltd.

THE following changes of address and sales policy are announced by Radio Gramophone Development Co., Ltd :

The London Depot, Dealer, Sales Service and Export Department is now at 3-4 Hampton Court Parade, East Molesey, Surrey. Telephone: Molesey 4357/8.

The Publicity Department has moved to 21 Bloomsbury Street, London, W.C.1. The telephone number is Museum 1600.

(*Continued from page* 427)

Some readers may consider that differentiation is unnecessary in the case of the last two classes! Propaganda is a difficult item to cover, since, as indicated earlier in this article, its motives may frequently be achieved by omission. However, I think all viewers will agree that it is high time that television adhered to certain standards of taste and that a classification of appeal, as indicated above, would be a valuable guide.

ELECTRADIX *Bargains !*

SOLENOIDS. Powerful electro magnetic D.C. iron clad Solenoid ⅝in. core, weight 1 lb. 10 ozs., screw-in core for use on 6-25 volts to lift 7-28 lbs., Type No. 1, 4/- ; Type No. 2, with 3 separate windings, 4/6. Wound Solenoid coils, 27 gauge enamelled wire, excellent as H.F. smoothing filter choke, 2/3 each.

MAGNETS. D.C. Electric magnets, weight 10 oz., lift on 2 volts 1¼ lb., 4 volts 3 lb. 6, volts 4 lb., new surplus, 7/6 each. Permanent powerful flat bar magnets, 2⅝in. x 1in., x ¼in., drilled 2 holes each end, and any pole pieces, 2/- pair. The wonder Midget magnets. Alni perm. steel disc ; ⅝in. diam. ⅜in. thick, with 3/16in. centre hole 3/6 each. Large stock of Horseshoe magnets. Send for special Magnet Leaflet.

METERS. D.C. moving iron ammeters, panel mounting 2in. dial, bakelite case, 0-5 amps, 12/6. D.C. moving coil milliammeters, 2½in. dia., flush panel, 0-1 m.a. 35/-. D.C. moving coil Weston meters, 2in. flush fitting f.s.d., 500 m/ma., reading 15 volts and 600 volts with extra resistance, resistance not supplied with meter, 20/-.

DYNAMOS. 12 volt 10 amp. D.C. machines, 1,400 r.p.m., new condition, 45/- ; 24 volt 30 amp., £4 ; 30 volt 5 amp., £5.

ELECTROLYTIC CONDENSERS. 150 watt working 64 M.F.D. metal can type with base clip, 2/6.

DIMMER RESISTANCES. Totally enclosed panel type, 100 ohms ¼ amp. or 50 ohms ½ amp., 2/6 each, post 6d. Open type wire wound, porcelain base, 10 ohms 1 amp., 2/6.

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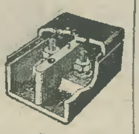
BELLS. G.P.O. Circular Bell on bakelite base, 5/-. Magneto bell in Mag. box 8 x 6 x 3½in., 5/-. Heavy 1/CA.C 230 volt alarm bells, 6in. gong, 42/-.

TELEPHONES for House or Office. Constructors' Parts for your own set-up. Ex G.P.O. stocks, wall type, comprising Bracket Mike, Transformer and Condenser, Magneto Bell in walnut cabinet, 8in. x 6in. x 3in., fitted terminals and connections, Switch Hook and Contacts, Hand Magneto Generator and G.P.O. Receiver, 35/- per pair, with wiring diagram.

WIRELESS CONTROL UNITS, ex-R.A.F., contain Yaxley switch and knob, connection strips, fuse and holder, coil socket and connections, 2/6, postage 9d. Larger model with 2 Yaxley switches and pilot lamp, 4/-, plus 1/- postage.

HAND MAGNETO GENERATORS. 4 and 5 magnet type, 150 volts 50 m/a., A.C. output, new condition, P.M. Steel magnet and gearing in handle, 12/6, postage 1/-.

TERMINAL BOXES.



Bakelite power terminal boxes 3½ x 2¾ x 2⅛ highly polished black with ⅛in. centre fillet and screwed cover 2-pole 5/16in. connection studs and nuts. Admirable terminal or branch top on large transformer, 2-pole lights, power or charging circuits 10/50 amps. Wall or ceiling fixing, 2/6 each, 20/- per dozen.

PARCELS. 10 lbs. useful oddments for the junk box. All clean, dismantled from Government and other surplus apparatus, 7/7 post free. (*Not for Overseas buyers.*)

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ELECTRADIX RADIOS

214, Queenstown Road, London, S.W.8

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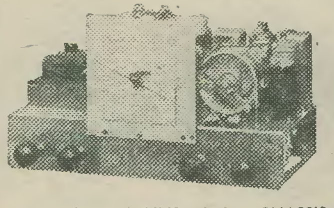
A NEW "TELERADIO" CHASSIS MODEL A70



6-valve A.C. MAINS R.G. CHASSIS, 15-50, 200-600, 540-2,000 Metres with TUNING INDICATOR, TONE CONTROL. **14 gns., plus P.T. £3.3.3, or in kit form from £8.10.0**

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VERY SPECIAL OPENING BARGAINS

VIDEO FILTER UNIT
This job contains a really excellent power pack operating from 250 cycle mains, contains transformer giving 350-0-350 120 milliamps, two 5 v. 2 amp., one 6.3 v. 2 amp., one 2 v. 1 amp. windings, and the following valves : 5, EF50 ; 1, EF55 ; 8, EA50 ; 1, R1 ; numerous jacks coils, resistors, tag panels, handsome blue front panel, size 17in. x 10in. x 8in. Price **£2 17s. 7d.** *Callers only.*

AMERICAN INDICATOR TYPE ID6 APN4
Contains 26 valves, types : 3, SL7 G.T. ; 14, 6Sn7 G.T. ; 8, 6H6 G.T. ; 1, 6J7 G.T. ; 1, 5in. C.R.T. Type 5CP1, and 100 Kc. crystal. **PRICE £3 19s. 6d.** *Callers only.*

THIS MONTH'S SPECIAL OFFER
Indicator type 62. Size 9in. x 12in. x 18in. Contains VCR97 tube (non Persistent) ; 16, SP61 ; 2, EB34 ; 2, EA50 ; 16 potmeters, Muirhead dial, 117 Mc/s. crystal, various switches, knobs, transformers, etc. **£2 19s. 6d.** *Callers only.*

Note : All C.R.T.s will be demonstrated to callers.

RECEIVER 3090
Complete in case size 12in. x 8in. x 12in. Contains the following valves : 4, SP41 ; 2, 6J5 ; 1, EB34 ; 2, EA50 ; 2, CV6 ; 1 motor generator, numerous relays, potmeters, resistors, etc. The generator, which is complete with all gears, etc., can be easily converted to a small motor for A.C. or D.C. operation. This really is a genuine bargain, at **only 19/6**, plus 5/- carriage and packing. Get one now while stocks last.

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Tuned 5 metre Converters. Brand new in makers' cartons. Price **only 27/6** post free.

R1124 RECEIVER
Range 30 to 40 Mc/s. Contains six new valves : 3, 9D2 ; 1, 8D2 ; 1, 15D2 (Frequency Changer) ; 1, 4D1 ; 24 ceramic trimmers, 6 ceramic valveholders, 6 valve screening cans, 30 resistors, 3 potmeters, mica and tubular condensers, ceramic coil formers, 5-way 4-bank switch with long spindle and IF transformers, etc. A real buy at **only 19/6**, plus 2/6 carriage and packing.

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Programme Pointers

This Month Our Music Critic, MAURICE REEVE, Deals With the "Pairing Off" of Musicians

COMPARISONS are odorous, said Shakespeare, but musicians would seem to take little heed of his wisdom, so far as the critical members of the fraternity are concerned. I don't know how many of my readers are given to the habit of pairing off the great musicians when engaged in musical discussion, but I have noticed with unfailing regularity that certain composers get sorted out, or fall, into pairs as naturally and as inevitably as bacon goes with eggs or strawberries with cream. And as it always occurs of our desire either to praise or belittle someone, the habit, or one might almost call it custom, may afford us some interest.

The most notable instance is, I suppose, that of the three great Bs, to wit, Bach, Beethoven and Brahms. These three giants, whose combined span from Bach's birth in 1685 to Brahms's death in 1897 covers the entire period of the German domination of the musical world, really form two pairs: Bach-Beethoven and Beethoven-Brahms. Bach and Brahms are not, I think, compared with each other to nearly the same extent, partly because of the great gap of time between the two, but chiefly because of Beethoven's commanding position between the two and because Brahms worked almost entirely in Beethoven's medium rather than Bach's.

I don't think I have ever heard the merits or the demerits of a Beethoven symphony, concerto or piece of chamber music expounded upon except to the holding of Brahms's works in the same genres as justification. And vice versa, of course. One person's remark that the Emperor Concerto is "divine" and the "greatest of all concertos" at once begets the reply, "I disagree. I don't think it's a patch on the second Brahms." Similarly, someone else only has to say they would walk a mile to hear Brahms's first symphony when they court the rejoinder that the other party wouldn't go a yard to hear it, but they'd go 20 miles to hear Beethoven's seventh! And so on and so on. Neither ever seems to be compared to his forbears Mozart, Haydn or Schubert, to his contemporaries, more or less, Schumann or Mendelssohn, and naturally never with anyone so entirely different as Tschaikowsky or Sibelius. It must be with each other, and always against each other; they never stand alone. Neither, as I said, do they invite comparison with each other. Were someone to say they preferred a Brahms or Beethoven symphony to one by, say, Sibelius, the reply would inevitably be that one can't compare the two. Why not?

Other "Rivals"

Other inseparable companions in rivalry who readily occur to the mind are Mozart and Haydn, Chopin and Liszt (also Schumann and Chopin and, less often, Schumann and Liszt), Liszt and Berlioz, Debussy and Ravel, and Elgar and Delius. Wagner, being Wagner, seems not to arouse any rival emotion in particular. It has become just as natural and inevitable to couple these names and to mete out praise for one with blame for the other all in the same breath and as part of the same sentence as it is to remark on what a lovely day it is, but you don't think it will last very long.

The reason for these pairings lies, usually, in certain similarities in the work of the two composers, similarities of style and thought due to a common outlook on their art and their approach to it. Not always, of course, because no two writers could be more dissimilar than Elgar and Delius. They have obviously been "made" to invite comparison by being easily the two most distinguished British composers of their day. Apart from that accident, neither seems to meet on common ground at any point. Both have their artistic roots planted in entirely separate allotments: the former being English to the very core but moulding his genius in a symphonic style, whilst Delius, who lived most of his life in France, gained his inspiration from that impressionable country plus a damp mistiness bequeathed by his native Yorkshire.

Pianists on Common Ground

Chopin, Liszt and Schumann, so far as their piano music is concerned, are, on the contrary, on the most uniquely common ground, though of three different nationalities. They were all actually born about the same time and were firm friends. Though so different in individuality, which is imprinted on every page of their music, each approached his keyboard tasks through the common medium of being great pianists (Schumann early on destroyed this side of his career by trying to practise with a gadget on his fingers) and through the artistic approach of the newly found romantic movement which they did more than anyone to build up to its greatest heights.

But they parted company at the piano. Chopin, of course, never wrote for anything else, and, in spite of the masterpieces of his two contemporaries and his forerunners and successors, his contribution to the literature of that instrument remains, and is likely to remain, unique and incomparable. Liszt and Schumann, on the other hand, left a vast output other than their piano works. Liszt, to the end of his long life, was ever the iconoclast and revolutionary, creating his own forms and writing in an idiom like no one else's, even in his Piano Sonata, which is still a great sonata for all that. His work ranged over a wide field, and I suppose he has influenced his successors to a greater extent than anyone else, Beethoven alone excepted. Schumann, on the other hand, and away from the piano—for which he was such an incomparably greater writer than for anything else—worked in the classical German symphonic mould at symphonies, concertos, chamber music, etc., though his idiom was always that of the incurable romantic. Chopin died at 39, Schumann at 46, Liszt at 76.

Liszt was a kindred spirit of Berlioz, born in 1803, whose music has a modernity about it which often belies its 100 years' old existence. He was one of the greatest of French composers, but an individuality and a temperament as ardent as Liszt's were not long likely to remain under any one man's domination. He was the product of his age and his many-sided genius, taking him down roads that all looked ahead, influenced all who came after, none more so than Wagner. Wagner's overwhelming genius, however, canalised all music into his own operatic conceptions, and presided there without competitor or rival.

Debussy or Ravel

The æsthetics of Debussy and Ravel, 1862-1918 and 1875-1937 respectively, based largely on their prodigal use of the tonal scale, have inevitably coupled them together in the listener-critic's mind, together, perhaps, with their common nationality. But these two great French masters are just as individual and different, each to the other, as are any one of the others I have mentioned. It would again seem to be in their piano music with its narrower frontier as compared to orchestral writing, that the greatest similarities occur.

Sullivan and Offenbach, Dvorak and Smetana, Borodin and Moussorgsky are among many other "pairs" which readily come to the mind. But space prevents their discussion. I would suggest, however, that a more general mixing of these great names in our musical criticism, and a less provincial and accepted attitude, would not only brighten things up considerably but might lead to undiscovered sources in the critic's art.

News from the Clubs

THE HOUNSLOW AND DISTRICT RADIO SOCIETY

Hon. Sec.: A. Pottle, B.Sc., 11, Abinger Gardens, Isleworth, Middx.

THE hon. secretary is now giving a course of talks on "Fundamental Radio" to the Hounslow and District Radio Society, which meets on alternate Wednesdays, at 7.30 p.m., at the Grove Road Schools, Cromwell Road, Hounslow—autumn session commencing September 8th.

SOUTHAMPTON RADIO CLUB

Hon. Sec.: John H. Sillence, 80, The Drove, Coxford, Southampton.

THE third annual general meeting of the Southampton Radio Club was held recently at 9, Bullar Road, Bitterne Park, Southampton. The main business of the meeting was the election of club officials for the following year, and the discussion of club policy and programme for that period.

Mr. P. Neves, A.M.Brit.I.R.E., A.M.I.E.T., Mem. R.S.G.B., the principal of the B.O.A.C. Radar School, Hythe (near Southampton), was elected president.

The president, in his opening address, stressed the fact that the rapid progress in radio during recent years was largely due to the efforts of the amateur enthusiast, and he felt sure that with increasing interest in radio as a hobby even greater progress would be made in the future. He hoped that educational authorities would give every encouragement to youth to take up radio, either as a career or a hobby. He added that in order to keep the club and its activities before the public eye, a number of popular lectures, to which the public would be invited, would be arranged. In the discussion which followed, it was decided that morse practice would be continued, in addition to which facilities would be made available to members or intending members wishing to take up morse at a later date. It was decided to supplement practical work with instruction in radio principles, designed to meet the requirements of members. It is proposed to build up a reference library, with donations of books by club members, further books to be added as and when club funds allow.

Anyone desiring details of the club's activities or to apply for membership, should write to the secretary, as above.

ST. PANCRAS RADIO SOCIETY

Hon Sec.: H. Brown, 84, Blenheim Gardens, Willesden Green, N.W.2.

AFTER a most active and interesting session, the club has closed down for a summer recess. Main activities have this session been chiefly centred around the design and building of television sets from ex-Service radar equipment. This has been very satisfactorily done and sets were demonstrated to the public at an open meeting in July. As a result of much publicity there has been quite an influx of new members wishing to gain the necessary knowledge to build these sets for a cost of about £10, hence it is hoped to have a special television session when the club restarts in September.

Details of meetings and activities can be obtained from the secretary.

OSWESTRY AND DISTRICT RADIO SOCIETY

Hon. Sec.: A. D. Narraway (G2APW), "Lamorna," Pant, Oswestry, Salop.

ACTIVITIES recently include N.F.D. participation and the recent 5-metre field day. In the latter, G4LU, G2AUZ, G3ASC and G2APW organised and ran a site in Denbighshire, 1,300 feet above sea level, and at times above cloud level and almost "airborne," so strong was the gale force. The equipment was 1133G modified TX run at 6 watts; the RX was converted into R107. At a recent society meeting, G5JU travelled from Birmingham to lecture on 144 Mc/s. to a crowded meeting. Great interest is shared by a group in the society on 144—one member being kept busy on technical articles relating to 144 Mc/s.

At the annual general meeting the following officers were elected: chairman, Mr. E. D. Power (G3ASC); vice-chairman, Mr. S. Brown (G4LU); hon. sec., Mr. A. D. Narraway (G2APW); assist hon. sec., Mr. G. H. Banner (G3AHX); hon. treasurer, Mr. P. J. Fay (G3AKG); and a committee of four, viz., Mr. Woodhead (G2NX), Mr. N. Brown, Mr. A. E. Smith, Mr. K. Lord (G3AOX). The committee were requested to explore the possibility of a "shack," equipment for which had already been promised, and to draw up a programme suitable for all members on a weekly basis at the "shack." All interested are invited to communicate with the hon. sec., as given above, enclosing a stamped, addressed envelope. The society librarian continues to be Mr. J. Cripps, 11, Legge Street, Oswestry. The society has decided to co-operate in the newly organised Association of Midland Radio Committees' activities, the headquarters of which is Wolverhampton.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY

Hon Sec. and Treas.: F. C. Ward, G2CVV, 5, Uplands Avenue, Littleover, Derby.

ACTIVITIES in the society are increasing steadily. Meetings are held fortnightly, at present on Wednesday evenings. A series of lectures and demonstrations relating to television is now in progress. Morse classes are being arranged, and it is hoped to cater for all members' interests during the coming winter season.

New members will be welcomed and are asked to communicate with the hon. sec.

THE WEST MIDDLESEX AMATEUR RADIO CLUB

Hon. Sec.: Mr. C. Alabaster, 34, Lothian Avenue, Hayes, Middx.

THE above club continues to be extremely active, in spite of the summer season. Recent lectures were concerned with frequency modulation and radio-frequency heating.

One of the assets of the club is a small library of radio and technical books donated by members. The club also subscribes to two difficult-to-obtain American radio magazines which are circulated amongst members at a nominal fee.

Meetings are held on the second and fourth Wednesdays of every month at 7.30 p.m., at the Labour Hall, Uxbridge Road, Southall, Middlesex.

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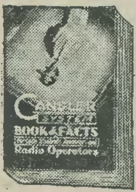

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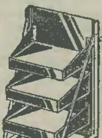

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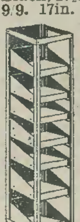

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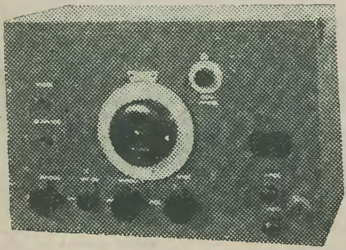

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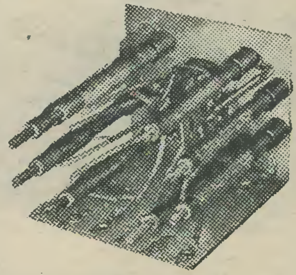

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Impressions on the Wax

Review of the Latest Gramophone Records

THIS month sees the issue of the second volume of the Medtner Society, which owes its inception to the munificence of H.H. the Maharajah of Mysore. The main work in the new volume is one appropriately dedicated to His Highness, namely, the Third Pianoforte Concerto, Op. 60. The composer himself plays the solo part in this and, as in the previous volume, he takes the keyboard where it is required in the remaining items. There are two of these. In the first, Margaret Ritchie's fine voice is heard in the Sonata-Vocalise, Op. 41; in the second, Medtner plays his Improvisation, Op. 31, No. 1. The seven H.M.V. records, which are available to special order only, constitute a survey of Medtner's music which will be found quite as attractive as that in the first volume.

Debussy's "Cathedrale Engloutie" is based upon an old Breton legend of a cathedral under the sea, whose bells may be heard tolling amid the sound of the waves. This legend seems a favourite one among Celtic peoples, for a variant of it exists in North Wales. "Clair de Lune," from the Suite Bergamasque, probably excels its companion piece in popularity owing to its use as a leading motif in the romantic "Frenchman's Creek" released a few years ago. Both of these piano pieces are played by Harriet Cohen on *Columbia DX*1496.

An interesting release which should have a wide appeal is Handel's "Royal Firework Suite," played by the Liverpool Philharmonic Orchestra, conducted by Sir Malcolm Sargent, on *Columbia DX*1494-5. Handel's original score specifies nine trumpets, nine horns, 24 oboes, and 20 bassoons, with optional strings. Georgian England liked its open-air music to be audible, and Handel assembled this massive array of wind with the English taste in view. To us, all these oboes and bassoons are far too top-heavy, and a body of strings to balance them would be unwieldy for ordinary concert purposes. To Sir Hamilton Harty goes the credit of bringing this excellent music to manageable proportions by making a selection of the numbers, scored for a normal modern orchestra, constructing a "Fireworks Music" suite on the same lines as his "Water Music" arrangement.

Maurice Ravel's Concerto for the Left Hand was written in 1931 for Paul Wittgenstein, an Austrian pianist whose right arm had been amputated during World War I. If you did not know for a fact that the concerto was specifically designed for a one-armed executant it would be hard to imagine so from hearing the records. It is played by the French pianist, Robert Casadesus, with the Philadelphia Orchestra, conducted by Eugene Ormandy, on *Columbia LX*1088-9.

Vocal

That very popular tenor, Beniamino Gigli, sings in Italian in his latest recording of "Segreto" and "Nostalgia d'Amore," on *H.M.V.* 6705. Tosti wrote multitudes of admirable songs during his settlement in England as singing-master to the Royal Family. These songs come into the category of drawing-room ballads, but the best of them are free from the rather milk-and-water sentiment sometimes found in the Victorian salon song. "Segreto," of course, merely means secret, and the secret concerned is evidently one of the heart. "Segreto" pairs well with "Nostalgia d'Amore," whose title we need not translate.

Another popular tenor is Josef Locke, and he has recorded two Irish songs in "Dear Old Donegal" and "The Rose of Tralee," on *Columbia DB*2429. He arrived at fame by way of Irish festivals, and it was John McCormack who advised him to develop especially his talent for ballad-singing.

Mme. Welitsch scored a triumph at the Cambridge Theatre this spring, being acclaimed especially for a superb performance of Donna Anna in a new production of "Don Giovanni." Opera of many kinds is her province, and in giving us this month a recitative and aria from Weber's "Der Freischutz," on *Columbia LX*1090, she has provided highly interesting and attractive fare for listeners to whom this opera means only the great, but overworked, overture.

Variety and Dance Music

Bill Johnson is heard in a new song, "Siesta Serenade," on *Columbia DB*2433. As the name implies, the song has Spanish overtones. Turning over the record we find "Calling for You," English version of the famous Italian song, "Core 'Ngrato," which was featured in the British film, "Man About the House."

Dinah Shore, now in this country, has recorded "Crying for Joy" and "Little White Lies," on *Columbia DB*2430, whilst Frank Sinatra sings "If I Only Had a Match" and "We Just Couldn't Say Good-bye," on *Columbia DB*2431.

Tony Martin has recorded the impressive "Tenement Symphony" which he sang to good effect in the M.G.M. film, "The Big Store," on *H.M.V. B*9666, and the popular French singer, Jean Sablon, sings "Miranda" and "Don't Take Your Love from Me," on *H.M.V. B*9667.

Geraldo and his Orchestra have made two records this month in "A Kiss and a Rose" and "Woody Woodpecker," on *Parlophone F*2305, and "October Twilight" and "When You're in Love," on *Parlophone F*2306. These latest recordings bear witness to Geraldo's musicianship and band-leading ability, and provide his large following with the instrumental and vocal blend that has made him such a constant favourite.

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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).

Photographing C.R. Tube Image

SIR,—I was interested in an article you published a few months ago on the photographing of cathode ray tube traces. The contributor infers that a camera of some sort is necessary.

I have recently experimented with gaslight paper applied direct on to the C.R. screen and have produced the enclosed. One is a 50 cycle sine curve and the other a distorted phase elipse from an iron-cored choke. For this method of photography the trace must be steady, as the exposure time is about 30 seconds. The third oscillogram is a "printed through"; this forms a method of making many copies of one good oscillogram.

The great advantage of this method is its low cost, about four pictures for a penny. The oscilloscopes I use are one I made from a unit using VCR97 and the other one I built using a Mullard ECR 30.—F. F. LEE (Beverley).

[*The "pictures" were quite good, and would serve, no doubt, for the majority of cases where permanant records were needed. We regret that they were not suitable for reproduction.*—ED.]

Push-pull R.F. Stages

SIR,—Readers may be interested in my experimental circuit from the discussion point of view.

A short time ago I was working out some details for a push-pull output stage when the thought struck me: "What advantage would be gained by having a push-pull R.F. stage?" Of course, a similar system has been used for the balance of dipoles, but not in commercial use for domestic receivers. I put the point to some leading engineers, but they could not give a satisfactory answer or deny the possibilities of such a system.

One point is, will it give a better signal-to-noise ratio, better amplification or even reduce fading to a minimum using the usual A.V.C. system? I have started to build a receiver using this method for the R.F. stage, and have yet to see the result. However, I can give a few details of the practical construction.

The two R.F. coils tuning the grids of V1 and V2 are a matched pair of P type coils with the aerial windings joined in series. The earthy ends of the grid windings are joined to a common point on the A.V.C. line (E), and the usual A.V.C. on/off switch is used to short the line to earth on the chassis.

The general snag came with the method to be used in getting a required centre tap to feed the H.T. to the anodes of V1 and V2; to unwind the primary of the H.F. coil and connect a centre tap without the use of a coil winding device would have been impracticable. The alternative was to couple an H.F. choke across the primary and place a centre tap on the choke where the two centre windings are joined. The secondary winding is used to tune the grid of the frequency changer as with conventional circuits. The tuning of the circuits is carried out by using a four-gang .0005 μF. variable condenser with small capacity trimmers to balance out any difference of capacity in the ganged condenser, especially in the first stage, which must be carefully balanced to prevent any difference in frequency between the two valves.

The last point is that R.F. valves V1 and V2 use a common bias network with the addition of a gain control of about 10k ohm.

This system is to be used with a superhet using push-pull output which requires the use of a 10 valve chassis.—F. P. SLEIGHT (Cleethorpes).

"What Is a Classic?"

SIR,—As regards the definition of a "classic," I have always regarded a "classic" as something which has stood the test of time. I apply this definition to all types of music, including jazz. In this way, I would call both "Tiger Rag" and one of Tchaikowsky's famous works, "classics."

I am inclined to reconcile this view with that of Mr. Steven Lane, for music which, played on an appropriate instrument, neither produces the desired effect nor a pleasing one can scarcely be expected to withstand the sharp scythe of Father Time!—D. R. H. DAVIS (Armagh).

C.R. Tube Data

SIR,—Some months ago you were good enough to publish a letter from me in which I urged readers who have purchased items of ex-radar equipment containing such things as cathode ray tubes VCR97, etc., to visit the Science Museum, Kensington, where they may recognise some surplus items which they might have purchased, set out and explained.

It is unfortunate that the publication of my letter coincided with the withdrawal of almost all of this equipment from the exhibition galleries.

However, it will all be on view again at the Radar Exhibition, which will, I understand, follow the present Illuminations Exhibition in the Science Museum.

A lot of people fail to understand that these tubes (VCR97, etc.) were not all made by one maker. They were all, like the VR91 (EF-50), made by various makers for the Government. I have seen VR91 valves which were made in America and Canada to the original Mullard specification. I believe the original VCR97 was G.E.C.

The one I purchased (in a 6A unit) had A^1 (pin 5) not connected to pin 5. But A^1 and A^3 are strapped internally and connected to pin 9. Pin 7 should, however, be connected to the coating and is so in my sample. (See C. R. Talbot's letter in the August issue of PRACTICAL WIRELESS.)

These tubes were used for different purposes. The unit 6A with a VCR97 was used in aircraft in connection with the "Aid to Surface Vessels" equipment, as was the 6C, both being fed from a common transmitter and echo receiver, working from a positive pulse, the type 6 unit working from a negative pulse.

The 6A was used by the navigator and the 6C by the tail gunner of a bomber. (Tube type VCR 138.)

The type 6B unit was used in the F.A.A. in conjunction with transmitter type T3040E and receiver type R3839E.

Hoping this information will be of value.—W. J. LAW (Ealing).

SIR,—I agree with Mr. C. R. Talbot (the C. R. is very appropriate) about the possibility of getting into trouble by making use of data in the April and February issues.

I must say that the articles by the Bristol correspondent were extremely valuable in other respects. The possible variations of VCR97 are: No. 5 to A^1 (if not already strapped internally to A^3), No. 7 to graphite coating (if not already strapped internally to A^3). The other connections which are standard being: No. 1 to modulator, No. 2 to cathode, No. 3 and 4 to heater, No. 6 to A^2, No. 8 to Y^2, No. 9 to X^2, No. 10 to A^3, No. 11 to X^1 and No. 12 to Y^1. The contact number is taken from location spigot, reading clockwise when looking into the base end of the tube and anti-clockwise when looking at the holder as when wiring up the unit. When, as is usually the case, the A^3 is connected to the earthy end of E.H.T., it is best to connect A^1 (No. 5), graphite coating (No. 7) and A^3 (No. 10) together in wiring up the holder, as this will take care of any possible variations of the VCR97.

I should be grateful if any reader could advise through this column on getting a Miller time base to synchronise with the signal and give fly back suppression without undue distortion of trace.

Also, where can I obtain high voltage H.W. metal rectifiers of 1,000 v. at a few mA and what are reference numbers of any suitable for C.R. use?—H. COOPER (Shaw).

"Desert Air-mail"

SIR,—With reference to your article "The Desert Air-mail," a mistake has been made in the last line. Our basic salary was £6 5s. weekly plus the 5s. an hour flying pay.

I am the holder of the first "Working" Air P.M.G. Licence. Capt. Duncan Sinclair, the examiner, has No. 1, I have No. 2, and I was the radio officer on Imperial Airways' first DH.66 to leave Croydon on the way to open their Eastern Service between Cairo and Karachi. The Chief Pilot, Capt. Woolley Dodd, was in charge, and we had Air Vice-Marshal Sir Sefton Brankner, the Assistant Secretary of State for Air, with us.

Incidentally, I transmitted, on Sir Sefton's behalf, the first two "Air Telegrams" to be sent from a British aircraft. I still hold the originals in Sir Sefton's handwriting. One was to the Air Ministry, and the other to an address in New York. They were transmitted during the flight from Gaza to Rutbah Wells and accepted for re-transmission by Rutbah, the Iraq Posts and Telegraphs Station.

I would very much appreciate the present address of my old friend and colleague, N. E. Wood; we were together for many years in both the R.A.F. and Imps.—A. E. BOOTH (Redruth).

L.S. Output for R.1155

SIR,—Some time ago I bought an "1155" set, having to convert it myself. I managed to get circuit details of the set and so "rigged" it up O.K. The snag is that I want to convert it to L.S. output, and up to present I'm afraid I haven't been very successful.

I wonder if one of your readers has had the same difficulty! If so, perhaps he could forward on to me circuit details, etc., of a L.S. stage for the "1155." I will gladly answer all letters and return any books or notes which are wanted back.—F. G. SHEPHERD, 12, Mill Road, Waterlooville, Hants.

Ex-Service Equipment

THE co-operation of readers is sought in helping others out of difficulties regarding items of surplus gear as follows:

W. G. W. Highfield, 91, Uplands Avenue, Wolverhampton, Staffs, wishes to contact a reader who may have experimented in converting the Test Set Type 72 to 2½ and 5 metre bands.

T. B. F. Perkins, Slapton, nr. Towcester, Northants, is in need of circuits and technical data of Rx. 3554.

G. Hughes, 14, Fraser Grove, St. Annes, Carlisle, requires data on the valve VCL.11, from the German Sachsenwerk receiver.

S. D. Dickinson, 12, Kingswood Road, Birmingham, 13, would like information on the Monitor Type 27, and German Services, Battery-Mains portable Siemens, K. 32.GWB.

J. Agius, 69, St. John Baptist Street, Sliewa, Malta, requires data on T.1154.F, especially so far as conversion for experimental purposes is concerned.

J. M. B. White, 63, Alexandra Road South, Whalley Range, Manchester, 16, requires details of the power supply section, etc., of modulator type 50.

F. Lewis, 1, Manor Crescent, Brampton, Chesterfield, Derby, would appreciate the load of the circuit of R.1124.C, with a view to conversion to standard television reception.

A. L. Moon, 1, Montague Cottages, Hankhan, Wisham, Pevensey, requires circuit diagrams of C.R.T. Indicator unit, type 6a and 6b and Rx/Tx R.3003.

J. W. Collier, 5, Crescent Road, Heybridge, Maldon, Essex, would like information of R.3170.A.

R. J. Cox, 26, Gillingate, Kendal, Westmorland, requires circuit diagrams and any other details of B.C.342 or B.C.312.

H. E. Rule, "Montaza," Kyle Avenue, West Hartlepool, wishes to contact any reader who has experimented with A.1134 from the point of view of making it into an intercommunication unit for the home.

T. Mair, Homeleight, Papworth Everard, Papworth, Cambridge, would like assistance in converting the 38 A.F.V. Walkie-Talkie to dry-battery use.

J. M. Henry, c/o Lowe, 99, St. Andrew's Road, Pollokshields, Glasgow, S.1, requires information, especially heater diagrams, of the B.C.454 series command receivers.

H. G. Hartshorn, W/O and Sgts. Mess, No. 11 H.Q. Regt., R.E., Harper Barracks, Ripon, Yorks, wishes to convert indicator unit type 230 and wave meter unit W.1646 to a modulated signal generator.

T. V. Attwood, 32, Park Lane, Netherton, Aintree, Liverpool, 9, needs information on T/R3523.E, and amplifier type 226.

E. K. Rigby, 53, Alan Road, Withington, Manchester, 20 requires circuit diagram of T/R9.H.

T. Young, 53, Limes Grove, Lewisham, S.E.13, requires circuit of R.1124.C. and details of power supply.

F. Taylor, 9, Bolton Road, Moses Gate, Farnworth, Lancs, requires information on Bendix B.C.433.G, and the number of the control box.

J. A. Brockie, 77, Burns Road, Aberdeen, needs details of the sockets and terminals, etc., of the U.F.1, 12-volt Vibrapack.

R. L. Woods, 27, Staveley Road, Leicester, would like details of Beacon receiver B.C.1206A.

W. R. Blaxland, Eastern Garage, Shoreham-by-Sea, Sussex, would like particulars or service sheet of indicator unit ASB-8, radar unit R-9A/APN-4.

E. H. Davies, 26A, Endlesham Road, S.W.13, would like data on the R.1147A.

J. Ewart, The Old Post Office, Ecclefechan, Dumfriesshire, would like details for fitting "S" Meter and converting for use on 10 and 20 metres, the receiver R.1224.A.

P. N. Hollis, 143, Lymington Avenue, Leigh-on-Sea, Essex, is in doubt regarding the connections at the rear of No. 52 communications receiver.

C. E. Jones, Tegfryn, Ruthin Road, Mold, Flints, is desirous of contacting anyone who may have experience in converting B.C.433.G, for mains operations.

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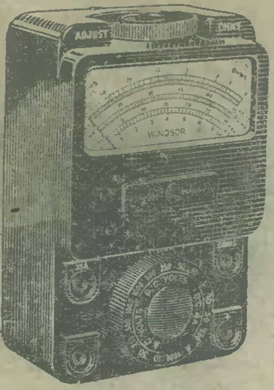

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