MIDGET RADIO CONTROL RECEIVER

1/-

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FEBRUARY, 1953

EDITOR:
F.J.CAMM

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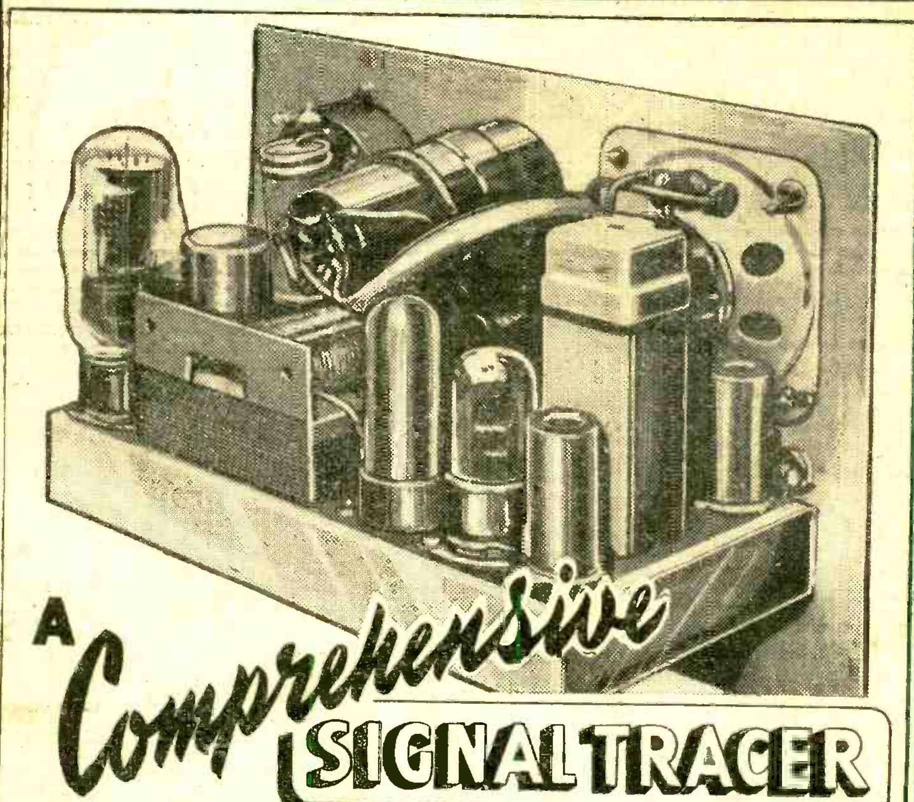

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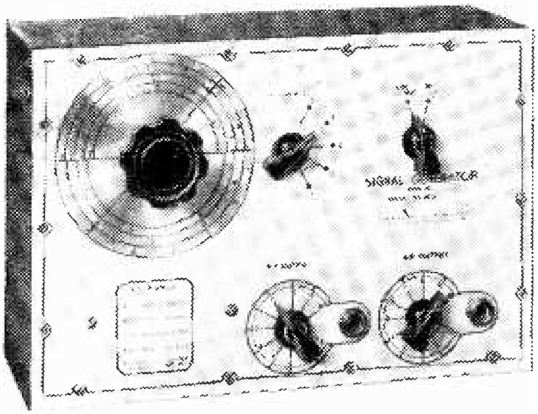

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Practical Wireless

EVERY MONTH
VOL. XXIX, No. 556 FEBRUARY, 1953

Editor F. J. CAMM

21st YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

Shortage of Service Engineers

H.R.H. the Duke of Edinburgh, speaking as a Guest of Honour at the annual dinner of the Radio Industry Council, said that the industry was in need of more highly-trained engineers. He said that it was a very grave matter that there are not enough qualified radio engineers and physicists coming from the Universities and technical colleges to meet the industry's requirements. "There must be millions of ordinary citizens who owe a very great debt to domestic electronics; the least they can do in return is to encourage the younger generation to take up radio and electronics as a career." He said that the future holds almost unlimited possibilities for radio and electronics and in relations with the peoples of the Commonwealth, in industry, in the home, in defence, and as an increasing part of Great Britain's export trade the radio industry is a growing factor in the nation's economy.

"It is sometimes forgotten," said the Duke, "that Britain had the first television service in the world and that the present transmitters are, for the time being, the most powerful in the world."

Mr. G. Darnley-Smith, chairman of the R.I. Council, responding to the toast, stated that the Council is proud of their industry and that they were a proud industry. He also spoke of the problems with which the industry had to contend, and particularly the doubling of the purchase tax, the cuts in production and the crippling hire purchase restrictions. "It seems as if the industry has been singled out for punishment," he commented. There is, fortunately a strong indication that declining sales, not only in the radio industry but in others which have been savagely taxed will force the hand of the Chancellor and we may expect tax concessions in the next budget. In the meantime the public is staging an unorganised but none the less effective strike against a system of taxation which is quite unjust.

SERVICE ENGINEERS' WAGES

THE Industrial Disputes Tribunal recently increased the wages of radio and television service engineers, the increase amounting to 15s. per week on all current minimum rates.

Wages, therefore, now become £7 8s. 6d. per week for holders of certificate B; £7 13s. 6d. per week for holders of certificate A; £7 18s. 6d. per week for holders of TV certificates and in all other cases £6 5s. 0d. These are not particularly high wages. Insufficient, indeed, to attract the radio engineers and physicists to which the Duke of Edinburgh referred.

TRANSISTORS—IMPORTANT DEVELOPMENTS

THE Radio Corporation of America recently gave a demonstration of valveless radio and television receivers. One of these was a personal radio receiver, the circuit making use of only one converter valve, but transistors in all other circuits. It is reported that the performance was equal to a standard all-valve receiver and that their use has enabled receivers to be made one-third the size with a comparable saving in cost and weight of the batteries needed, without reduction in the usual 100-hour battery life. They also demonstrated a portable F.M. receiver covering 88/108 megacycles, using 11 transistors. A car-radio had push-button tuning, used 11 transistors and no valves of any sort. An important feature is the elimination of the high-voltage power supply necessary with present car-radio receivers. The vibrator, transformer and rectifier are not necessary in a transistor receiver because the transistors operate directly off the car battery. This particular car-radio receiver uses only one-tenth of the current of the present radio set.

A tiny radio transmitter employing one transistor was also demonstrated by R.C.A., but the most impressive demonstration was of a battery-operated television receiver, valveless except for the cathode-ray tube. This television receiver was portable and made use of a 5in. screen. It was no larger than a portable typewriter case and complete with battery weighs only 27 lb. Satisfactory pictures were received by means of the self-contained frame aerial. It uses 37 transistors, the total power consumption being 14 watts, or rather less than one-tenth that of a standard table model television receiver.

Another application was a transformerless power amplifier making use of four transistors, mounted on a midget valve socket.

In a few years, it seems, transistors will oust the valve as we know it to-day.—F. J. C.

ROUND the WORLD of WIRELESS

Mr. L. Atherton and Mr. A. E. Crawford

MR. L. ATHERTON, B.Sc., A.M.I.E.E., joined the Equipment Division of Mullard Ltd. recently, to take charge of the Special Products Commercial Group which specialises in ultrasonic equipment and laboratory and industrial applications of electronic techniques.

Previously, Mr. Atherton was at the Ministry of Supply Atomic Energy Factory, Springfield, Preston, as head of the group concerned with the measurement and control of hazards associated with the handling of radio-active materials. During war service with the R.A.F., Mr. Atherton was seconded to T.R.E. at Great Malvern for work on Doppler applications of radar.

Mr. L. Atherton, B.Sc., A.M.I.E.E., who recently joined the Equipment Division of Mullard Ltd., taking charge of the Special Products Commercial Group.

Mr. A. E. Crawford, A.R.Ae.S., of the Equipment Division, has been assigned to investigate applications of ultrasonic and other electronic equipment. He is undertaking this work at one of the Wandsworth factories.

Radio for S.E. Asia Police

SPECIALLY designed by The General Electric Co. Ltd., the final shipment of H.F. and V.H.F. radio equipment, which the company are supplying for the Indonesian Police, has been sent to South-east Asia.

This contract, valued at £100,000, has been completed in a period of 18 months, in spite of the fact that much of the apparatus had to be designed to meet the particular requirements of the Indonesian authorities.

B.I.R.E.

THE following meetings will be held during January, 1953:

Scottish Section.—Thursday, January 8th., 7 p.m., at the Institute of Engineers and Shipbuilders, Glasgow: Film Evening.

North-Eastern Section. — Wednesday, January 14th, 6 p.m., at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne: "Hearing Aids," by R. A. Bull. B.Sc.(Eng.).

Merseyside Section.—Thursday, January 15th, 7 p.m., at the Electricity Service Centre, Whitechapel, Liverpool: "Design and Application of Quartz Crystals," by R. A. Spears, A.M.Brit.I.R.E.

West Midlands Section.—Tuesday, January 27th, 7.15 p.m., at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton: "The Search for Bandwidth Economy in Television," by D. A. Bell, M.A., B.Sc.

A programme booklet giving details of the meetings of all sections of the Institution has now been published and copies may be obtained by those readers who are interested from the Publications Officer, Brit.I.R.E., 9, Bedford Square, London, W.C.1, price 4d. post free.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound licences issued during the year ended October, 1952. The grand total of sound and television licences was 12,870,101.

Region	Number
London Postal ...	1,807,612
Home Counties ...	1,512,364
Midland	1,390,692
North Eastern ...	1,821,893
North Western ...	1,469,764
South Western ...	1,058,672
Welsh and Border ...	712,341
Total England and Wales	9,773,338
Scotland	1,150,393
Northern Ireland ...	213,488
Grand Total	11,137,219

German Exhibition

REPRESENTATIVES of the German radio industry have decided, in agreement with the local authorities, to hold the Great German Radio and Television Exhibition from August 29th to September 6th at the Dusseldorf exhibition grounds.

The exhibition was originally planned for last year but was postponed.

Communication in Kenya

THE serious situation which has developed in Kenya due to the Mau Mau activities immediately produced a demand for emergency communication equipments.

A number of Pye Radiotelephones already in Nairobi were put into service by British East Africa Corporation Ltd., Pye distributors in that territory, and have been of great assistance in the present crisis.

BBC Retirement

THE BBC has announced the retirement of Mr. R. J. Gilbert, engineer-in-charge of the Ottringham transmitting station.

Mr. Gilbert joined the BBC at Savoy Hill as an assistant maintenance engineer in 1924. After serving at Plymouth and at the transmitting stations at Washford, Droitwich and Lisnagarvey, he became assistant engineer-in-charge at the Start Point transmitting station in 1939. He became engineer-in-charge at Stagshaw in 1942 and has held the same post at Ottringham from 1945 until his retirement.

Factory Expansion

TO cater for the increased commercial activities of the equipment division, Mullard have acquired another factory at Wandsworth in Garratt Lane, London, S.W.18. All engineering development facilities, together with centralised workshop areas, are now being concentrated in the older factory at Brathway Road. At Garratt Lane are housed the main assembly and production lines for all classes of equipment, as well as factory administration and service departments. Research and advanced development will continue to be done at the company's Research Laboratories at Salfords, Surrey.

These changes are the culmination of a scheme that has been in operation for some time. It is considered that they will result in higher efficiency in handling a large volume of contract work.

Marconiphone Valve Division Change of Address

THE Marconiphone Co., Ltd., announce that for the greater convenience of distributors and more efficient working, the valve division has been transferred from Hayes to London.

All correspondence, orders, etc., should be sent now to the new address:

E.M.I. Sales and Service, Ltd., Valve Division, 3, Stanhope Street, London, N.W.1.

Spherical Loudspeakers

THE School Broadcasting Council has approved the use in school halls of the spherical type loudspeaker which has been developed and introduced by Hadley Sound Equipments, Ltd., Smethwick, Staffs.

Pye on Luxembourg

PYE LIMITED are sponsoring a quarter-hour programme on Radio Luxembourg at 7.30 every Friday. The first programme on December 19th was introduced by Bill Gates and starred Frankie Laine, 1952's most popular male singer.

The first commercial featured the Pye "Handy" Portable, Model P31MBQ, as the perfect Christmas gift. Dealers were asked to display a window-bill advertising the programme to ensure a maximum audience.

Radiotelegrams to Ships

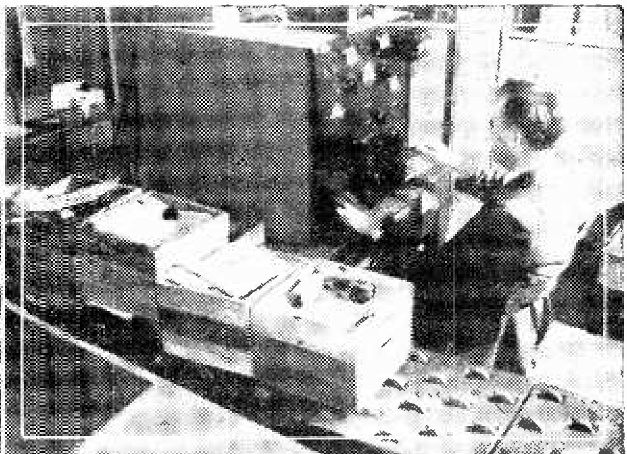
RADIOTELEGRAMS handed in at any postal telegraph office or dictated over the telephone can be sent through a Post Office coast station to ships at sea in any part of the world equipped with radio apparatus.

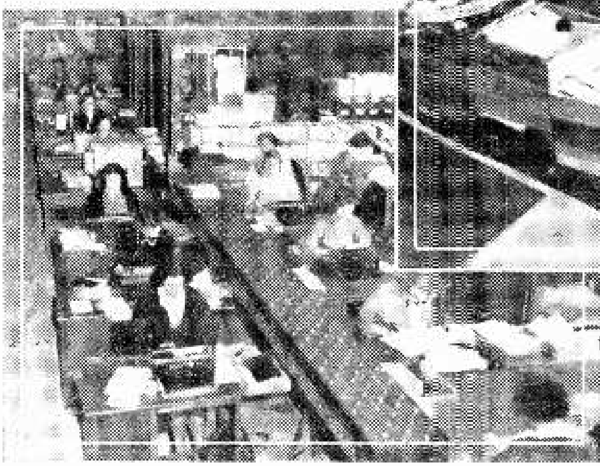
The Post Office conducted a large amount of such traffic over the Christmas period, the public having been asked to send their radio greetings in good time for Christmas or the New Year. The messages were held in the ship's radio office for delivery on the appropriate date.

Improved Valve Service

A NEW cathode ray tube and radio valve stores and service department is now in operation at the Brimsdown factory of the Edison Swan Electric Co., Ltd.

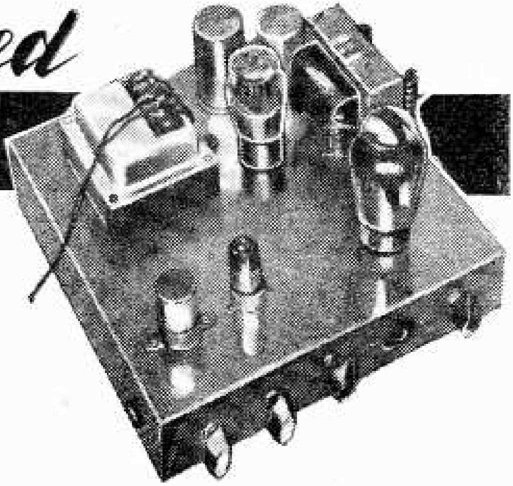
A special conveyor system has been installed to link the factory to the stores so that as tubes and valves are completed, tested and packed, they are loaded on to the conveyor and transported direct to the stores. All valves returned under guarantee are tested and returned or replaced within 24 hours.





Valves and tubes completed and tested at the Brimsdown factory of Edison Swan Ltd., are loaded on a conveyor (left). Faulty valves returned are tested (above) and either replaced or returned.

A Single Ended HI-FI Amplifier



FOR some time there has been a demand for an amplifier that has an output sufficient for a small hall and is low in both overall distortion and cost. This amplifier which has been developed and tested in our laboratory employs the minimum of valves (only three) and can be used in conjunction with a normal magnetic or crystal P.U. to give an output of 10 watts with an overall distortion of just under 2 per cent. This latter is obtained with the use of negative feedback over two of the three stages. The speaker chosen was the Rola G12 as it has a very good frequency response and a natural resonance at about 60 cycles: there is, however, no reason at all why another type of high-class 12in. speaker should not be used. The table on page 67, however, was made with the G 12 and will naturally not hold good for any other speaker.

The choice of valves was given very careful consideration as it was decided to use the Mullard ECC40 for the tone control and drive (it is a double-triode) and an EL37 for the output as, having an exceptionally high slope, it requires only a very low drive voltage, but takes an anode current of 100 mA. The rectifier is the new Mullard type GZ30 which is the direct equivalent to the international type 5Z4G with which most of the readers are conversant.

It is not generally realised that considerable distortion can be introduced in the drive stage of the amplifier, especially where high gains have to be used to drive a valve of low slope, such as the 6L6G which requires a drive voltage of 10 volts R.M.S. for an output of 6 watts, at a distortion of 10 per cent.; whereas the EL37 requires an input of 10.8 volts R.M.S. for an output of 11.5 watts at 13.5 per cent. distortion. These figures are for amplifiers without feedback. The EL37 will give an output of 10.5

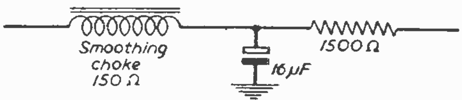


Fig. 1.—Smoothing circuit details.

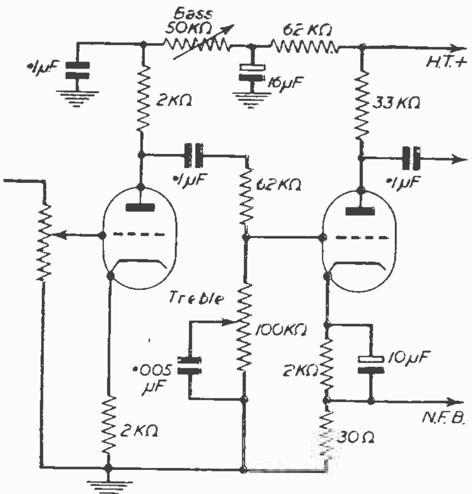


Fig. 2.—Tone control arrangement.

COMPONENT LIST

15H 50 mA. choke, Elstone.
MR15 Output transformer, Elstone.
EP90 Mains transformer, Varley.
32-32 μF 350 volt 323235 Electrolytic, Dubilier.
16 μF 500 volt CT1650 Electrolytic, Dubilier.
32 μF 500 volt 325OHR Electrolytic, Dubilier.
10 μF 25 volt Electrolytic, T.C.C.
50 μF 50 volt Electrolytic, T.C.C.
3 0.1 μF, Type 460, Dubilier.
1 0.005 μF, Type 460, Dubilier.
3 2K Ω ½ W. resistor, Dubilier.
1 30 Ω ½ W., Dubilier.
2 62 K Ω 1 W., Dubilier.
1 33 K Ω 1 W., Dubilier.
1 100 K Ω ½ W., Dubilier.
1 3 K Ω ½ W., Dubilier.
1 150 Ω 1 W., Dubilier.
1 .25 M Ω pot. (carbon).
1 100 K Ω pot. (carbon).
1 50 K Ω wire-wound pot.
1 ON/OFF Switch, Bulgin.
4 Pointer knobs, Bulgin.
1 GZ30 Valve, Mullard.
1 EL37 Valve, Mullard.
1 ECC40 Valve, Mullard.
1 Closed circuit jack, Bulgin.
1 Plug, Bulgin.
1 Four-pin valveholder, McMurdo.
2 I.O Valveholders, McMurdo.
1 B8A Valveholder, McMurdo.
1 Type 10 chassis, Kendall and Mousley.
1 Type 10 instrument case, Kendall and Mousley.

Design and construction of an amplifier giving 10 watts at just under 2 per cent. distortion. Negative feedback is used. Maximum power output obtained in the lab. was 14.5 watts. Uses the latest valves.

watts at 10 per cent., but if negative feedback is introduced this distortion can be almost eliminated, but as the distortion is reduced so is the gain of the amplifier, so a compromise was chosen to give a distortion of just under 2 per cent. at 10 watts output.

It is not generally realised that if the output is increased past a certain point with negative feedback circuits that the distortion rises sharply. The low-frequency response of the amplifier is quite good at an output of 7 watts. There is a distortion at 50 cycles of 10 per cent., but this is due to the falling frequency response of the output transformer (it falls at the rate of 3 db per octave below 150 cycles). The transformer chosen is the Elstone MR/15 as this is a relatively low-priced job in the high-fidelity class, and has a good anode current rating, and being a multi-ratio job it can be used to match the amplifier to any speaker.

The smoothing circuits have been given careful consideration and the hum level of -60 db below 10 watts is obtained. This is very low, and the hum can just be heard in a quiet room at a short distance from the speaker. The noise due to the valves is between -80 and -90. This latter is mentioned but as it is so very low is of no consequence.

The Circuit

A new type of circuit has been developed for the tone-control circuit, and this is capable of giving a low-frequency gain at 50 cycles of 100 times power, that is 20 db; it also incorporates a top cut. The use of such a high bass lift is very useful where the amplifier is being used for dances, as the extra lift brings out the rhythm of the percussion without interfering with the top response. The control has the reverse effect of the bass cut employed in recording so that the response can be restored to that of the original music. This facility can be used for the reproduction of 33⅓, 45, and 78 cycle records.

The reservoir condenser chosen is a 32 μF high-ripple type made by Dubilier. The rating is well in excess of that required but has the advantage that should the amplifier be switched on with an open circuit in the H.T. circuit no damage will result to the smoothing. The old type G12 speaker had a 1,500 Ω speaker field which could be used for smoothing. If this is not used, the circuit used in Fig. 1 can be employed, this uses a smoothing choke, condenser and resistor. It is suitable for the modern G 12.

The tone-control circuit is one developed in our laboratory, and besides giving a large bass lift of some 20 db will also give an amount of top cut. The circuit is simple and only uses one valve, a double triode of the ECC40 type made by Mullard Ltd.

It is used with a very low resistance in the anode circuit of the first section, and this gives a gain at all frequencies. In series with this is a potentiometer of the wire-wound type with a 0.1 μF condenser between the junction of the resistor and the potentiometer. The circuit is shown in Fig. 2. If a wire-wound resistor is not used, the noise level is apt to be rather high. The device introduces an amount of phase shift at the low end of the audio spectrum.

The make of valve-holder can be quite important in these circuits, and those made by McMurdo in the B8A range are very good. With this make the solder tags from the pins are sufficiently stiff to be bent to take resistors and condensers. The treble cut control consists of a condenser across a potentiometer

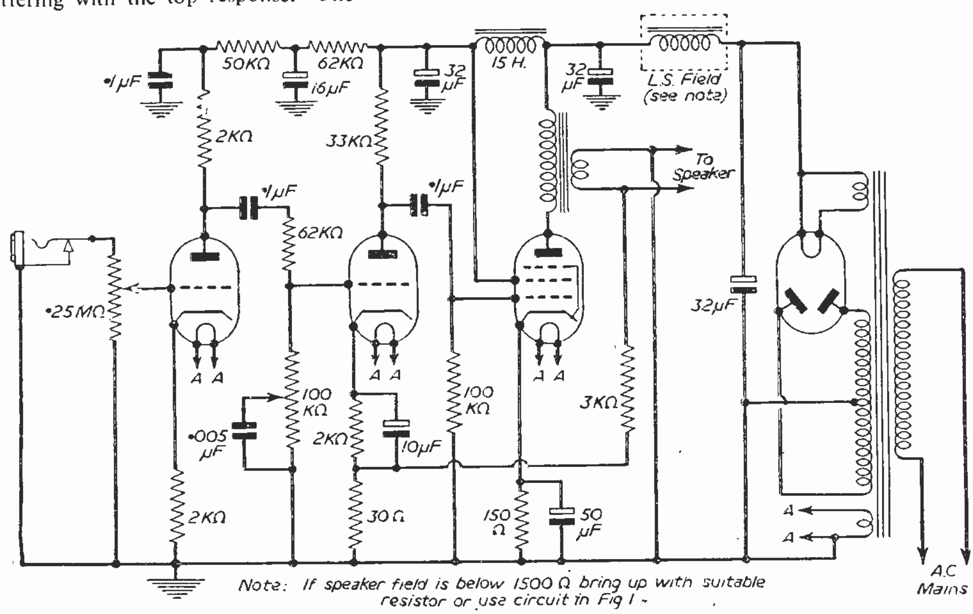


Fig. 4.—Theoretical circuit of the complete amplifier.

of 100 k Ω shunted by a small condenser. A .005 μF condenser is specified, but various people will require different amounts of cut, and if the value of the condenser is raised the cut frequency will be lowered. The value specified is one that will give a general all-round pleasure.

The graph will give a good general idea of the use of the tone-control unit. The unit can be incorporated in almost any amplifier, and provision is given for negative feedback.

Construction

The chassis chosen is the type 10, made by Kendall and Mousley, of Tipton, and is 10in. square and 2½in. deep. There is also an instrument case made by this firm that will accommodate the chassis. The chassis layout is shown in Fig. 3. The hole for the transformer is cut out first. The holes for the condensers and the valve-holders can best be cut with the aid of a Q-Max cutter, as the holes made with the aid of this tool are far neater than those made with the aid of a tank cutter.

After all the drillings have been made and the holes cut, mount the components. If the length of the control spindles is in excess of requirements the shafts should be clamped firmly in the vice. On no account should the cutting of the shaft be done with the control in position on the chassis—or the drag on the shaft will cause irreparable damage.

Wiring

The wiring is best started by terminating the leads from the mains transformer and then following this with the heater windings of the valves. The latter should be carried out with closely twisted wire. The heaters should be earthed in one place in the circuit only, as then all heater wires are carrying equal currents. This results in hum radiation being kept to a minimum. The H.T. wiring can follow the heater wiring. As a four-pin plug and holder was used for the connection to the speaker, it is advisable that the wire to and from the speaker field or alternative circuit should be closely twisted—again so as to reduce the hum. The 32-32 μF condenser used for the smoothing and the screen decoupling is of 350 volt rating, as, due to the fact that an indirectly-heated rectifier is used, the other valves are in a conducting state when the rectifier starts to conduct. this prevents the voltage from rising to a dangerous level as would be the case if the 5Y3G or equivalent directly-heated valve is used.

The fact that the bass lift decoupling condenser is of 500 volt working is of no significance.

Care should be taken to ensure that the wiring is carried out neatly, as long leads can be a source of trouble, causing oscillation that is very hard to trace.

When purchasing the components the writer considers it good policy to buy new, especially with condensers, as there have been so many cases of faulty coupling condensers burning out valves by making them over-run their maximum limit. The one-controls are best of a standard make such as Morganite or Amplion, as these firms will replace a faulty control if one should be obtained from them via a reputable retailer.

Having wired the amplifier, with the exception of the negative feedback circuit this latter remains to be set. The values of the components given are for a 15 Ω output. The connections to the output transformer are anode to tag No. 2 and H.T. to tag No. 6. To match to 15 Ω join tags B to H, then C to G. The output is taken from tags A and F. If other connections are required for other load impedances full details will be found in the data sheet enclosed with the transformer. If the ratio of the output transformer is altered for a different load the value of the negative feedback resistor will have to be altered; if the output is reduced to 7 Ω it will have to be reduced to 2,000 Ω, but if two 7-Ω speakers are to be used in parallel it will have to be reduced to 1,500 Ω. The use of twisted leads within the amplifier are by far the best for the reduction of unwanted feedback. If the actual polarity of the leads are not known, try one way to the transformer, then reverse them and measure which gave the greatest gain. That one is incorrect and the one giving the least should be used. The use of negative feedback does not alter the load impedance required by the valve.

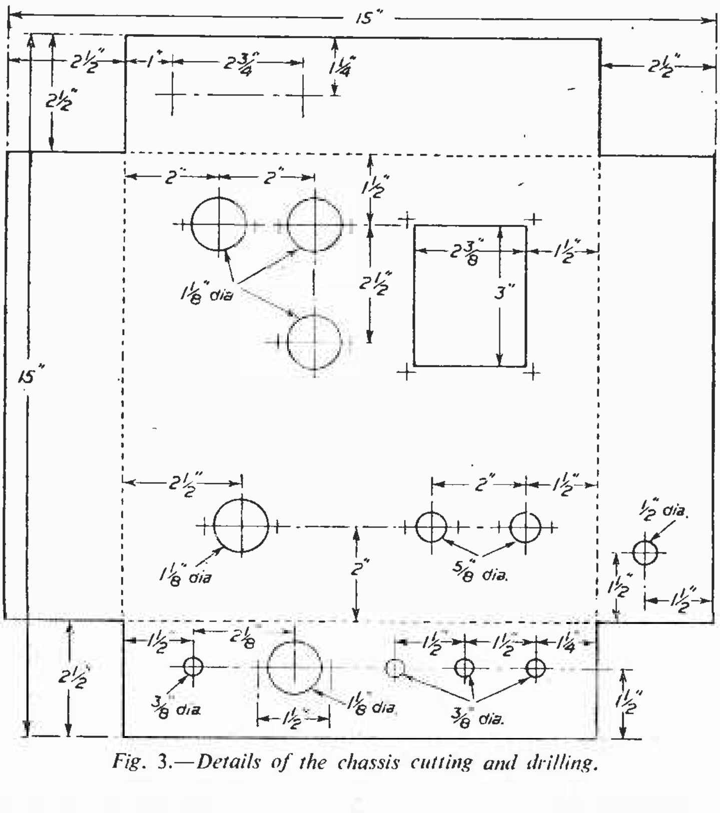


Fig. 3.—Details of the chassis cutting and drilling.

but when the valve is viewed back from the speaker it appears to be of lower impedance and applies a damping factor. For instance, in this circuit the valve has an impedance normally of 12,500 Ω when viewed from the speaker, but with the amount of feedback used this has the effect of shunting the speaker with a damping resistor of only 100 Ω. The distortion is also greatly reduced as is the overall gain of the amplifier. The use of negative feedback reduces the overall gain of the amplifier, so that higher gains

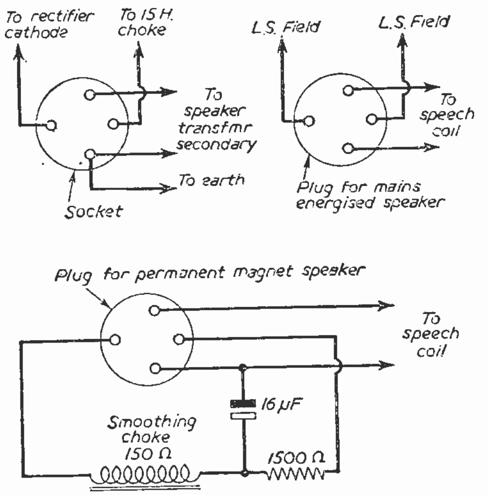


Fig. 5.—Output plug and socket connections.

have to be used in the earlier stages, and consequently a large amount of distortion can be produced here. A large number of constructors seem to regard the stage prior to the output as distortionless, but this is not correct.

Operation

Having finished the wiring and tried a record with a crystal P.U. the reproduction should be found to be very pleasing. If it is not to standard the first thing to do is to check the voltages at the various points

Frequency characteristics of the amplifier using a Rothermel crystal P.U. with tone correction filter.

	Normal	Both controls fully operated
6 Kc/s	Plus 7	Plus 3
5 ,,	,, 9	,, 4
4.5 ,,	,, 8	,, 5
4 ,,	,, 7	,, 5
3.5 ,,	,, 4	,, 2
3 ,,	,, 0	,, 0
2 ,,	,, 0	,, 0
1 ,,	,, 0	,, 0
500 cps.	,, 0	,, 0
250 ,,	,, 0	,, 9
160 ,,	,, 1	,, 15
100 ,,	,, 2	,, 19
70 ,,	,, 2	,, 28
50 ,,	,, 2	,, 28

in the circuit, they are given in the table. The meter used was a Universal AvoMinor, as this is used by so many constructors, it has a resistance of 400 Ω per volt. The use of any other type of meter would give different readings on the tone-control valve but not at the other points. Meters of the moving-iron type are not suitable for use in this type of circuit as the very heavy current drawn by them renders the readings useless. These moving-iron meters draw some 30mA. full scale so that overloads to the mains transformer and rectifying valve can result.

If a moving-coil P.U. is used extra gain will have to be incorporated in the form of an H.F. pentode. Suitable circuits have been given in the past numbers of this journal which have employed many different types of valve.

For those requiring the unit for portable use, a good instrument case for housing is a must, as it protects the valves during transit. There are many suitable cases on the market and one should be chosen to give enough head room for the valves; the writer used the type "12" made by Kendall and Mousley of Tipton. Steel handles for these cases

Voltage chart. Readings taken with AvoMinor (400 O.P.V.).

GZ30—Cathode. 375.
EL77—Anode. 235 v.
EL37—Screen. 240 v.
EL37—Bias. −12.5 v.
Drive Anode. 135 v.
Drive Cathode. 1.6 v.
Tone Section set at max. boost.
Anode. 75 v.
Cathode. 1.5.
Voltages at various condensers.
Reservoir. 375.
Smoothing. 245.
Screen Decoupling. 240.
16 μF Decoupling. 110. (Taken on 250 volt scale.)

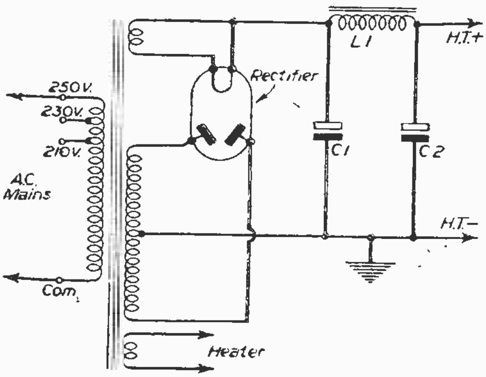
are available. The simplest type of connector for the speaker is by means of a valve-holder mounted on the front of the amplifier. The connection to the speaker can then be made by means of a suitable plug. The breaking of the H.T. positive line when the plug is removed helps to guard the output transformer as if the load is removed whilst the amplifier is in use the output transformer can very quickly be ruined. Another point is that the smoothing choke or speaker field is away from the amplifier, and it cannot feed hum to the output transformer.

As in the design of a Hi-Fi amplifier there is very considerable experimental work; we cannot enter into correspondence concerning the use of valves and components other than those specified.

Designing the Power Unit

MAIN FEATURES EXPLAINED FOR THE CONSTRUCTOR

THE design of the power unit or rectifier stage is quite simple, but there are several points that the beginner is apt to overlook. The power supplied to the rectifier stage, or perhaps I should say voltage, is given as the effective value. This is 0.7 of the peak value of the wave; the rectified voltage is very near the peak value, and at "no current load" it reaches this value. So to find the working voltage of the reservoir condenser we must multiply the output voltage of the mains transformer by 1.4; this gives the peak voltage, and a few volts should be added to give a factor of safety. For example, if a 250-0-250 transformer is being used, then the peak voltage will be 250 × 1.4,



Typical Power Unit Circuit.

equals 350 volts, so that a condenser of 375 volts working would be suitable. Again, if the transformer was a 350-0-350 we would require a working voltage of 350 × 1.4, equals 490 volts, so a 500 v.w. type would be in order, but a 550 volt working type would give a better safety factor. There is no reason why a higher working voltage cannot be used. The writer finds that for most uses in the laboratory it is as well to keep a supply of 8 μF and 16 μF condensers of 500 volt working such as those insulated tubulars made by Dubilier. These are very useful, as the insulation is very thick and is not easily spoilt by accidental touching with a hot soldering iron. For those who prefer a solder tag instead of a wire end, there is an excellent insulated 8 and 16 made by Hunts. The insulation on these is, however, rather thinner than those made by Dubilier.

Ripple Current

Another point to watch is the maximum ripple current. This is a point overlooked by many competent engineers. The maximum ripple current is equal to the maximum D.C. drawn, i.e., if the load current is 80 mA. then the ripple current should be higher. Where there are two condensers in one case, the total ripple should not be above the maximum stated for the condenser. For example, if a small amplifier is rated at 60 mA., and there is an output valve of the 6V6 type, the reservoir section will take a current of 60 mA. from the supply, whilst the smoothing section will have a ripple of 50 mA. at full output from the 6V6, so that the total ripple for both sections together will be 110 mA. If the output stage is push-pull, the fluctuation due to the two valves will be equal and of opposite phase so that the ripple will be zero.

There are some special high-ripple condensers, made by both of the previously mentioned firms, for use in high-power amplifiers with ripple currents of up to half an ampere. These condensers are, of course, a little more expensive, but they are cheaper than using several condensers of lower ripple current in parallel. If condensers are used in parallel, the capacities are added, and so are the ripple currents. This latter only holds if the condensers are of the same type and capacity.

Typical Circuit

The diagram shows the circuit of a typical power pack. The choice of suitable values of chokes and condensers is one that puzzles the newcomer. The value of C1 plus C2, multiplied by the inductance in henries (the value of the condensers in μF), should be at least 300 with the value of C1 being equal to C2. If C1 is larger than C2 the smoothing will not be improved, but the voltage regulation will be better. This latter means there will be less voltage drop as the load current is increased. A high-resistance choke will give a big variation in voltage. The drop may be calculated by Ohms Law: a choke of 500 ohms resistance will cause a drop in the output of the power unit of one volt for each 2 mA. of load current. This can be very useful. Take, for example, the design of an amplifier using a 250-0-250 transformer with a load current of 50 mA. at a voltage of 250. The output at the rectifier will be 350 volts, less a few volts drop across the rectifier valve; there will be about 90 volts to be disposed of. Ohms Law states that resistance equals volts divided by amps., so the resistance required will be 90/.05 (voltage in volts and the current in amps.), equals 90 × 20, so 1,800 Ω would be used. If this is dropped in a choke there will be ample wattage rating but if a resistance is being used for the extra drop then the rating of the resistor will have to be 90 × .05, equals 5 watts.

The power dissipated in heat by a resistor can be calculated in three ways: (1) by multiplying the voltage drop by the current; (2) square the current (multiply by itself) and multiply by the resistance; (3) divide the square of the voltage by the resistance in ohms. The units must be in ohms, amps. and volts (milliamperes must be converted to amps. by dividing by 1,000).

The manufacturers of most types of valves give the voltage drops of the rectifier valves at various currents and also give the maximum size of reservoir condenser that should be used.—J. S. K.

On your Wavelength

by THERMION

The W.F.S.R.A.

I HAVE received a number of enquiries regarding "The World Friendship Society of Radio Amateurs." Readers have wished to know how the club is run, whether it is a profit-making institution, whether annual general meetings are held, whether the officers are elected annually, whether a balance-sheet is published and what are the benefits of membership.

I accordingly wrote to the secretary enumerating these questions and in reply I have received an application form (typewritten) which contains the following message: "I hereby promise that I will, to the best of my ability, make such use of my amateur radio station as will be conducive to international friendship and that I will do what I can, as a radio amateur and as an individual, to help all those interested in amateur radio." Applicants must sign this form giving their station call, if any, and address.

The general secretary tells me that the society is not run for profit. Apart from the "small sum due from subscriptions" there is little else received. The sum, however, is not stated, but I am informed that the money "is used to help provide for printing expenses, certificates, postage, etc. The subscriptions are 7s. 6d. for adults and 4s. for juniors per annum.

"Monthly accounts are kept and information as to the society's funds is available to paid-up members on request." It is not stated whether these accounts are audited accounts, but I am informed that "an annual audited account is in course of preparation." Surely every member of a club is entitled to receive automatically through the post a copy of the balance-sheet as signed by auditors without having to ask for it?

The officers "do not usually retire each year. As few of our members can act in an official capacity it is not necessary. All officials give their time and services without remuneration except for certain out-of-pocket expenses." What their out-of-pocket expenses are is not stated.

"Preparations for election of officers for 1953 are in progress. Paid-up members are entitled to one vote. A list of present officials is enclosed."

I asked whether the W.F.S.R.A. was associated directly or indirectly with any political body. The answer was: "I cannot stress too emphatically that we favour no political party. Such a controversial subject is barred, as also are religion, colour discrimination or creed. Each member is entitled to hold his own opinion on such matters."

The Service Scheme is free to members. The Service Bureau consists of four area engineers and the four areas are Cheshire, Kent, Middlesex and Yorkshire. This seems to be rather a circumscribed area for a body claiming to be a world society.

I am also informed that the council "meets at headquarters from time to time and a minute book of Proceedings is kept." They have a "Bedfast" section to assist invalid members.

In a short monograph on the history and aims we are told that the society germinated before World War II when Duane Magill (W9DQD) conceived the idea of using their common interest in radio to cement a bond of personal friendship between radio amateurs the world over; to form an association in which "technology and humanitarianism are on equal terms." Owing to the breakdown in Magill's health the administration was transferred to the present general secretary. Membership had dropped to a few dozen during the war. In 1950 the membership had risen to 200 and I am informed that in 1951 it had doubled, there being now 146 U.K. members, 175 overseas members "and the flourishing junior section of 86 members." It can hardly be said that a band of 460 or so members spread throughout the world would be able to promote the objects of world friendship. The promotion of world friendship is a political issue best left in the hands of politicians. The society issues a monthly journal and also "occasional dedicated programmes from station OTC, the international goodwill station of the Belgian National Broadcasting Service at Leopoldsville in the Belgian Congo, which station also broadcasts DX news every week."

That is as much as I am able to pass on to readers about the W.F.S.R.A. It is observed that notices of this organisation do not appear in the official journal of the Radio Society of Great Britain, and I have searched the columns of contemporaries but have been unable to find any published notices.

Parsons and Sponsored Programmes

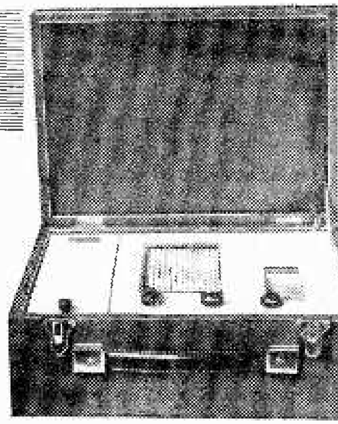
MY comments on the views of Dr. Garbett, Archbishop of York, concerning sponsored programmes, and particularly television programmes, have brought a number of letters from sky-pilots who state that everything which concerns human beings concerns the Church. It should be remembered, however, that the Church gave very full evidence expressing its views before the Beveridge Committee on Broadcasting, but those views were rejected. It was wrong, therefore, of Dr. Garbett to reopen the matter. I express, once again, my opinion that the Church should keep out of politics and technical matters, on neither of which subjects are they competent to speak.

Compulsory Suppression

ALL new vehicles sold after July 1st, 1953, must have suppressors, to avoid interference with television reception. That is as it should be, but television enthusiasts must not expect to have it all their own way. Already there are nation-wide complaints of the interference caused by television receivers to ordinary radio reception. Shall we, therefore, shortly have a public outcry asking for compulsory suppressors to be fitted to television receivers?

There are more radio than television receivers at present, and the older service is entitled to similar treatment.

A BATTERY-MAINS Attache Case PORTABLE



GENERAL FEATURES OF PORTABLE DESIGN AND A PRACTICAL CONSTRUCTIONAL FEATURE

By F. C. Warren

(*Continued from page 33, January issue*)

IN order to determine the number of turns-per-volt for winding the secondaries for H.T. and L.T., the transformer primary was connected to the mains and the output voltage of the existing secondary winding measured. The existing secondary was then carefully unwound and the number of turns counted, and thus the turns-per-volt calculated. This turned out to be about 30, which was roughly as expected as the transformer had a core approximately ½in. square. A layer of Empire cloth was wrapped round the existing primary and the H.T. secondary was then wound on, consisting of approximately 2,700 turns of 40 s.w.g. enamelled wire, to give an output of about 90 volts. Alternate layers were interleaved with thin tissue. The winding was done by hand, which was rather tedious, and is the reason why the number of turns is given as approximate, but no other method was available, and it can be done in a couple of hours or so. The L.T. winding consisted of 480 turns of 30 s.w.g. enamelled wire with a centre tap at 240 turns, so as to give an output of approximately 8-0-8 volts. Empire cloth was interleaved between the H.T. and L.T. windings, and the outside of the L.T. winding was wrapped in insulating tape. The transformer bobbin was just sufficiently large to take these windings when finished.

The H.T. rectifier need only be a half-wave type large enough to deliver some 10 milliamps, but the L.T. rectifier which is a full-wave type must be large enough to deliver 250 milliamps for the valve heaters, and should be of at least 6-volt working. The small types sold for trickle-chargers are usually suitable.

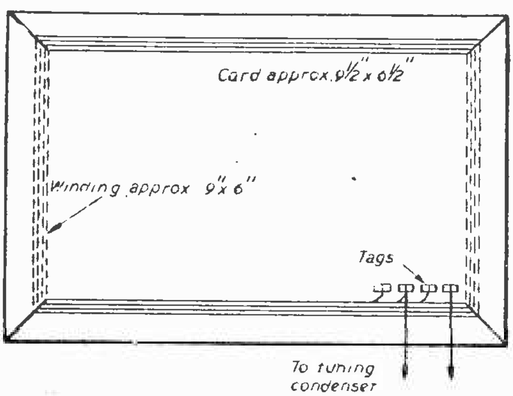


Fig. 7.—Details of the frame aerial.

When testing the power unit it is advisable, and indeed necessary, to have a dummy load connected, particularly to the L.T. section, before switching on. A load for the L.T. can easily be made from one or more torch bulbs so that roughly 250 milliamps is being absorbed.

On load the L.T. output of the power unit is about 1.3 to 1.4 volts, and the H.T. output about 65 to 70 volts. A suitable dummy load for the H.T. section can be a resistor of about 7,000 ohms.

The connections of the power unit to the switch, which is a four-pole three-way Yaxley type, are shown in Fig. 2, which also shows the connections from the switch to the batteries and to the receiver. As will be seen, one section of the switch is used to control the mains input, which is quite safe as only a few milliamps are drawn from the mains. However, a good quality switch should be used, having well-spaced contacts. In the "off" position, only the mains input connection is broken, so that the L.T. section of the power unit is left connected to the filaments which absorb the charge on the large condensers.

The batteries are designed to fit in the case alongside the power unit and are simply wedged into position by means of sponge rubber wedges.

Recommended batteries are the Ever-Ready type B.101 at 67½ volts for H.T., and A.D.35 at 1.5 volts for L.T. The Vidor equivalents are L.5500 at 67½ volts for H.T. and L.5040 at 1½ volts for L.T. Of course, various other batteries are suitable and may be used if preferred. For example, larger batteries can be accommodated in the case if the mains unit is excluded. The battery leads can be terminated in suitable plugs or clips to fit the batteries used.

Lining Up and Operation of the Receiver

The receiver was first tried out on batteries, using a P.A.2 aerial coil and a wire aerial instead of the frame aerial. When signals were received and the set had been roughly lined up, the I.F. transformers were adjusted, though with the midget type employed having iron-dust cores; the range of adjustment is fairly small so they cannot be far off tune.

The frame aerial was then coupled to the set in place of the coil and signals were received faintly. Turns were unwound from the aerial until the signal strength was maximum. When doing this it is important to bear in mind the directional properties of the frame aerial. The definite increase in signal strength as the last half-turn of extra winding is unwound is most marked, as is also the definite decrease as you go past the optimum position. When the frame aerial has been accurately matched to the coil its ends can be soldered to the tags on the card. The oscillator padder and trimmer condensers can now be finally adjusted.

It may be mentioned in passing that the set constructed by the author was tested on an H.T. battery giving only some 40 volts, and on the frame aerial the signal strength was more than adequate on both Home and Light Programmes, and adequate on the Third Programme. The set also pulls in an amazing number of foreign and regional programmes.

Operation from the mains should be tried next when the power unit has been tested. With the power pack described, the hum level was barely audible. Of course, more volume was obtained on mains operation than on batteries; in fact, the set overloaded the speaker on the stronger stations.

Scale Calibration

The scale was cut from card to the shape shown in Fig. 6, and secured in position by a nut and bolt at either end to the front support bracket and the oscillator coil bracket on the tuning condenser respectively. The scale was calibrated by tuning in signals of known wavelength such as the Home Service, Light Programme, and Third Programme, and marking the positions under the cursor on the card in pencil. The card was then removed and the distances between the pencil marks measured and the appropriate divisions in metres marked on in pencil. The scale was then finished by marking in the divisions and numbers in indian ink. The scale can be marked in any desired manner, but the type of marking employed can be clearly seen from Fig. 6 and the illustration on page 72.

If not previously done, the receiver chassis and power chassis can be finally bolted together so as to produce a single unit for mounting in the casing. The leads from the speaker transformer and from the switch to the receiver should also be connected finally, and also the leads from the volume control. The latter are preferably screened leads. An earth wire was also connected between the two units to ensure good electrical connection.

Casing and Front Panel Construction

The important considerations in the casing are rigidity and appearance. The casing is constructed in two parts, the box-half and the lid, which are covered with a leather-cloth of any chosen colour. When finished the two parts are hinged together and clasps and a handle added. Preferably, the sides of both case and lid are made from ¼in. board or plywood and the top and bottom of ⅛in. plywood, though a hardboard such as masonite could be used for top and bottom. The dimensions and details of the casing are shown in Fig. 10. The parts of the case are screwed together, simple butt joints being employed at the corners, and panel pins being interposed between the screws.

The finished casing is fitted with hinges and clasps, as shown on page 72, and also a carrying handle of the lie-flat type.

Since the case is to be covered in leather-cloth, the wood used need not be perfect, though in order to get a good appearance and avoid bumps in the covering it must be smooth.

It is advisable to fix the hinge clasps and handle before covering the case, and make sure that the whole assembles together satisfactorily. The fittings are then removed while the case is covered with the leather-cloth. Preferably a thin leather-cloth is used as this is easier to work and produces a neater finish.

When sticking the leather-cloth, a good glue should be used, and the wood well covered with glue by mean of a brush. The leather-cloth should be smoothed over with a cloth when stuck to the wood to remove air bubbles and any wrinkles.

In order to cover the box, a piece of cloth is cut sufficient to cover the bottom and sides and extend over the edges into the inside of the box for about ½in. The bottom of the box is glued and placed downwards on the wrong side of the piece of leather-cloth in a central position, and smoothed over so that it is firmly glued. The sides are now glued one by one and the cloth glued in place up the side and over the edge of the box, the extra material at the corners being cut out of the cloth, leaving a small overlap. If this is well smoothed down, the joints at the corners are hardly visible. The lid is covered in a similar manner. In addition, a panel of stout card is also covered with leather-cloth on one side. This fits inside the lid over the frame aerial.

Most leather-cloth is about 48in. wide, and half a yard is adequate for covering both parts of the case and the panel. As a guide, the sizes cut for each part are given below for the size of case described.

Box half, 20½in. × 17¼in.

Lid, 12in. × 15¼in.

Inside panel, 11½in. × 8½in.

Sizes may vary slightly, depending on the thickness of wood employed. Of course, a different size or

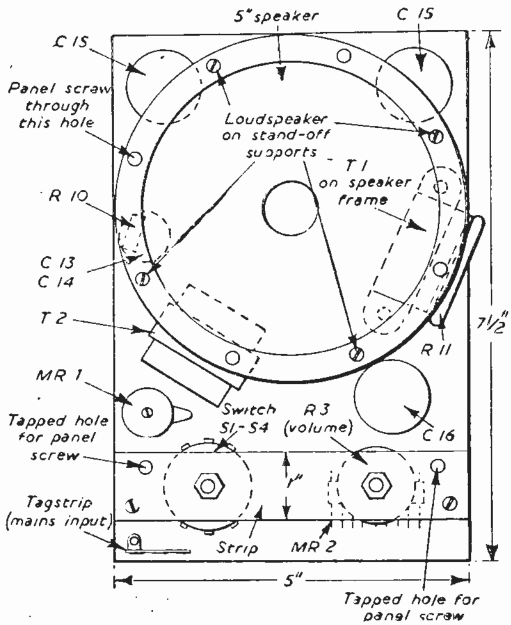


Fig. 8.—General idea of the layout.

shape of casing will need different sized pieces of leather-cloth.

The odd wasted pieces of cloth cut out as each part of the case is being covered—for example, as the corners are being formed, will most easily be removed by a sharp razor blade, which can easily slit through the leather-cloth.

The front panel was made from a piece of ⅛in. three-plywood and the appropriate holes cut out as shown in Fig. 9. The flap for the battery compartment is cut from the panel and then hinged at its top edge as shown. The front surface was sanded smooth and given three or four coats of a good quality enamel, with a sanding between each coat to produce a fine mirror finish. Preferably the front panel is enamelled to contrast with the colour of the leather-cloth of the case. For example, the receiver constructed was finished with a mottled grey case and a cream front panel.

A suitable material, such as expanded metal backed by fabric, is secured behind the speaker aperture, and a piece of cellulose acetate sheeting, or thin Perspex, is glued behind the dial aperture.

Suitable markings to indicate the "mains" battery and "off" positions of the switch can be produced on the panel by applying miniature transfers to the front panel.

The panel rests on small blocks of wood secured inside the box half of the case and, in order to hold the flap closed, a metal panel screw with a knurled head is fixed through the flap so that it can be screwed into a hole tapped in a metal bracket fixed inside the front of the box half of the case. The mains lead is also stowed in the battery compartment when not in use, and a small notch is cut out of one corner of the flap so that the latter can be lowered when the mains lead is plugged into a power point.

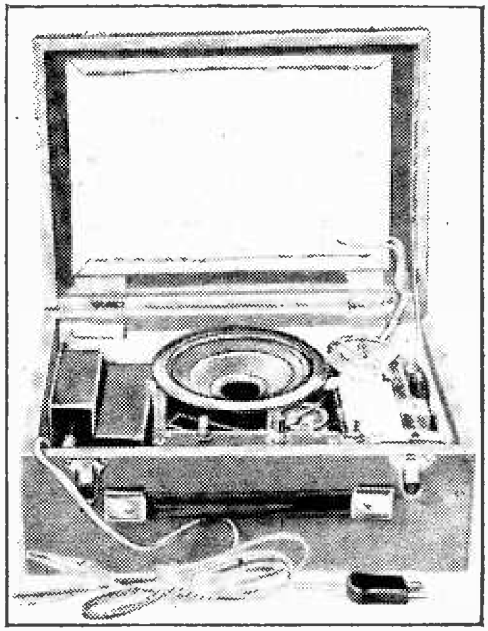
The frame aerial is placed inside the lid and secured by drawing pins, and the cover panel positioned over it and held by the heads of one or more screws screwed into the side walls of the lid.

A stay is provided to hold the lid open and may be formed from a piece of plastic-covered wire fixed by screws to the side wall of the lid and inside the casing below the level of the front panel.

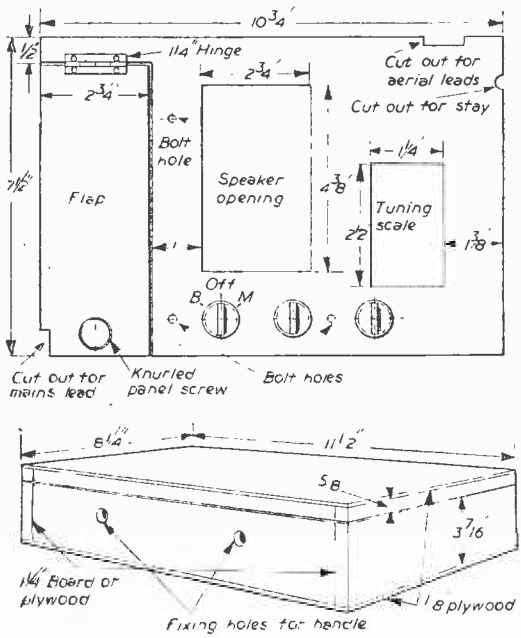
The panel is secured to the receiver in the casing by three countersunk headed bolts which are recessed into the panel and have their heads painted to match the front panel. Two of these bolts thread into holes tapped in the strip carrying the switch and volume control on the power unit, whilst the other passes through a hole in the speaker frame and is secured by a nut.

The assembled receiver and power unit are held in the case by means of two countersunk headed bolts passed through holes in the bottom of the casing so that their heads are flush with the bottom and thread into holes tapped in the chassis plate of the power unit. The whole assembly can, therefore, easily be removed by simply undoing five screws and removing the frame aerial.

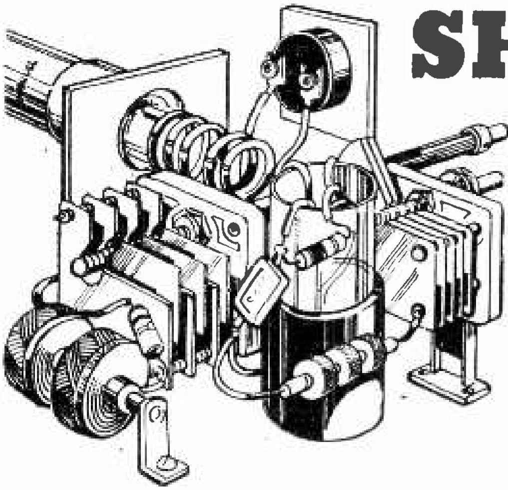
If desired, small rubber feet may be fitted to the bottom of the case at each corner.



The portable with cover raised.



Figs. 9 and 10.—Details of the cover and carrying case.



SHORT-WAVE SECTION

Modern American Amateur Communication Receivers

1.—DESCRIBING IN DETAIL THE COLLINS 75A-1

TO the American radio amateur the name of Collins has long been synonymous with superlative design, performance and precision engineering. That the Collins' traditions are retained in their latest product is beyond doubt, as the illustrations accompanying this article and the specification testify.

This model is known as the Collins 75A-1 and is a 14-valve (including rectifier) A.C. mains type double superheterodyne communications receiver, permeability-tuned throughout. Many of the ideas and tuning principles embodied in this design are entirely new.

Tuning Mechanism

By means of a precision lead screw the vernier tuning dial is directly coupled to the variable-frequency oscillator. This entirely removes any possibility of backlash.

Another interesting feature is that the iron cores used to tune the first R.F. mixer, first I.F. and second mixer stages are all mounted on a movable platform. The coupling between the platform and the V.F.O. shaft is carried out by means of metal belts and split gears, thus providing ganged tuning. Cord drive is, however, fitted to the slide-rule type dial pointer.

Band Switching

To switch the R.F. stages a multiple section switch is used, and each section and its associated components is completely and efficiently screened from the others. Crystal selection and dial illumination according to the band to be used is carried out by additional switch sections.

Special attention has been given to the location of the B.F.O. coil in the interests of efficiency, and a long shaft is the coupling medium between the unit and the panel control knob. The remaining stages are fixed-tuned by means of iron cores and ceramic variable capacitors.

Valve Line-up

R.F. amplifier 6AK5; First mixer, 6SA7; I.F. amplifier, 6SK7; Second mixer, 6L7; Crystal oscillator, 6AK5; 500 Kc/s I.F. amplifier, 6SG7-6SG7; Detector and noise limiter, 6H6; A.V.C., 6SJ7; V.F.O., 6SJ7; B.F.O., 6SJ7; Power amplifier, 6V6 and rectifier 5Y3GT.

Frequency Coverages

10 metres, 28.0 to 30.0 Mc/s; 11 metres, 26.0 to 28.0 Mc/s; 15 metres, 20.8 to 21.8 Mc/s; 20 metres, 14.0 to 15.0 Mc/s; 40 metres, 6.8 to 7.8 Mc/s; 80 metres, 3.2 to 4.2 Mc/s.

Variable I.F.

The frequency coverages of the variable I.F.s is as follows. On the 15-, 20-, 40- and 80-metre bands, 2.5 to 1.5 Mc/s, while on the 11- and 10-metre bands it is 5.5 to 3.5 Mc/s.

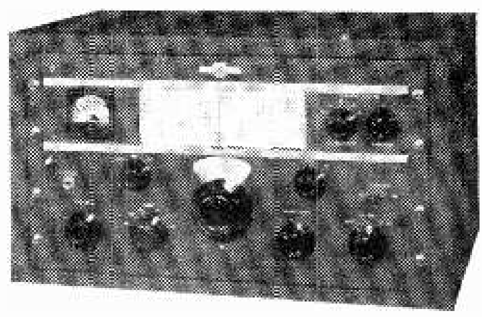
Band Changing

The system used in this receiver is, as the manufacturer's claim, unique because in the R.F. and first mixer stages the inductance of only one set of coils—that is, the 80-metre ones, is varied by the tuning slugs.

What happens when the bands are changed is that the 80-metre coils are paralleled with a tuned circuit, the characteristics of which will combine with the 80-metre coils, and thereby produce a tuned circuit suitable for the desired frequency range.

It should be noted that while five sets of tuned circuits are used, i.e., one for each band, variation of the inductance is carried out on the 80-metre coils alone by means of the tuning mechanism. It is also interesting to note that the two frequency ranges of the variable I.F.s are produced in exactly the same way.

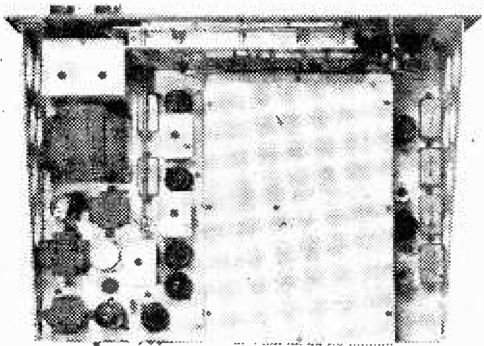
In order to produce heterodynes suitable for amplification by the variable I.F. amplifiers, and within the prescribed limits, a multi-crystal oscillator with a total of six separate crystals, one for each band, is used. Low-frequency type crystals are employed



General view of the Collins 75A-1 receiver.

for harmonic operation. The H.F. oscillator harmonic output is, in each instance, higher in frequency by 2.5 to 1.5 or 5.5 to 3.5 Mc/s, depending, of course, on the particular band in use.

In order to produce a 500 Kc/s heterodyne for the fixed frequency second I.F. stages, another signal is introduced to beat against the variable I.F. This is provided by a Collins 70E-7 precision oscillator.



Top view of the chassis.

Panel Layout

The Collins 75A-1 is finished in what is known as St. James grey wrinkle, which we would refer to as grey crackle finish. Referring to the illustration on p. 73, the panel controls are as follows. Bottom left, R.F. gain. Next and to the right is the band switch. Above it, A.V.C.—C.W. control. Centre, tuning controls. Right bottom, audio gain control. Next filament on and off switch, and B, i.e., H.T. Extreme right, noise limiter on-off switch. Top of panel right are the crystal selectivity and phasing controls.

A headphone jack is shown on the extreme left. The "S" meter is calibrated in steps from one to nine, each step being 6db. There are also additional calibrations for 20, 40 and 60db above S9. Sensitivity and zero adjustments are provided.

Bandspread

Due to the new and very efficient method of permeability tuning employed, linear calibration on all bands is achieved. On the hundred division vernier dial, each division represents one kilocycle when tuning over the 80-, 40-, 20- and 15-metre bands, and two kilocycles on the 11- and 10-metre bands.

The tuning ranges as shown earlier are covered by 10 turns of the vernier tuning dial.

Quartz crystals used in the first conversion circuit, together with a V.F.O. of extreme accuracy and stability enable precise calibration with visual tuning accurate to one kilocycle which represents one dial division at 21 Mc/s or 2 Kc/s, one dial division at 27-30 Mc/s.

I.F. and Image Rejection

Readers who have experimented with double superhet receivers of much less ambitious types are fully aware of the troubles which come under the above heading. Due to modern design the model under discussion has an inherently high rejection to spurious frequencies, the figures quoted being image 50db minimum even on 10 metres, while the I.F. rejection is 70db minimum.

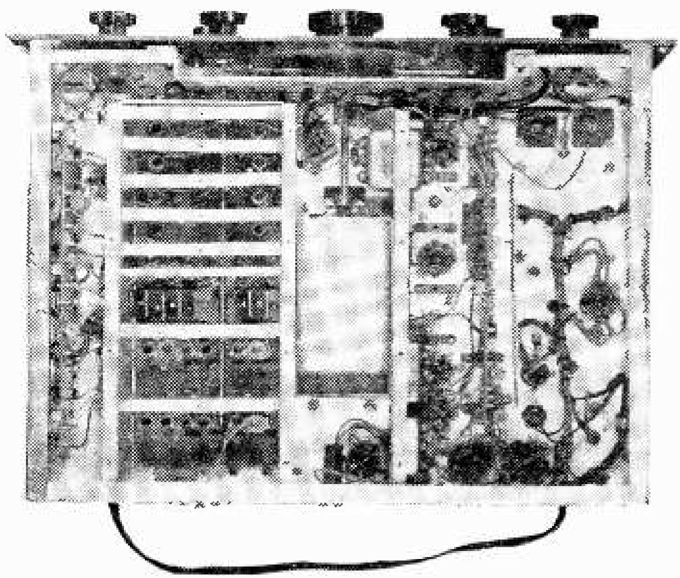
Such is the efficiency of the I.F. sections that only one R.F. stage is necessary to provide high image rejection and selectivity, together with high sensitivity and signal-to-noise ratio. A one microvolt input signal provides one watt of audio output with a 6db signal-to-noise ratio. The aerial impedance is 300 Ω with a four kilocycles bandwidth.

The advantages of variable bandwidth crystal filters are known and appreciated by the amateur, and in this receiver five-step variation is available from four kilocycles to 200 cycles at two times down (6db down from the resonant frequency peak). Except from the extremely sharp position where the loss is approximately 6db there is no loss in gain with the crystal filter in use.

A.V.C.

This is applied to the R.F. stage and three I.F. stages, the output being constant within 5db for a change of input from five microvolts to .5 volt, and maximum sensitivity on weak signals is assured.

The input impedance is 300 Ω, but a wide variety of balanced and unbalanced aerial systems can be used without serious losses being experienced. Readers will notice that the slide-rule type tuning dial which is calibrated in megacycles has a number of heavy line markings. These denote the individual amateur band widths.



Views of underside of chassis.

The Loudspeaker and its Mounting

SOME HINTS ON LOUDSPEAKERS AND SIMPLE CABINET CONSTRUCTION

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

IT has been stated on many occasions that one of the secrets of good reproduction lies in the loudspeaker and its mounting. If anyone doubts this statement, let them try connecting a modern loudspeaker to an old set and even under these adverse conditions the results will speak for themselves.

The number, variety and size of loudspeakers is legion : most are good, some superb.

The amateur of moderate means is limited in his choice of a speaker and must resort to doing the best he can with a standard single cone type and ignore the temptation of the twin diaphragm types, although if funds permit by all means purchase one.

The range of loudspeakers extends from the miniature 2½in. diameter to the 18in. auditorium type, plus a few sizes with elliptical cones. The larger types, 18in., 15in. and 12in., can be ignored for normal domestic use if only on the score of cost and space required.

The smaller types up to 6in. in diameter are hardly suitable for really high quality reproduction ; their power handling capacity is limited to 3 watts, which is insufficient to enable quiet passages of music to be heard in a large room. In addition, the bass resonant frequency of these smaller units is about 100-150 cycles, which can give rise to boominess if mounted in normal-sized radio cabinets with an air mass of the same resonant frequency.

Our choice, therefore, lies in either an 8in. or 10in. unit, and although the former can be made to give a very good account of itself, the latter size should be the choice every time, for the following reasons.

The mass of the diaphragm and speech coil assembly is sufficient to provide a low natural bass frequency in the order of 60-75 cycles.

The depth of cone from frame to speech coil allows of a large cone movement which extends the bass response. Frame and centring device are proportionately stouter in design and construction, providing absolute rigidity and increased power handling capacity.

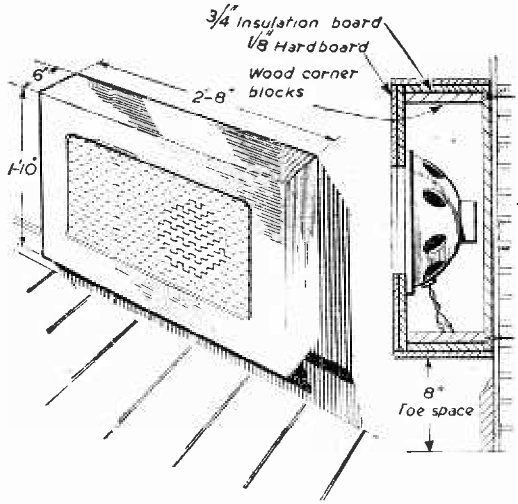
The large cone gives free movement, which makes for sensitivity.

To summarise, the 10in. unit makes an ideal all-round instrument.

Points to Watch

Occasionally a secondhand speaker is offered for sale : if the price is attractive it is worth while examining the instrument, particularly if of the larger type, but there are one or two points to watch. First examine the cone material ; see that it is not damaged in any way—it should be taut and not soft and flabby to the touch. See that the corrugations are of good shape and not dented or misplaced. If the unit is centred with a spider, see that this is flexible and not cut or of bad shape. Now examine the frame ; if the enamel frame is chipped and the metal below rusted, it is possible that pieces of both have worked their way between speech coil and magnet. To test this, gently move the cone backward and forward with the ear close to the magnet ; if the air space is free, all will be silent, but a scratching noise will indicate an obstruction. Note also, during this process, the actual movement of the cone ; this will test the compliance of the cone, centring device and corrugations. The action should be quick and certain, and the cone should fly back to its natural position immediately pressure is removed. Examine the fixing of the outer edge of the cone to the frame ; looseness here will give rise to all kinds of unwanted noises when working the speaker. Sight your eye along the edge of the metal chassis where this is bolted to the baffle. I have known cases where a speaker has been bolted to a stout but warped baffle and the uneven mounting, after years of use, has strained the alignment of the frame. The best test, of course, is under actual working conditions, but this is not always possible.

Of the two types of moving-coil units—permanent magnet or coil energised—I prefer the latter. From my experience I am convinced that the energised speaker gives a better and clearer cut bass response, is more sensitive, and lively than the P.M. type. I think it is a pity that most manufacturers seem to fit



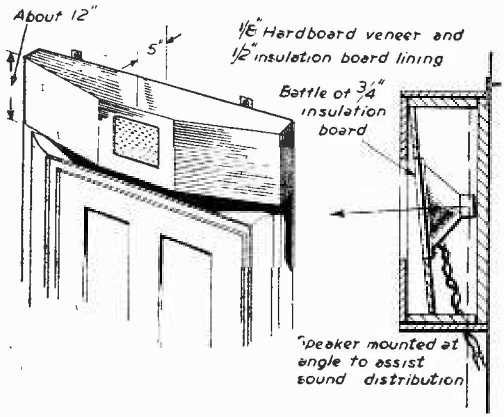
Figs. 1 and 2.—A wall-type shallow baffle.

P.M. speakers and ignore the mains energised type. Doubtless the tremendous power of the electro magnet accounts for this improved performance.

Matching

Having chosen the speaker, it is important that it is correctly matched to the output valve. Correct matching is essential to obtain the best from amplifier and speaker.

A study of the valve-makers' charts will give the optimum load for any output valve. To take an example, the old Mullard Pen A4, a popular and efficient valve, has a matching impedance of 8,000 ohms. If we wish to connect a speaker with a 3 ohm speech coil to this valve, we must first arrive



Figs. 3 *and* 4.—*A high-level baffle.*

at the correct matching ratio. Divide 8,000 by 3 and then find the square root of the answer. In this case 52. In actual practice a ratio of 50 to 1 will prove satisfactory.

Mounting

Now as to the mounting for the speaker unit. This can range from a simple flat baffle to a bass reflex cabinet. The flat baffle to be effective must be (a) large, and (b) substantial, and these requirements bring their own difficulties. Size requires room, and "substantial" usually implies cutting hard, heavy timbers with limited woodworking tools.

For the enthusiast with limited tools, space, experience in woodwork and cash, the shallow box baffle has, in the writer's experience, much to recommend it. The author recently described such a cabinet in a recent issue of this journal which is still in operation and giving very good results. The original speaker has now been changed for a more modern instrument and it is hoped to conduct further experiments as time permits.

At the moment a very shallow cabinet is being experimented with, and this is shown in Figs. 1 and 2. Hardboard is used as the veneer and this is backed with $\frac{3}{4}$in. building insulation board. Both materials are easy to obtain and simple to work.

The hardboard is tough, paints, stains and polishes well and the insulation board has admirable sound-absorbent properties which are essential for the type of cabinet contemplated.

The hardboard and insulation board are glued and pinned together. As rather a lot of glue is required, I have found the cheapest way of obtaining sufficient is to use ordinary glue size powder mixed in the proportions of 1lb. powder to 1 quart of water. Liberally coat both surfaces and a few panel pins and plenty of pressure will ensure a secure job. Rigidity is provided by wood blocks at each corner.

Corner braces of three-ply will assist constructional strength, and these can be used for screwing the cabinet to the wall. The front with speaker attached can be glued and pinned into place as a last operation.

A very decorative and at the same time effective baffle can be made in this way and it has the advantage of providing means for the lady of the house to sweep beneath it. Being in the form of a built-in fixture, it can be decorated to match either the woodwork or furnishings of the room.

Preliminary experiments with a small cabinet of this type have proved most promising. There is no tendency to box resonance and reproduction is crisp and with sufficient bass to be natural without a trace of boominess. This small cabinet is fitted over the door something on the lines shown in Figs. 3 and 4. By tapering the cabinet each end to line flush with the projection of the architraves it looks less offensive than making a normal square cabinet and hanging this over the door. If painted to match the door and its linings it will not look out of place.

A little point that is sometimes overlooked is the covering to the speaker opening. Undoubtedly the aluminium open mesh type are to be preferred to the fabric ones, which do tend to attenuate the higher frequencies. I have used the following with success: it looks well and has the advantage of cheapness. Obtain an ordinary open-mesh dish cloth from one of the popular stores. These are usually about 12in. square with $\frac{3}{8}$in. meshes. Dip this in black Indian Ink, allow to dry, then glue to the baffle board, making certain that the meshes are kept square and even for appearance's sake and then brush french polish over the cloth, two or three coats will be necessary. The result is a matt black mesh which is quite stiff.

Some readers may object to both these cabinets on the grounds that they are too shallow and would give rise to all manner of troubles in the form of boominess and box resonance. I, too, feared this, but must say from preliminary experiments that these objections do not appear to be justified and which I put down to the following reasons:—

The lining of sound-absorbent material plus wall paper and plaster absorb a great deal of the rear radiations from the speaker and considerably reduce echo effects.

Power output is kept within reasonable limits.

I will admit, however, I would not care to use either of these cabinets with a 10-watt amplifier, even with the gain turned back a little.

MIDGET RADIO CONTROL RECEIVER

A COMPACT DESIGN FOR CONTROLLED BOATS, CARS, ETC.

By F. G. Rayer

THIS receiver is of sufficiently small dimensions to be accommodated with ease in radio-controlled model boats of no great size. (It is not suitable for model aircraft.) It does not make use of the popular " soft," gas-filled valve generally utilised, as this valve has a rather short life. Instead, a standard button-based pentode or beam tetrode is used. Both the 1S4 and 1T4 have been employed with success. With the former, a slightly greater change of anode current arises upon receipt of the signal. The latter valve, however, can be controlled over a fair range. It has only about half the H.T. and filament consumption of the 1S4, and is particularly useful for long periods of operation from midget batteries. The wiring diagram is for the 1S4; if the 1T4 is employed then the socket marked " G " in Fig. 3 becomes the screen grid connection, while the grid socket is that adjacent to the positive filament tag.

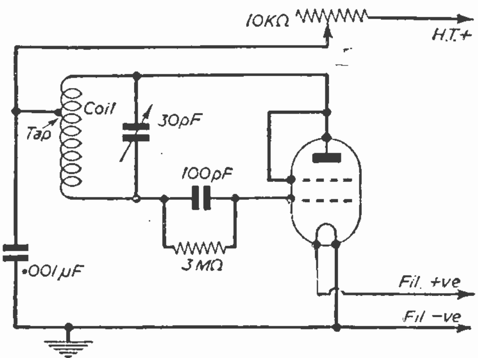


Fig. 1.—Theoretical circuit.

The circuit, shown in Fig. 1, is a standard one, and the layout can be made particularly compact by employing small components. For tuning, a 30 pF air-spaced trimmer is used. Once set, this only requires occasional adjustment. Bias is generated by self-oscillation. Upon receipt of a carrier-wave the amplitude of oscillation changes, thereby bringing about a change in anode current. This operates the relay, the contacts of which are wired to the various electro-magnetic or other controlling mechanisms in the model.

Layout Details

The receiver is built upon two small pieces of aluminium, the dimensions and layout being given in Fig. 3. The trimmer, for tuning, is mounted on a small piece of paxolin. This trimmer must be adjusted with an insulated tool when tuning. A length of ebonite or other rod is recommended, one end being arranged to fit the trimmer.

The coil is shown in Fig. 2. The wire should be pulled out straight before winding. One end should then be secured to some fixed object and the other looped round a former of suitable diameter. The turns can then be wound on, side by side, by rotating the former and slowly moving forward, keeping the greatest possible tension on the wire. The former is then removed and the coil pulled out slightly.

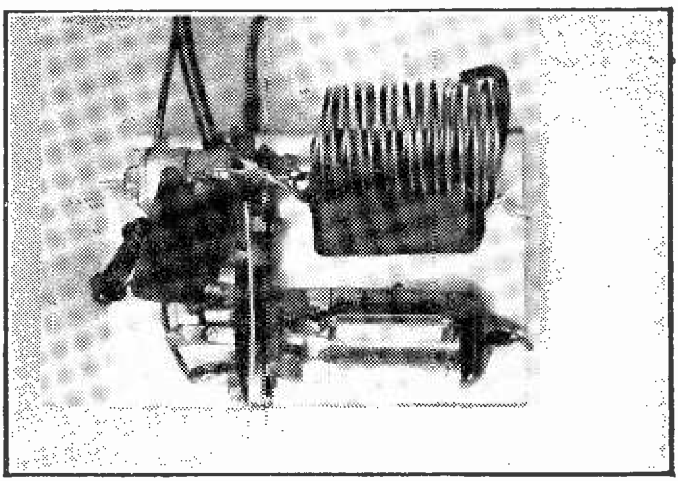
Wiring in the receiver must be short and direct. It will be found that the 10K variable resistor is not shown in Fig. 3. This control is most conveniently situated a little way from the receiver near the relay, but unduly long wiring should be avoided.

Aerial Details

The receiver will operate with a wide variety of aerials, but it is most convenient to select one arrangement and retain it. Any modification to the aerial will make it necessary to re-tune.

For short-range use and minimum size, a wire about 9in. long may be soldered directly to the grid tag of the 30 pF condenser. This may project vertically, and should be formed into a small loop at the top. For somewhat greater range, a longer wire can be used. An 18in. length of 20 S.W.G. wire, if pulled until it is felt to stretch, will stand vertically with ease.

For longer range, a larger aerial can be used. The damping arising from this will prevent oscillation if it is directly coupled. Accordingly, it must be taken to a tapping on the coil or wired in series with a 50 pF pre-set condenser. It is also possible to couple the aerial by means of a coil of about two turns at the grid end of the coil shown.



General view of the receiver.

Adjustments

The completed circuit is shown in Fig. 4, but a meter reading up to about 5mA should first be included in one H.T. lead. It is suggested that the tapping be left unsoldered for the moment. Batteries are connected and the 10K resistor set to minimum. The usual aerial is also coupled according to the method adopted, as already mentioned. The transmitter should be " off."

The receiver should now be adjusted until it is not oscillating. If anode current increases sharply upon touching the aerial, oscillation is present. This may be stopped by turning the 10K resistor to reduce the anode voltage, or by moving the tapping towards the anode end of the coil. As oscillation stops the anode current will rise : touching the aerial will now cause no change in anode current.

The transmitter should then be switched on and the receiver tuned throughout the range until a current dip is noted. If this does not arise stray capacity may be resulting in an incorrect tuning range. This can be compensated for by slightly pulling out or compressing the coil. With a fairly long aerial and 1S4, one turn will require to be removed. But with a short aerial this is not necessary. The 1T4 also appears to have less internal self-capacity between electrodes than the 1S4. The transmitter should be tuned to approximately 27 Mc/s.

Having made certain that the correct frequency can be tuned, the 10K resistor and the position of the tapping should be adjusted for maximum current dip. The greater the H.T. voltage the greater will be the dip, but the tapping will require to be nearer to the anode end of the coil to avoid too violent oscillation. A dip of about 1mA should be anticipated with 9in. aerials on both transmitter and receiver, and these situated in the same room. For final adjustments the full transmitter aerial can be added and the receiver placed in the model at 20 or 30yds. range.

Finally, correct adjustment of the relay is essential for maximum range. With the transmitter off, the relay tension spring should be adjusted so that the armature is *just* held down. It will then rise when anode current decreases. The contact adjusting screws should be set so that very little free movement of the armature is present, and so that the latter is as near as possible to the relay core. A high-resistance relay, as made for such purposes, is essential, and may be obtained from various advertisers.

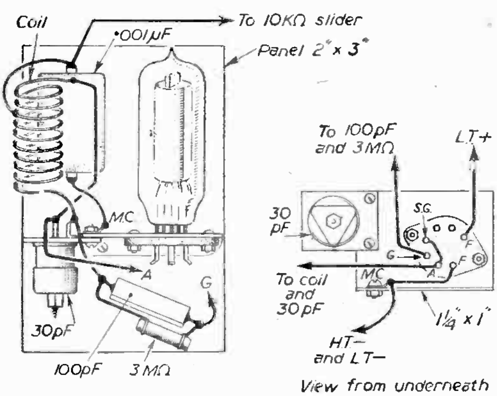


Fig. 3.—Layout of the receiver.

The final range achieved will depend primarily upon the care in setting up adjustments, and upon the power of the transmitter. Using a 2ft. aerial on the receiver, and an 8ft. aerial (vertical rod) on the transmitter (the latter consisting of two small-power triodes powered from 2-volt accumulator and 90v.

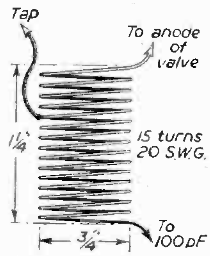


Fig. 2.—Coil details.

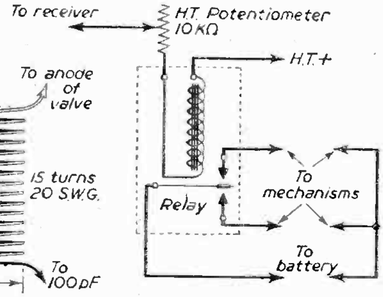


Fig. 4.—Relay circuit.

H.T. battery) a range of about 50yds. was obtained. This was considered ample for the purpose in view (controlling a boat on a pond). The range increases sharply with larger aerials, and with an increased H.T. voltage at the transmitter. However, the range of all single-valve sets must necessarily be limited, though for most ordinary model-control purposes this is not very important.

Barnstaple Transmitting Station

ON Thursday, December 11, 1952, the new permanent transmitting station at Fremington, between Barnstaple and Bideford, took over the West of England Home Service on 285 metres (1,052 kc/s), from the temporary transmitter operating from a caravan on the site. This is one of a number of low-power stations being built by the BBC to improve reception of the Home Services in certain areas.

The new transmitter is of higher power than the caravan transmitter and should extend the coverage beyond the immediate surroundings of Barnstaple and Bideford to include the outlying districts such as Northam and Great Torrington. The equipment, which is housed in a building some 14ft. square, is designed for completely automatic operation without the attendance of staff. It comprises two Marconi transmitters working in parallel to give an output of 1⅓ kW. ; they will be switched on and off automatically by a time switch. Later a third transmitter unit will be added to increase the power to 2 kW.

The station receives its programme over Post Office lines from Bristol and the incoming and radiated programme is checked by automatic monitoring equipment designed and developed by BBC engineers. Should a fault develop in one of the transmitter sections, the faulty section will be automatically disconnected and the service continued on reduced power. The engineers at the parent centre at Bristol can check the operating conditions at Barnstaple by making a telephone call to the station ; this causes appropriate equipment at the station to send out over the telephone line a series of coded tones—similar to those used in automatic telephone practice—indicating the condition of the station apparatus.

LOOKING AT V.H.F.

AN EXPLANATION FOR THE NEWCOMER TO SHORT-WAVE WORKING

By H. E. Smith (G6UH)

Foreword

WHAT are the V.H.F. bands? As distinct from the H.F. bands, which extend from 1.6 to 30 Mc/s., the V.H.F. range extends from 30 Mc/s. to 200 Mc/s. Frequencies higher than this are the U.H.F. and micro-wave bands. There may be some little argument as to exactly where V.H.F. ends and U.H.F. begins. The operator who spends most of his time on 145 Mc/s. always refers to the 1.6 to 30 Mc/s. bands as the "low-frequency bands"! So with the progressive activity on the U.H.F. and micro-wave bands, 145 Mc/s. will in time become "low-frequency" to these operators. It is all a question of relativity. The main purpose of these notes, however, is to assist those interested in taking the "long jump" from 30 Mc/s. to 145 Mc/s. Entirely new techniques must be adopted for successful operation on V.H.F., the one outstanding requirement being plenty of patience. We shall concentrate on the band 144 to 146 Mc/s. (2 metres) and deal with several preliminary points.

Why can't we build a V.H.F. receiver to cover a wider range, say 90 to 150 Mc/s.? The answer is, of course, that we *can*. While this would be quite useful to listen to aircraft, service and commercial signals, it would not allow any *serious* listening on the 144-146 Mc/s. amateur band, owing to the compression of the band into a comparatively narrow channel. Incidentally, the use of ganged condenser tuning for V.H.F. operation is not recommended because of the capacity losses incurred.

Another question is, what do we expect to hear on the 144-146 Mc/s. band? Stations over 100 miles distant are "DX" to the V.H.F. listener, and, under normal conditions, the reception range is up to 50 miles or so. The question could be answered in another way. What we can expect to hear is governed by our height above sea level, coupled with height above local terrain, height and type of aerial in use, noise factor of the receiver, and reception *conditions*. Reception conditions are still an uncertain factor. Many theories have been evolved, high barometer, fog, temperature inversions, etc., all said to produce good V.H.F. DX conditions. From time to time, however, the band will "open up" for no apparent reason, and signals up to 300 miles or so may be heard, even on the simplest of aerials.

V.H.F. Converters

Let us look at the receiving side of V.H.F. This usually presents the biggest problem to the beginner, and is, in fact, the item requiring the greatest concentration and patience. A 2-metre converter, even of the simplest type, requires great care in its construction, and the use of correct types of valves if optimum performance is expected. Normal octal-based valves should never be used in a V.H.F. converter. The self-capacity alone is far too high, and the lead inductance within the valve precludes the use of sizeable tuning coils. Use only valves designed for operation at these frequencies.

Among the more popular types, we have the Mullard EF50, EF54, EC91, ECC91, Marconi Z77, American 6AK5, 6J4, 6J6, to name but a few. In a class by itself is the Brimar 12AT7, which will operate successfully up to 500 Mc/s., and gives an outstanding performance at 145 Mc/s., whether used as an oscillator/mixer, or R.F. amplifier.

The simplest of all V.H.F. converters consists of a single valve (the ECC91 or 6J6 twin triode) used as a mixer/oscillator, and utilising the main communications receiver as the I.F. amplifier. The circuit, shown in Fig. 1, is simple to construct, but care must be taken to screen the oscillator coil from the grid coil, otherwise there may be excessive oscillator injection voltage, causing an increase in noise level and a *decrease* in sensitivity. The intermediate-frequency should be chosen relative to the strength of signals audible on the main receiver at that point, as some I.F. breakthrough may be experienced, and this can be quite troublesome. A good frequency for the I.F. is approximately 26 Mc/s., but if the main receiver is of a type which does not cover this band, choose a frequency as high as possible with a clear channel. Whatever frequency you choose, remember that the oscillator coil should tune to 145 Mc/s. *minus* the intermediate frequency.

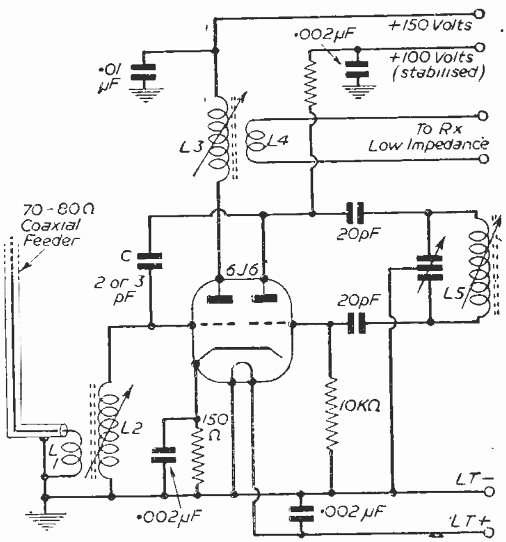
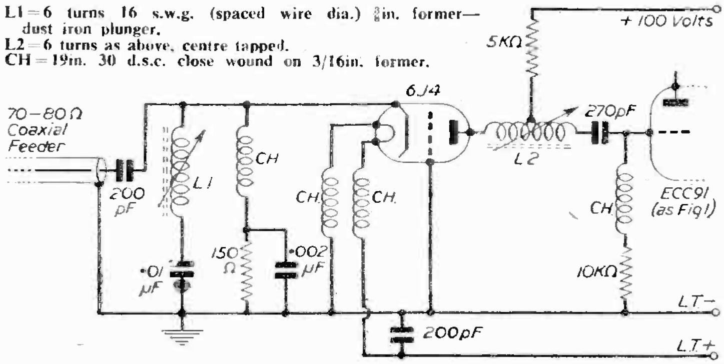


Fig. 1.—6J6 (ECC91) as mixer-oscillator for 144-146 Mc/s.

L2 = 5 turns 16 s.w.g. enam. (spaced wire dia.) on ⅜in. former, with dust iron plunger.
L1 = 2 turns 16 s.w.g. enam., overwound on L2.
L3 = Tuned to I.F.
L4 = 2 or 3 turn link coupling coil.
L5 = 6 turns 16 s.w.g. enam. (spaced wire dia.) on ⅜in. former with dust iron plunger with 10 pF split stator tuning condenser.

Fig. 2.—6J4 (EC91) grounded grid R.F. amplifier.

L1 = 6 turns 16 s.w.g. (spaced wire dia.) ⅜in. former—dust iron plunger.
L2 = 6 turns as above, centre tapped.
CH = 19in. 30 d.s.c. close wound on 3/16in. former.



All resistors and condensers should be of the best type obtainable and rigidly mounted in the chassis. Keep all leads as short as possible, and make certain that every connection is well and truly soldered. Attention given to all these apparently minor points will pay dividends when the converter is finally put on test. There are two methods of tuning a V.H.F. converter. The oscillator may be fitted with a pre-set trimmer and all tuning carried out on the main receiver (varying the I.F. setting), or a slow-motion drive fitted to the oscillator tuning condenser and the main receiver dial left in one position. The latter is recommended, as there will be less chance of I.F. breakthrough, and by using a suitable condenser the 2-metre band may be spread over almost the whole of a 180-degree scale, thus making it easier to search for the weak signals.

Although the simple converter shown in Fig. 1 will give quite reasonable results, the sensitivity and signal-to-noise ratio may be improved almost tenfold by the addition of an EC91 as a grounded-grid R.F. amplifier. The construction of such a stage is simplicity itself and, provided the cathode and anode circuits are screened from each other, no instability will be experienced. The grounded grid circuit provides somewhat less overall gain than a neutralised triode or a pentode, but it has the unique feature that the input circuit is a good match for low-impedance feeder, and optimum aerial coupling, which is usually a problem on V.H.F., can be accomplished with ease.

Fig. 2 shows a typical grounded-grid stage, coupled to the mixer half of a 6J6 (ECC91). Always peak up the tuned circuits on a signal. Maximum hiss does not necessarily mean maximum signal. This especially applies to V1 anode circuit.

A simple guide to performance is as follows. With a carefully constructed V.H.F. converter, as shown in Fig. 2, it should be possible to observe the change in noise level produced by the aerial. If the feeder is removed from the input, and a carbon resistor of the same value as the feeder impedance substituted across the input, a change in noise level of between 4 and 6 dB should be expected. This test should be made with all gain controls at maximum, of course, and with A.V.C. off.

The performance of any V.H.F. converter depends largely on the efficiency of the aerial system. The aerial should, in fact, be the main consideration when V.H.F. operation is contemplated. A six or eight element stacked array is the best type to start with, being very tolerant in its matching requirements. It also has a very wide front and rear coverage, and is extremely receptive to the low angle signals encountered on V.H.F.

BBC Arrangements for Sound at the Coronation

THE BBC has made provisional plans for sound and television coverage of the Coronation of H.M. Queen Elizabeth II on June 2, 1953.

Some 250 commentators and observers will describe the occasion for a world-wide audience. The following are the "sound" arrangements.

For domestic listening the BBC plans coverage on a similar scale to the Coronation of the late King George VI in 1937.

Commonwealth Broadcasts in English

The Home sound programme will be broadcast simultaneously to Commonwealth countries, to British forces overseas, ships at sea, and English speaking listeners throughout the world. The team of commentators will include Commonwealth representatives.

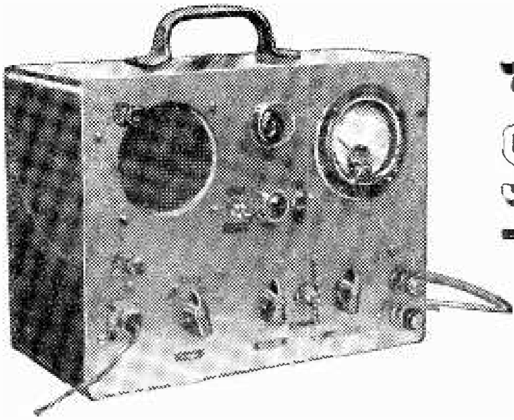
Sound Broadcasts in Other Languages

In addition to the broadcasts in English, accounts of the ceremony will be broadcast in every language used by the BBC in its external services. These are: Danish, Norwegian, Finnish, Swedish, Dutch, French, German, Polish, Czech, Slovak, Hungarian, Italian, Spanish, Portuguese, Greek, Turkish, Albanian, Bulgarian, Rumanian, Russian, Serbo-Croat, Slovene, Afrikaans, Maltese, Hindi, Tamil, Marathi, Bengali, Sinhalese, Urdu, Arabic, Hebrew, Persian, Cantonese, Kuoyu, Burmese, Malay, Thai, Japanese, Indonesian and Vietnamese.

Sound Recordings

The time factor will not always allow for the overseas transmissions in sound to be broadcast direct. Some will therefore be recorded for use later during the day. During the following twelve hours the General Overseas Service will transmit edited programmes in English containing recordings of the day's most historic moments. The normal evening transmissions of the external services will include descriptions of the celebrations in London that night, interviews with well-known visitors from many countries, as well as recordings of the morning ceremony.

To achieve world broadcasting coverage on this scale, a total of 250 sound and television engineers will be manning the various outside broadcast points. The G.P.O. engineers will provide about 400 sound and TV circuits and 800 extensions for microphones, cue-lights and headphones.



A Comprehensive SIGNAL TRACER

A DESIGN FOR THE SERVICEMAN

By D. Allenden, Graduate I.E.E.

FOR servicing and fault-finding in radio receivers, one of the most useful instruments is undoubtedly the signal tracer. Furthermore, this is an instrument which can be constructed by those having little experience, as it usually has few critical circuits. If the time and money expended on such an instrument is to be utilised to the greatest advantage, some consideration must be given to the design of the unit itself, especially from the point of view of ease and convenience of operation. The instrument to be described has been developed with these points in mind, and among its more prominent features may be mentioned :

(a) Only a single input socket and test prod required, modes of operation being controlled by a suitable selector switch.

(b) No tuning controls. No adjustments are therefore required when moving from R.F. to I.F. circuits, or from one waveband to another.

(c) In addition to its normal function of monitoring the signal passing through a receiver, it can also be used to feed broadcast signals into a defective set.

(d) When not in use as a signal tracer the instrument can be used as a receiver in the workshop.

The instrument consists basically of two untuned R.F. stages, diode detector, A.F. amplifier, and output stage. A signal may be fed into either of the stages by operation of the selector switch. Other controls permit the instrument speaker to be replaced by an output meter for quantitative measurements, and a magic eye is provided which is useful for checking oscillator and A.G.C. circuits.

Circuit

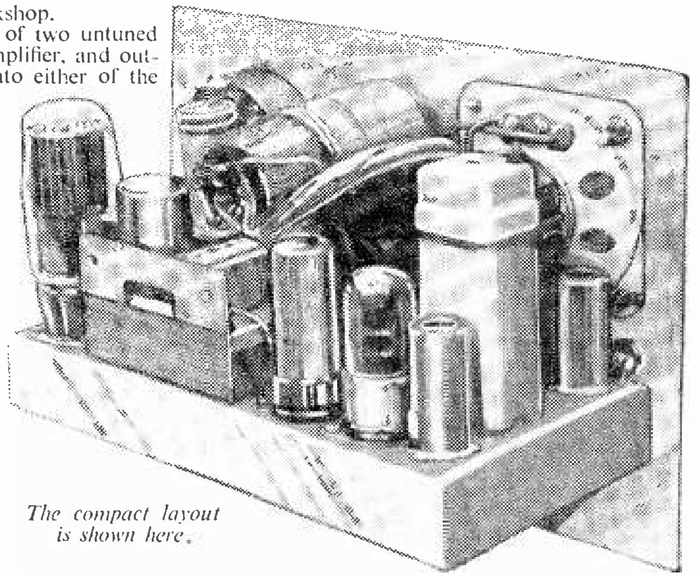
The complete schematic is shown in Fig. 1. The first two stages employ miniature valves, but this is only to reduce the physical size of the instrument. The first stage is a variable-mu pentode in a normal resistance-capacitance circuit, gain being controlled by the conventional cathode resistor, which forms the "R.F. Gain" control of the instrument. Coupling and decoupling capacitors are naturally smaller than those used for audio frequencies, since the stage is intended to handle R.F. only.

This valve feeds directly into the second R.F. stage, for which a straight pentode of the high gm type is employed. The screens of V1 and V2 are fed by a common dropping resistor from the H.T. line, and it will be noted that the whole H.T. supply to the first two stages is decoupled from the remainder of the system by R22 and C20.

The output of V2 is fed to the diodes of the V3 (6SQ7). The demodulator circuit is a little unusual, due to the fact that the input signal to the diodes has one side earthed directly, and the other at a high D.C. level. The normal diode detector circuit, in which the diode is placed at the earthy end of the input cannot, therefore, be employed.

The final audio voltage is developed across audio gain control VR2, from whence it is fed to the triode section of the 6SQ7.

An A.G.C. bias is provided by filtering the audio signal by means of R13 and C11, but this bias is not employed for the control of the stages of the instrument itself, and is merely fed to the grid of the tuning indicator V5.



The compact layout is shown here.

The triode section of the 6SQ7 functions as a normal A.F. amplifier, but it should be noted that there is no cathode bias resistor, as with this circuit such a resistor would automatically also bias the signal diode. Grid current bias is employed and for this purpose a very high value of grid leak is necessary. The value shown is 20 megohms, but this may, if desired, be reduced to about 5 megohms, but should not be any lower than this figure. Adequate decoupling is again provided in the anode circuit by C13 and R17.

The output stage V4 which uses a 6V6 is conventional in its general outline. However, provision is made for cutting out the internal speaker when necessary and substituting an output meter.

Metering

The meter actually employed was a surplus 80 volt 2,000 c/s thermovoltmeter, which is ideal for the purpose. It has an impedance of about 5,000 ohms, so will itself suitably load the output valve. The square-law calibration means that a linear power scale may be inscribed if desired, and the consumption at full scale is some 2 watts. There is the further advantage that the readings of such a meter are comparatively sluggish owing to its large thermal time constant, and a steady reading can therefore be obtained even on the average broadcast signal. Full details of the meter are given in the components list, and these instruments are still to be found in the surplus stores, but for the benefit of those who wish to use meters other than that specified, details are given on methods of employing either moving-coil meters or low-sensitivity moving-iron meters.

The switching for the output meter and speaker is carried out by means of a D.P.D.T. tumbler switch, S2. One pole is used to disconnect the speaker from the output transformer, whilst the other connects the output meter to the anode of the output valve via a 1 μF capacitor C19.

A 'phone jack is provided at the input to V4, so that, if desired, 'phones may be plugged in at this stage. Insertion of a plug into the jack automatically breaks the feed to V4 grid and silences the internal speaker.

Terminals are provided at the output valve anode for connection of an oscilloscope.

The circuit is tapped at V1 grid, A.F. gain control, at V4 grid, and at the output meter. These points are taken to the selector switch S1, a two-pole five-way type. The selector arm of this switch is fed from the input socket on the panel. The five positions of this switch operate as follows :

(a) R.F. In this position the input goes to V1 grid via a coupling capacitor C1. This position is used for tracing in R.F. and I.F. circuits.

(b) AUDIO 1. In this position the input to the tracer is fed to the A.F. gain control, and two stages of audio amplification are available. This position is used for tracing in low-level A.F. circuits.

(c) AUDIO 2. The input goes directly to the grid of the output valve V4. This position is used for high level A.F. signals.

LIST OF (

V1—Mullard EF92 (6K7, 6SK7, EF39, 6SG7).	**R1, R8,**
V2—Mullard EF91 (EF50, 6AC7, 6SH7).	**R2, R6,**
V3—Brimar 6SQ7 (6Q7, EBC33).	**R3,**
V4—Brimar 6V6GT.	**R5, R**
V5—Osram Y63.	**R18—15**
V6—Mazda (or 5Z4 with 5-volt rectifier heater winding).	**R11—10**
T1—Mains transformer 350-0-350 v. 100 mA., 4 v. .2 a. or 5 v. .2a., 6.3 v. 5 A.	**R12, R1**
T2—Output transformer, 5,000/2 Ω, midget type.	**R13, R1**
S1—Single bank 2-pole 5-way, ceramic preferred.	**R16—20,**
S2—Double-pole double-throw tumbler switch, Cutler-Hammer type.	**R20—22**
S3—Double-pole on/off mains switch, Cutler-Hammer type.	**R4, R8—**
M1—0-80 v., 2,000 c/s thermovoltmeter, or alternative as discussed in text.	**R21—2.2**
	R9—47

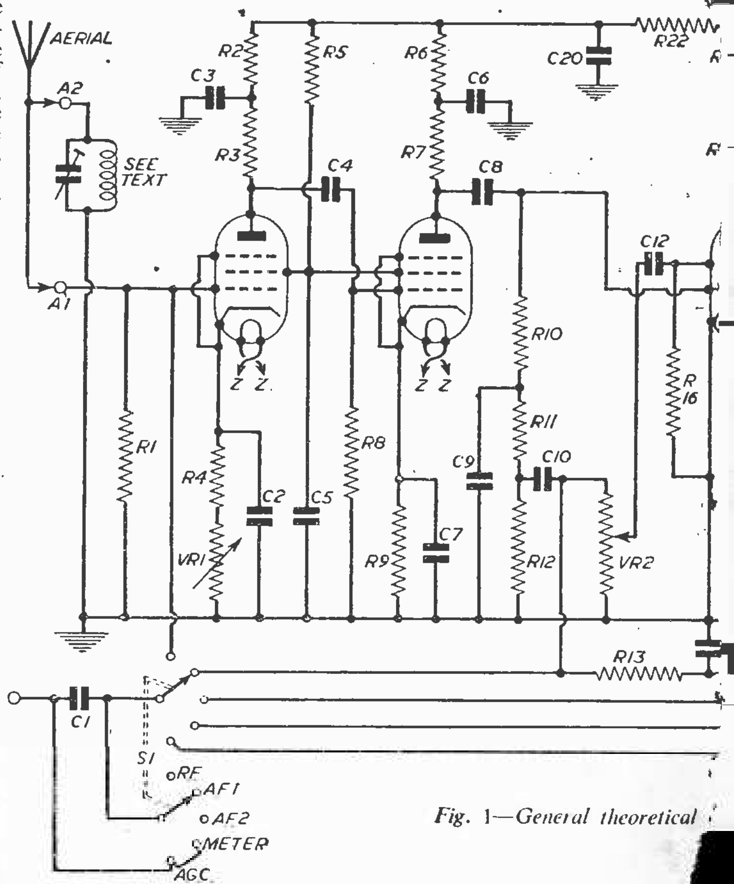


Fig. 1—General theoretical

(d) METER. In this position the output meter is connected directly to the tracer input. Note that in this position the low value coupling capacitor C1 is short-circuited by the second pole of the switch S1.

(e) A.G.C. Here the input socket feeds to the grid of the tuning indicator C1, being again short circuited. This position is useful for checking for the presence or otherwise of A.G.C. and oscillator voltages.

It should be apparent that if a tuned circuit resonating at the frequency of a powerful broadcast transmitter is connected from V1 grid to earth, and a short aerial erected, the tracer will function as a receiver. The selector switch may then be used to abstract an R.F. or A.F. signal from the tracer to feed into a faulty receiver. For the little extra outlay involved this is an extremely valuable feature. The tuned circuit is switched in and out of circuit merely by insertion and removal of the rod aerial. When the aerial is in place, terminals A1 and A2 are bridged, and this connects the tuned circuit to V1 grid. Spring-loaded terminals are used for A1 and A2 so that the aerial can be easily and quickly inserted or removed. The station to which the circuit is tuned will naturally be a matter for the personal preference of the constructor, so coil details are not given.

...PONENTS

...10—100 K Ω ½ watt.	VR1—50 K Ω R.F. gain control.
...22—4.7 K Ω ¼ watt.	VR2—1 M Ω R.F. gain control.
...2 K Ω ½ watt.	C1, C3, C5, C6—0.05 μF.
...33 K Ω ½ watt.	C2, C7—0.1 μF.
... K Ω 1 watt.	C4, C8—500 pF.
...0 K Ω ¼ watt.	C9—200 pF.
...9—0.22 M Ω ¼ watt.	C10, C12—0.01 μF.
...4, R15—1 M Ω ¼ watt.	C11, C13, C20—0.25 μF.
... M Ω ¼ watt.	C14—0.05 μF.
...0 Ω 1 watt.	C15—0.002 μF.
...470 Ω ½ watt.	C19—0.5 to 1 μF.
... K Ω 5 watt.	C17, C18—16 + 16 μF, 450 v.w.
... Ω ¼ watt.	C16—25 μF.

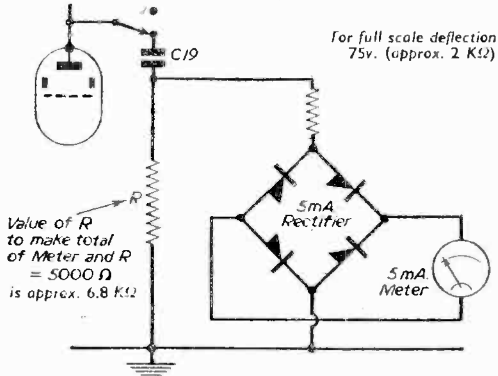
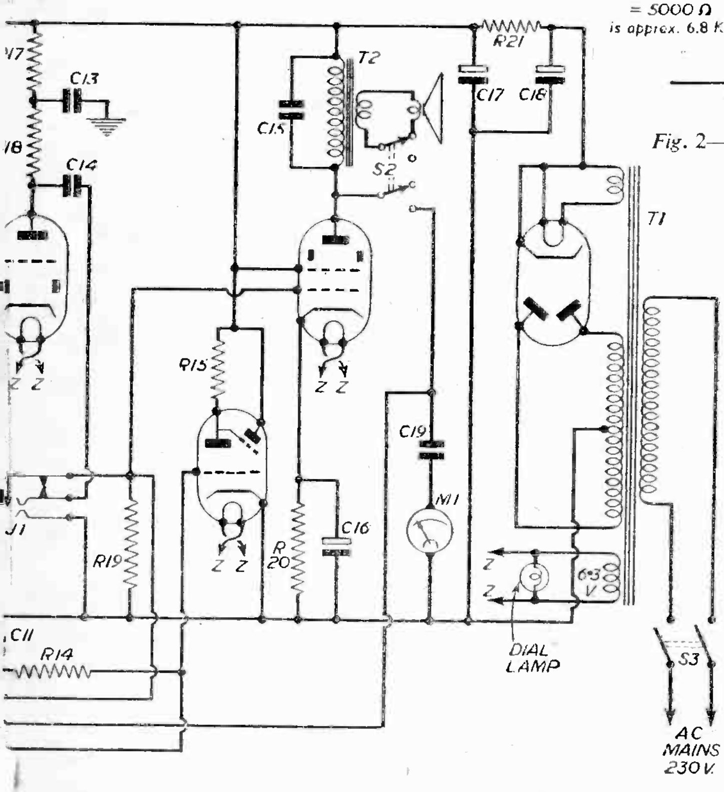


Fig. 2—Details of fitting an A.C. meter.



...cuit of the signal tracer. Details are shown separately ...ove for fitting an A.C. meter.

Power Supply

The power pack is conventional, but has been deliberately built to have larger capacity than is required for the tracer alone. H.T. and L.T. voltages are brought out to an octal socket, mounted on the side of the instrument, so that power is available for the operation of faulty receivers or subsidiary test gear.

Construction

Construction is straightforward, but some care is necessary over the layout, especially with regard to the first two stages. Adequate decoupling is provided in the circuit, but even so, if the layout is at all restricted the stages

(*Concluded on p.* 106)

The Professional Finish

AN ARTICLE DEALING WITH THE FINISHING OF VARIOUS METALS WHEN USED FOR FRONT PANELS OF INSTRUMENT CASES. ALSO A FEW NOTES ON THE CARE AND HANDLING OF THE MATERIAL

MANY amateur radio enthusiasts go to a lot of trouble with a piece of test equipment that they are building to get the inside wiring perfect, the layout has been arranged very carefully to avoid various stray effects and then comes the case. This very often is something that was handy, in these days not infrequently an ex-W.D. instrument case. The front panel seems just to have happened; may be it was a nice piece of aluminium sheeting once, but now the polish is very nice in places; the marking out lines would have looked better on the rear; the marks where the drill slipped are pretty bad; the printing would have looked a little better done with a paint brush instead of a mop! It is a good thing that most of the instrument panels are not quite as bad as that. Many amateurs would like to know how to get just that little extra bit of finish. It is a point in the lab. to do your best with every little job, no matter how small.

As instrument cases are usually professionally made—whether or not they are ex-W.D. or new—the finish is usually quite good, so the subject of instrument panels will be dealt with.

First a word about the care of the metal. A lot of people seem to think that it will look after itself. Steel sheeting will to a certain extent, provided that it does not get damp, but the softer metals such as aluminium, copper and brass scratch and mark very easily. The best way of storing the metal, in the writer's opinion, is to lean it against the wall under the bench in a place where it will not get anything dropped on it; failing this it should be wrapped in paper and kept dry until wanted for use.

Aluminium

When required, a piece should be taken from the stack and placed face down on a piece of newspaper to prevent the front getting scratched. The marking out can quite well be done on the back, remembering that the layout will be reversed. Then, with the aid of a sharp scriber, set-square and rule, mark out the size of the panel. This done, there is the cutting. For steel and brass, the writer uses a hacksaw, even down to 22 gauge, but for duralumin, aluminium and copper, prefers the use of a carpenter's tenon saw.

After the marking out of the holes for the drilling, it is as well to use the centre punch to prevent the drill from slipping. Quite a number miss this out, as the holes do not have to be dead in place. On drilling do not take it through, but stop when the blister is just starting to break, or when the point of the drill can be seen, then turn the panel over and finish the drilling from the front; this stops any burrs being formed.

The panel is all but finished, and to get that real finish a coat of cellulose enamel is quite good, and it can be finished with some of those transfers that are on the market at the moment. But the average amateur would rather do the job the hard way and get a finish that looks good and will stand up to the rough treatment.

Steel

Steel seems to be one of the problem metals to finish: everyone seems to just paint it and leave it, to look like what it is—painted steel. Here is a simple process that will rust-proof it and give a nice finish. First clean off all the grease, either with a de-greaser such as trichlorethylene or by boiling in caustic soda solution. When this is done, very carefully polish the surface with very fine emery cloth, being careful to rub one way only. If a graining effect is required, use coarser emery and continue until the surface of the sheet is worked evenly. Then, taking care to get no grease or oil on the surface, immerse in a solution of 1oz. of copper chloride to 1 pint of water and leave for a few seconds, until the entire surface has become a nice red copper, then remove and wash under the tap for a few minutes, and dry. If the panel is a large one the solution can be applied with the aid of a piece of rag, provided the rag is kept wet. So much for the copper finish. Where a nice blue-black, metallic finish is required, immerse the panel in a solution of hypo (the ordinary photographic variety) to the strength of 2oz. to a pint of water. It should be heated before use to speed up the action. As soon as the required depth of colour is attained remove the panel from the solution and wash. This colouring process can be done with either a copper or brass panel.

Alloys

Light alloy sheeting requires a different technique, as these are usually finished in a light colour. Aluminium and duralumin can be finished a very nice matt by rubbing in one direction only with very fine emery cloth. Aluminium can, if it has a good polish to start with, be finished by immersing in a solution of lye, that is caustic potash, to the rate of 2oz. to the gallon of water. This strength will be slow-acting but will not damage the hands. The aluminium should be left in the solution for an hour or so until the surface has gone a dull white, almost like mother-of-pearl. This treatment is not suitable for duralumin as it will turn the metal black.

Having obtained a nice surface on our panel the next thing is to "sign-write" it. Ink can be used on all the finishes described after they have been washed, white ink being best for the blue-black finish.

An ordinary steel-nibbed pen can be used, and a mapping pen for very fine work, but if a really neat finish is required there is nothing to beat the Uno stencil. These can be obtained from about $\frac{1}{8}$in. upwards and are quite inexpensive. The writer uses the size 3 and 5 ($\frac{1}{4}$in. and $\frac{3}{8}$in. respectively). These should be used with the aid of a fixed straight edge.

If the panels are left in this state they will deteriorate, so they should be finished with a coat of varnish. The varnish that the writer uses is made by mixing one part of copal varnish with two parts of trichlorethylene. This is very thin and easily applied and gives protection without being noticeable; also it does not act as an ink solvent as do some other varnishes.

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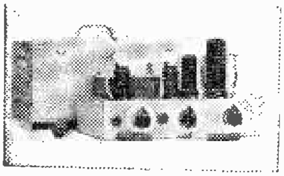

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Electronic Music

SIMPLE OSCILLATOR CIRCUITS FOR THE EXPERIMENTER

By W. J. Delaney (G2FMY)

CORRESPONDENCE resulting from the recent publication of our small electronic organ shows that there is a wide demand for the larger type of polyphonic organ. As we explained in the article referred to, an organ which will permit the playing of any number of notes at once calls for an oscillator for each note. In the simple design a single oscillator was used, but the note produced by it was changed by modifying the resistance in the grid circuit and many readers who are interested in this field of electronics have wondered why it is not possible to modify this circuit so that a full organ may be obtained.

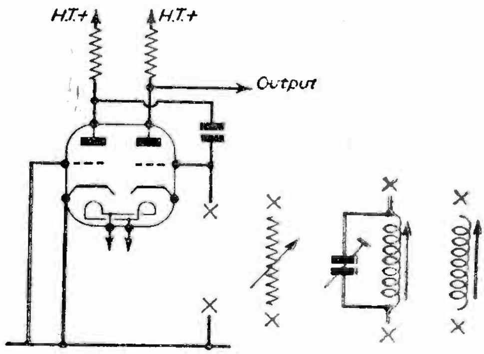


Fig. 1.—Typical oscillator stage in which the frequency can be controlled by modification in the grid circuit.

For the benefit of those to whom this is a new section of study it may be stated that the standard organ keyboard consists of 61 notes (five octaves) unlike the piano, with its usual 80-88 notes. The fundamental, or note corresponding to the key position, is known in organ language as an 8 ft. note, and based on the simple law that the frequency of an open tube is proportional to its length, the octave above a note is referred to as its 4 ft. and the octave below as its 16 ft. As the organ is usually provided with stops known as "couplers" by means of which the octave tones may be played by the operation of the normal 8 ft. key, these octave tones are sometimes referred to as 16 ft. and 4 ft. stops. Therefore, the organ will have an effective tonal range very little short of the piano, when we add the 16 ft. and 4 ft. tones of the bottom and top octaves respectively. All that we need, therefore, is an oscillator for each of 61 notes, plus a frequency multiplier to give the additional top and bottom extensions and we have the full organ range. But actually it is much simpler than that. Frequency multipliers were mentioned for the bottom and top extensions, and these may also be used to obtain other ranges on the keyboard, so that in the end we come down to the basic fact that we need only 12 oscillators—one for each note of the normal scale—and can then cover the remainder of the keyboard with frequency multipliers or dividers.

Suitable Oscillators

There are various circuits which may be employed for the oscillator, and those who are interested in television will know the variety and difficulties which are associated with the timebase circuits. The simplest arrangement is the multi-vibrator as was used in the simple organ, and this can be adopted, with fixed resistors or condensers for each note. It should be remembered that in this circuit the frequency can be altered by varying either C or R or both. Whilst this circuit is quite good it is not economical, as we have to consider also the frequency dividers. These may be self oscillators of an exactly similar type, with the C/R value adjusted to twice or half the frequency, and if they are fed from the fundamental oscillator they will automatically divide. In practice it is not quite so simple as this, as a buffer is generally required between the main oscillator and the chain of frequency dividers to avoid "pulling," and component tolerances may not enable a circuit to divide exactly. A more economical scheme utilises a single triode as "blocking oscillator," and this may be half of a double valve of the type previously referred to, the other half acting as the required buffer.

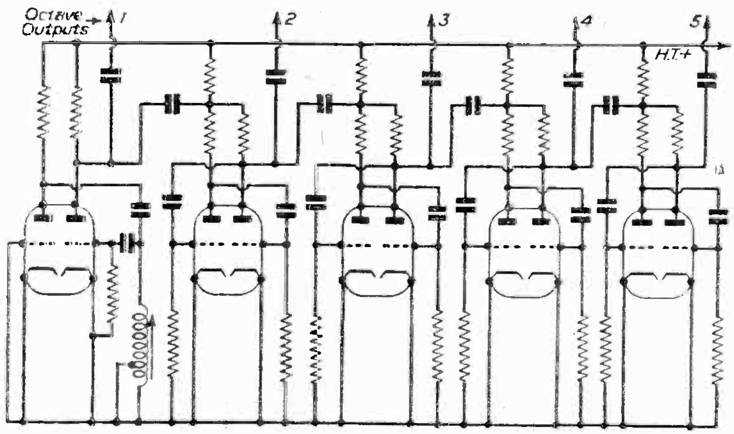


Fig. 2.—Frequency multiplier using the arrangement of Fig. 1 to produce 5 octaves.

The simplest way of getting a triode to oscillate is by means of a transformer between plate and grid, and the grid winding may be tuned to obtain the required note. This arrangement is used in the well-known American Baldwin organ, and the frequency dividers are similar, with the transformers wound on a large core which carries five windings feeding two other double triodes, and the common iron core keeps the frequency thoroughly locked, and provides a five octave generator with only three double-triodes. The main difficulty for the constructor is, of course, the winding of the special multi-transformer.

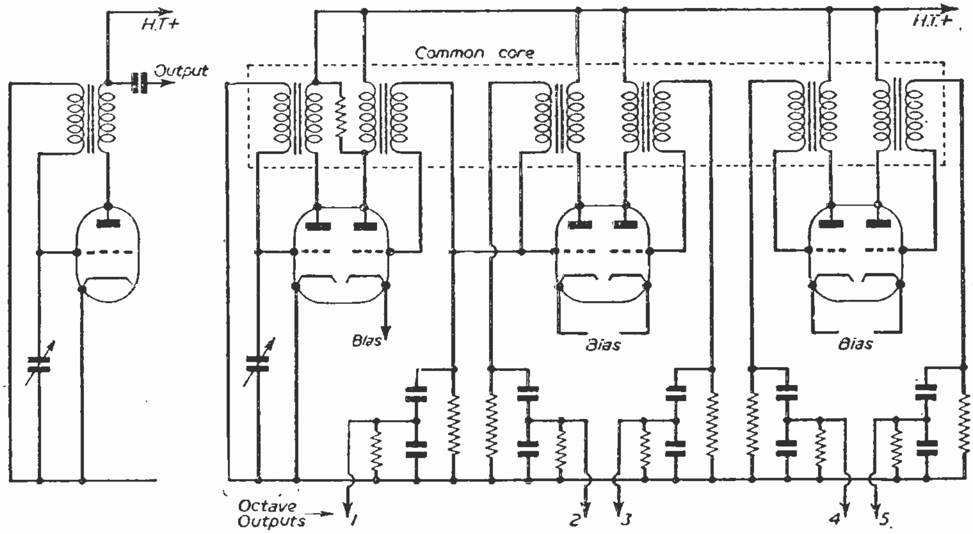


Fig. 3.—A blocking oscillator and a frequency muliplier or divider using a chain of transformers on a common core.

Simple Oscillators

For simplicity, as distinct from economy, the first type of oscillator has much to recommend it. In place of the variable grid leak a tuned circuit may be wound on a small former, with an adjustable iron core to facilitate tuning. Alternatively, a variable resistor in series with fixed values may be used, and it is then a very simple matter to adjust each additional divider or oscillator for the octave range. This scheme, however, calls for five double-triodes for a five octave range and is thus heavy in initial expense as well as on heater current. In addition it does not synchronise very easily, and as a rule each stage must be carefully adjusted. In the case of the three-valve arrangement just mentioned, if the oscillators are run properly it divides accurately due to the coupled transformers. The optimum conditions with 6SN7's operating in this circuit are found to be those obtained when the anode voltage is 11 times the cathode bias, and this 11/1 ratio must be maintained exactly for perfect working. Then, modification of the capacity across the grid winding will change the five outputs exactly—in other words, the chain will divide perfectly.

Experimental Values

For those who wish to experiment with this type of circuit the main oscillator transformer ratio should be about 6 to 1 and the others simply 1 to 1, with a fairly high inductance primary, and high value grid leak. Working voltages which have been found satisfactory are 165 volts H.T. and 15 volts for bias, and these values, as already mentioned, are critical in their ratio.

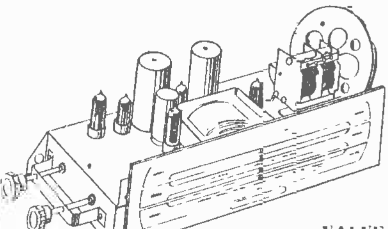
Towyn Transmitting Station

IN accordance with the previously-announced plan to improve reception of the Home Service programmes in certain areas, the BBC is building a low-power transmitting station at Towyn. As, however, the building and installation will take some considerable time to complete, it has been decided to instal a temporary transmitter in a caravan on the site so that listeners in this area may have an improved service during the present winter and much earlier than would otherwise have been possible.

The caravan transmitter was brought into service on Sunday, December 14th, and radiates the Welsh Home Service on 341 metres (881 kc/s). The power is less than that planned for the permanent station, but it is hoped that listeners in Aberystwyth, in addition to those in the Towyn and Aberdovey areas, will benefit during this temporary low-power condition. Ultimately, the station is intended to serve the areas around Cardigan Bay, from Cardigan in the south to Pwllheli in the north, but maximum coverage will not be achieved until the permanent station is in operation.

The temporary transmitter is housed in a standard four-berth caravan, which has been modified to BBC design to accommodate the transmitter and its associated apparatus.

RADIO-GRAM CHASSIS.—End drive model illustrated. Slightly soiled, but re-sprayed. 5 valve, superhet, latest pin type valves. Ext. speaker and gram. pick-up sockets. 4 watts A.F. output. Drive any low imp. P.M. speaker. PRICE £7-17-6. Complete working order (no speaker). Carr. 4/6. Also brand new front drive models. 1953. Six wave-band, £15-15-0 ; three wave, £10-19-6.



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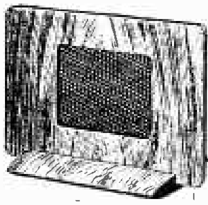
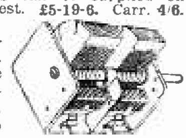
GT1C	U50	1S5	PP225	6J5	AR6
PM25	6V6G	1R5	6AB6	6J7	C2C
EY51	EF80	1T4	6B7	9D2	E1148
ECL80	6B8	EF91	6C9	SP2	VP133
VT60	PT41	10F1	77	UY41	9004
807	6L18	6F15	7B6	0Z4A	CV6
5Z4	20D1	12SG7	SP41	TT11	955



EXTENSION SPEAKERS.—Brand new 5in. P.M. speaker on latest type polished baffle stand. Gold-sprayed metal fret. 5ft. lead connected. 19/9. Also available in totally enclosed cabinet type baffle at 25/9. Post 1/9.



CONDENSERS.—Bargain offer of tuning condensers. Two gang. .0005 mfd. Standard size (soiled) and half size (Plessey, brand new). All at 2/9. Also single types at 2/9. Post 6d.

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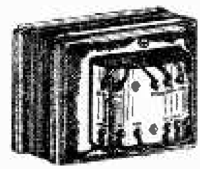

ELECTROLYTICS.—Daly, unused, 30-30 mfd., 450 vdc, 3/9 ; 32 mfd., 275 vdc, single tag, 2/9 ; 8 mfd., 350 vdc, bolt fixing, 1/9 ; 12-12 mfd., 350 vdc, 3/9. Post 6d.

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HUNTS' MIDGET MOLDSEAL CONDS.—.1 mfd. 150v., 1/6 ; .02 mfd. 150v., 1/6 ; .005 mfd. 350v., 1/6 ; .01 mfd. 350v., 1/6 ; .02 mfd. 600v., 1/2 ; .001 mfd. 350v., 1/3 ; .002 mfd. 350v., 1/3 ; Midget Electrolytics, 32-32 mfd. 250v., 2in. x 1in., 9/- ; 16 mfd. 350v., 4/-.

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FILAMENT TRANSFORMERS.—200/240v to 6.3v. 3a., 12/6 ; 200/240 v. 6.3v. 1½a., 8/6 ; 200/250v. to 3-30v. 2a., 24/-.

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T.C.C.—Picopack, 1 mfd. 350v., 2 mfd. 150v., 10 mfd. 25v., 20 mfd. 12v., 2/6 ; 100 mfd. 350v., 13/6 ; 250 mfd. 60v., 10/- ; 2,500 mfd. 3v., 6/9 ; .001 mfd. 6 kV., 6/- ; 12 kV., 10/- ; 15 kV., 10/- ; .01 mfd. 6 kV., 10/- ; .1 mfd. 7 kV. (Dubilier), 20/-.

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L.W. Break-through in S.W. Converters

CAUSE AND CURE OF AN ANNOYING FAULT

By W. Nimmons

AN annoying defect of a short-wave converter, used in conjunction with a standard broadcast set, is sometimes manifest. It may assume alarming proportions at the sensitive end of the volume control, and in some cases may completely wreck a weak short-wave station we are trying to receive.

This is long-wave break-through, manifest when the broadcast receiver is set to the long waves to receive the short-wave stations on the converter. It arises in a very simple way: the broadcast receiver picks up the long-wave stations direct and brings them forward to the loudspeaker, *in addition to* the signals which are brought forward from the converter.

At first sight it may not be clear why this is so. The converter, in the majority of cases, is fed directly into the aerial terminal of the broadcast receiver, but there is an H.F. choke in the anode circuit of the converter. See Fig. 1 and you will notice that there is a short aerial connected to the aerial terminal of the broadcast receiver: this is the wire which connects the converter to the broadcast set. This wire should be as short as possible, otherwise it will pick up the long-wave signals if the set is an efficient one at the sensitive end of the volume control.

But even if this wire is only a few inches in length the trouble still persists. Why is this? We get a clue if we remove the aerial from the converter; the break-through ceases. Therefore it would appear that the aerial, in addition to supplying the converter with short-wave signals is also supplying the broadcast receiver with long-wave signals.

There does not seem to be much that we can do to circumvent this bringing forward of long-wave signals to the specially receptive broadcast set. The signal appears to make its way actually through the converter by jumping from wire to wire by reason of the capacity existing between them. As a short-wave converter must have short, close wiring this seems to aggravate the trouble. In addition, some long-wave energy may go through the frequency-changer valve itself, appearing at the anode quite independently of the short-wave signals. For these reasons it appears impossible to prevent the unwanted signals from percolating through to the aerial terminal of the broadcast receiver.

But it need get no farther. A complete cure for this form of interference is possible.

Let us take a concrete example. Suppose Mr. A. has a four-valve A.C./D.C. broadcast receiver to which he wishes to add a converter. He accordingly builds a simple battery job which he attaches to the broadcast set's aerial terminal by means of a wire a foot long. The converter behaves indifferently, and long-wave break-through is very prevalent.

Cause

What is wrong? Simply that the signals from the converter are prevented from finding their way back to the filament of the F.C. valve. Mr. A., being conversant with the ways of A.C./D.C. sets, has neglected to provide an earth.

Cure

He can, however, get all the benefits of an earth by connecting a 1 μF condenser between the negative filament terminal (earth line) of the converter and the earth terminal of the broadcast set. A glance at Fig. 2 will make clear the implications of this: not only is a path provided for the spent H.F. energy but the aerial terminal of the broadcast receiver is effectually short-circuited as far as long-wave signals are concerned. This means that break-through is no longer prevalent, and in addition the short-wave signals come in with a punch.

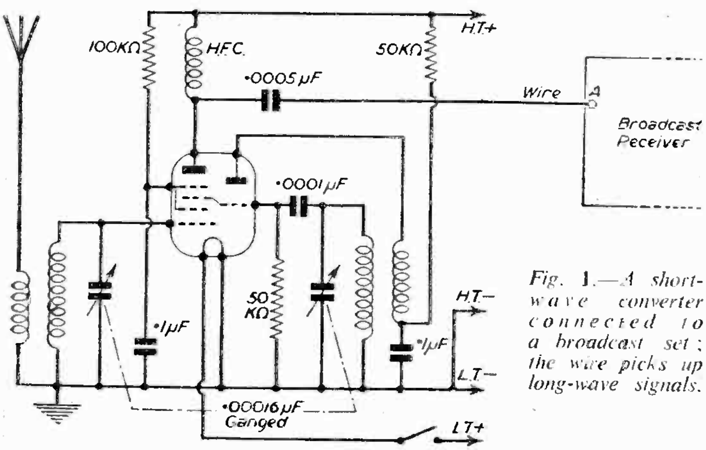


Fig. 1.—A short-wave converter connected to a broadcast set; the wire picks up long-wave signals.

Much the same sort of considerations apply when the converter uses a mains valve, as in Fig. 3. The 1 μF condenser is shown taken to cathode. Were it not for this condenser, with its straight and direct connection, the returning H.F. energy would have to go via the electric wiring! This is not an ideal way of doing things, and may lead to undesirable effects such as parasitic oscillation.

The only time a condenser is

not required is when a battery-fed converter is used in conjunction with a battery-fed broadcast receiver. Here the two sets of L.T. leads will probably go to one accumulator. If not, then it is essential to connect the negatives of the two accumulators together with a short length of wire.

It is sometimes possible, instead of using the long-wave section of the broadcast receiver, to utilise the top part of the medium-wave band. This naturally depends upon the setting of the trimmers of the converter, which must be set to give a difference between the signal and oscillator sections so that the resultant frequency falls on, say, 600 kc/s or 500 metres, instead of, say, 214.3 kc/s, or approximately 1,400 metres.

Here the same considerations apply. It is difficult to find a clear channel free from medium-wave stations at optimum settings of the volume control, unless the 1μF condenser is included between the negative line of the converter and the earth terminal of the broadcast receiver. When receiving a powerful short-wave station, of course, the volume control is kept well back and the medium-wave stations do not then intrude themselves. It is in the nature of short-wave listening, however, that the weak stations are nearly always the most interesting, and steps have to be taken to preserve them as much as possible.

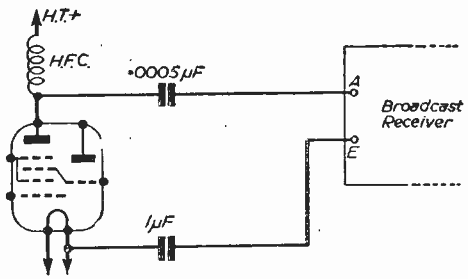


Fig. 2.—The 1.0 μF. condenser effectually prevents long-wave breakthrough.

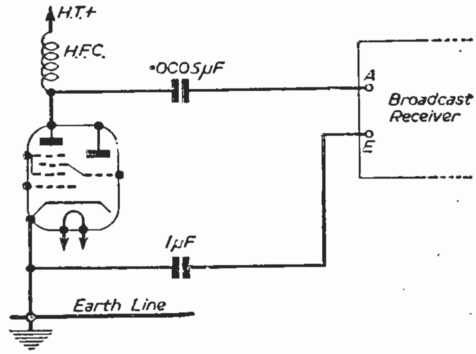


Fig. 3.—The anti-breakthrough condenser is equally effective with a mains valve.

Simple Bass and Treble Boost

A USEFUL TONE CONTROL CIRCUIT WHICH CAN BE ADDED TO ANY AMPLIFIER

By T. J. Gaunt

THE simple type of bass and treble boost described in these notes may be applied to most types of domestic receiver. The only requirement is that the receiver has the normal type of volume-control consisting of a potentiometer of about 0.5 megohm, the value not being at all critical. Very old receivers with controls on the H.F. circuits are not suitable.

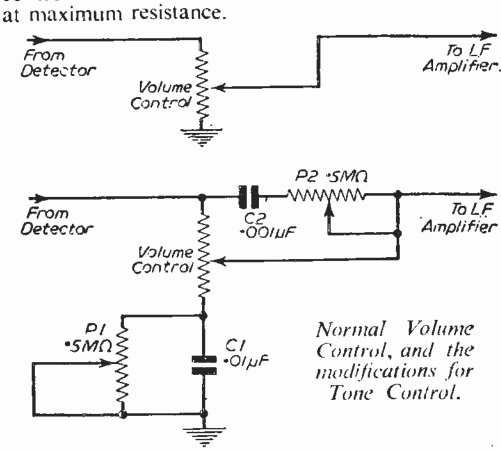
The amount of boost available will depend on the spare gain in the L.F. section of the set; in other words, the distance that the volume-control has to be advanced in order to obtain normal listening level. If the set requires almost full gain, then little boost will be available.

The circuit is very simple. For the bass boost the "earthy" end of the volume-control is disconnected and a 0.01 μF capacitor inserted, across which is a 0.5 MΩ potentiometer.

The capacitor will give a higher impedance to low frequencies and will thus be equivalent to a higher setting of the volume-control for bass frequencies only, the medium and high frequencies being little affected. At low settings of the volume-control, a very large amount of boost is obtained, and this compensates for the ear's apparent insensitivity to low frequencies at low levels, producing a very pleasant effect.

The Treble boost circuit consists of a 0.001 μF capacitor in series with a 0.5 MΩ potentiometer direct from the "top" end of the volume-control to the grid of the following valve. This forms a by-pass circuit for the high frequencies and will provide a considerable boost at low volume levels.

Both circuits are at minimum with the L.F. boost control at minimum resistance and the H.F. control at maximum resistance.



Normal Volume Control, and the modifications for Tone Control.

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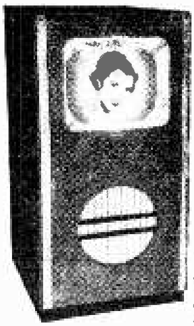

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A reprint of the data, by permission of the Editor of "Practical Television," together with some additional diagrams and notes produced by our Television engineers are available as a constructor's envelope. Price 5/-, post free.

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Thus its owner will become independent of B.B.C. transmissions and can fault find or test at any time. It operates entirely from A.C. mains and is quite suitable for use with superhet or straight receivers.

A complete kit of parts (in fact everything except the cabinet), with full constructional and operational data will be supplied for 29/6, plus 2/6 post and insurance; alternatively data is available separately, price 2/6 (credited if you buy the kit later).

NOTE.—Cabinets as per the illustrated prototype will be available shortly.

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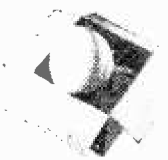

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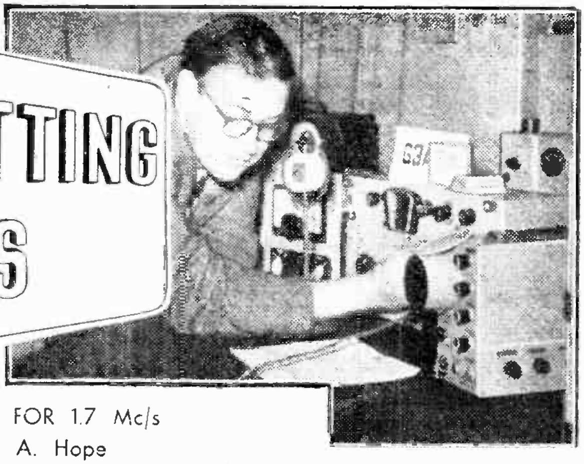


EXCITER UNIT FOR 1.7 Mc/s

By Wm. A. Hope

AT some time or another the amateur is faced with T.V.I. problems concerning his master oscillator or later stages in the transmitter. Because of the existing frequency relationship between the "top-band" and the TV frequencies, harmonic radiations must be eliminated at all costs. The author is a strong believer in that prevention of harmonic radiation is better than cure; so, with T.V.I. in mind, this exciter was built to investigate its possibilities from an amateur viewpoint.

Theoretical Aspects

From Fig. 1, which is a block diagram of the unit, it will be seen that V1 is a continuously running Clapp oscillator, which is variable over a frequency of 1,250-1,500 kc/s. This range is obtained by using one of the Denco coils, Range 2, in the Denco catalogue. V2 is a conventional Pierce C.O. running at a frequency of 500 kc/s. This type of crystal was obtained, at a cost of 7s. 6d. It is of the Western Electric type, having an FT243 holder with ½in. spacing. These crystals are of the highest standard, and should be used wherever possible. Provision is also made for keying the C.O. by the insertion of a self-shorting jack in the cathode circuit of V2.

The Clapp and C.O. frequencies are now fed into valve V3, where they are mixed and a frequency, equal to their sum, is obtained at the anode of the 6AG5 valve (V3). Wide-band couplers are used to couple both the oscillators to the EL91 buffer and driver stages. These can be of the Labgear type E5018, which cover 1,700-2,000 kc/s.

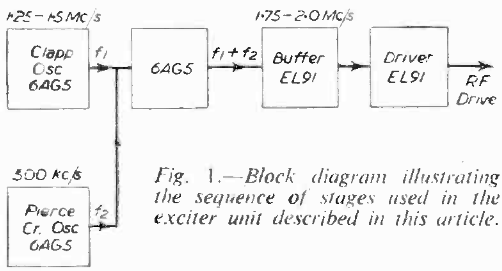


Fig. 1.—Block diagram illustrating the sequence of stages used in the exciter unit described in this article.

Details, however, are given for the construction of the wide-band couplers as used by the author. The EL91 valve gives an R.F. output of approximately 2-3 watts with 250 volts on its anode. This is obviously enough drive for any medium-power amateur transmitter, and should provide enough R.F. to drive a single 813 P.A. The anode circuit of V5 is metered to give an indication of the point of resonance of the tank circuit.

Construction

The Clapp Oscillator

The components used in this unit should be of a reliable make, and should be tested before construction is commenced. It is of the utmost importance that all components be reliable in order to ensure that the Clapp operates correctly. Wherever possible, temperature compensated condensers should be used. The Denco coil may have to have its iron-dust core removed, as it was found that its presence impaired the note of the Clapp. The Clapp circuit is totally enclosed, like the C.O., by metal screening; and, for optimum results, the Denco coil should be equidistant from the sides of the screening compartment. If this is not possible, care should be taken not to

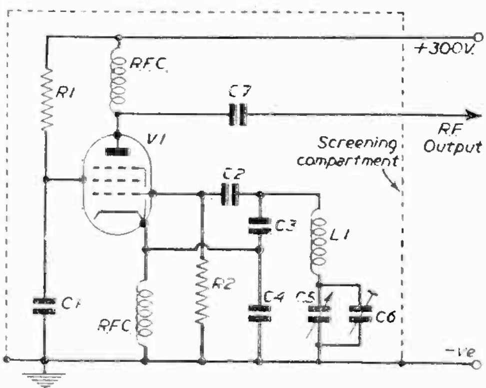


Fig. 2.—Clapp oscillator unit.

place the coil any nearer than ¾in. from the metal screening.

The Pierce C.O.

This circuit, being conventional, did not present any difficulties; and, if extreme care is taken in its construction, it should operate satisfactorily. If a "stubborn" crystal is employed and no oscillations are obtained, C9, the 100 pF. trimmer, should be adjusted until its capacity allows oscillations to commence. This, however, should be unnecessary as most crystals will oscillate freely when used in this type of circuit.

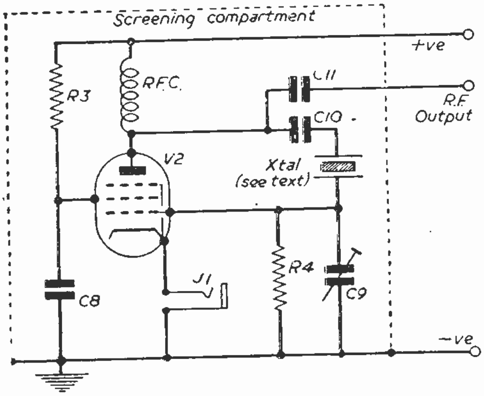


Fig. 3.—Pierce C.O. circuit.

Wide-band Couplers

The author used two ex-Govt. I.F. transformers with a 1in. former. The existing windings were removed together with all decoupling resistor and condensers contained therein. Ninety-five turns of 30 s.w.g. wire were wound on for both sets of coils, leaving 1in. between each pair of coils. The coils should be dipped in boiling wax to keep them free from movement. Across each winding was wired a 30 pF. trimmer. Fig. 5 will clarify this. It may be necessary to vary the positions of the coils in relation to one another, but the author did not find this necessary in his case.

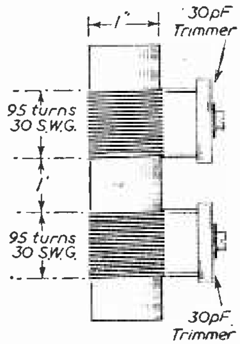


Fig. 5.—Wide-band coupler data.

The Tank Circuit

The tank coil, L5, was wound on a 2½in. diameter former made of ceramic, and consisted of 50 turns of 20 s.w.g. enamelled wire with three turns for the coupling coil, L6. 100 pF. were found to tune the tank coil to resonance.

Power Pack

This unit was exactly the same as that used by the author in the five-band V.F.O. unit described recently. Stabilisation of the H.T. supply being essential.

Setting Up

After all the wiring has been checked, the valve heaters should be switched on and allowed to settle down to their operating temperature. The services of the station Rx are now required to test the Clapp and crystal oscillators. The H.T. should be switched on and the station receiver tuned to the centre of the "top-band," i.e., 1,807.5 kc/s. The Clapp oscillator tuning condenser should be set to half capacity, and its associated trimmer adjusted until the oscillatory note of the exciter is heard on the receiver with the B.F.O. on. The constructor must now ensure that the exciter will cover the entire "top-band" from

(*Concluded on page* 101.)

LIST OF COMPONENTS

R1—10 K Ω ¼W.
R2—100 K Ω ¼W.
R3, R4 } 100 K Ω ½ W.
R5—100 K Ω ½ W.
R6—10 K Ω ½ W.
R7—200 ohms.
R8—50 K Ω ½ W.
R9—5 K Ω ½ W.
R10—650 ohms.
R11—2.2 Megohms.
R12—450 K Ω
M1—0-50 mA.
R.F.C.—Eddystone R.F. choke Type 1010
L1-L6—See text
C1—.01 μF. paper
C2—100 pF. mica.
C3—.002 μF. paper.
C4—.002 μF. paper.
C5—100 pF. max. variable.
C6—30 pF. trimmer.
C7—50 pF. paper.
C8—.01 μF. paper.
C9—100 pF. trimmer.
C10—100 pF. paper.
C11—50 pF. paper.

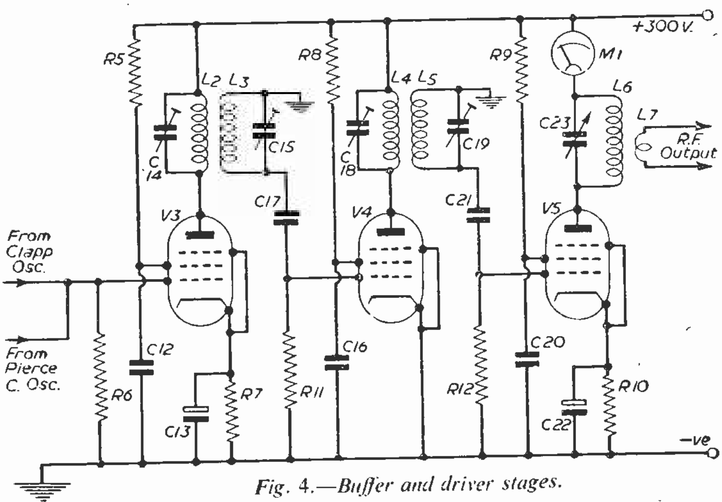
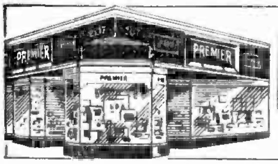


Fig. 4.—Buffer and driver stages.

C12—.01 μF. paper.
C13—10 μF.
C14, C15 } 30 pF. trimmer.
C16—.01 μF. paper.
C17—50 pF. paper.
C18, C19 } 30 pF. trimmer.
C20—.01 μF. paper.
C21—50 pF. paper.
C22—10 μF.
C23—100 pF. variable.



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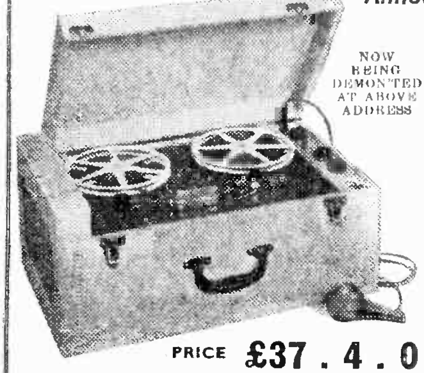

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Twin-gang and Pair of L. and M. T.R.F. Coils with circuit to suit above, 8/6.

Standard Wave-change Switches. 6-pole 3-way, 2/- ; 4-pole 3-way **1/9** ; 5-pole 3-way, **1/9**. Miniature 3-pole 4-way, 2-pole 5-way, 4-pole 3-way, 2/6.

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Twin-gang .0005 Tuning Condensers, 5/-. With trimmers, 7/6.

Midget .00037 dust cover and trimmers, 8/6.

P.M. SPEAKERS	with trans.	less trans.
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Post and packing on each of the above, **1/-** extra.

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Constructor's Parcel, comprising chassis 8in. x 4in. x 1½in., with speaker and valveholder cut-outs, 5in. P.M. speaker with transformer, twin gang with trimmers, pair T.R.F. coils long and medium, iron cored, four valveholders, 20 K. volume control and wave-change switch, 23/-, post and packing, 1/6.

Output Transformers. Standard type 5,000-ohms imp., 2-ohms speech coil, **4/9** ; Miniature type 42-1, **3/3**. Multiratio 3,500, 7,000 and 14,000 2 ohms speech coil, price **5/6**. 10-watt push-pull 6v6 matching 2 ohms speech coil, 7/-.

Mains transformers, primary 200-250 v. 280-0-280, 250 mA., 6 v. 6 amp., 5 v. 3 amp., drop-through, **29/6**. P. & P., 3/-.

Mains Trans. Pri., 200-250 v. Sec., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps., 13/-. P. & P., 1/6.

300-0-300 100 mA., 6 v. 3 amp., 5 v. **2** amp., **25/-**.

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Semi-shrouded, drop-through, 280-0-280, 80 mA., 4 v. 6 amp. 4 v. 2 amp., 12/6.

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350-0-350. 120 mA., 4 v. 4 amp., 4 v. 3 amp., drop-through, **21/-.**

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250-0-250, 60 mA., 6 v. 3 amp., 12/6.

250-0-250. 80 mA., **6** v. **4** amp., **14/-.**

Pri. 230 v. Sec. 200-0-200 35 mA., 6 v. 1 amp., 1 amp., **8/6.**

Heater Transformer, Pri. 230-250 v. 6 v. 1½ amp., 6/- ; 2 v. 2½ amp., **5/-**. P. & P. each 1/-. 2, 4, or 6 volt 2 amp., 7/6.

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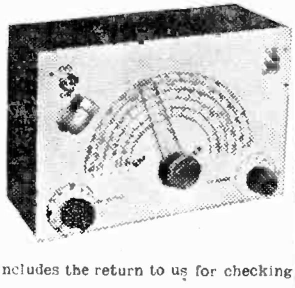

Kit of parts for Signal generator. Coverage 110 Kcs.-320 Kcs., 320 Kcs.-900Kcs., 900 Kcs.-2.7 Mcs., 2.75 Mcs.-8.5 Mcs., 8.5 Mcs.-20 Mcs. Metal case 10in. x 6¾in. x 4¼in., size of scale 6½in. x 3½in. 2 valves and 1 rectifier valve. A.C. mains 230/250. Internal modulation 400 cps. to a depth of 30 per cent. Frequency calibration accuracy plus or minus 1 per cent. Modulated or unmodulated R.F. output continuously variable 100 milivolts. **£3/10/0.** P. & P. 4/-. Circuit diagram and point-to-point, 3/6. This includes the return to us for checking and calibration.

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(*Continued from page* 98.)

1,715-2,000 kc/s. If it does not, the 30 pF. trimmer must be adjusted until complete coverage is obtained. After the oscillators have been checked, we can now go on to setting up the tank circuit of V5. With both oscillators running at a frequency of, say, 1,800 kc/s, rotate the tank capacitor slowly until a pronounced current "dip" is shown on the milliammeter in the anode circuit. At a certain setting, a small "dip" will be observed, but this should be ignored as this "dip" is obtained at the second harmonic frequency. Each time the exciter frequency is altered, the tank capacitor must be tuned until the "dip" is obtained. If temperature-compensated condensers are not used, some frequency drift is likely to occur. Because of this, about half an hour should be allowed for the frequency of the exciter to settle down, before being switched to the transmitter input. The exciter can be used as a low-power transmitter on "160" giving an output of 2 watts or so to the aerial. When used in conjunction with the main transmitter, the exciter should be coupled to it by a short length of 80 ohm co-axial cable. Frequency multiplication can, of course, be used in the later stages of the transmitter in order to cover the higher amateur frequencies. In conclusion, the author would like to state that the note obtained from this unit appeared to be very stable and should be of great value to the amateur living in a densely populated TV locality who wishes to work during TV hours.

25 years of Photo-electric Equipment

RADIOVISOR PARENT LTD., have recently celebrated their twenty-fifth year as designers and manufacturers of photo-electric equipment. They were the first company to develop industrial photo-cell applications in this country, and in 1927 patented the first really practical commercial light-sensitive cell. This offered very definite improvements over anything known at that time. It is interesting to recall that in those early days the thermionic valve was in its infancy and an indirectly-heated A.C. valve was not then commercially obtainable.

Naturally, there was reluctance on the part of engineers to adopt light-actuated control equipment, and they were not at all anxious to use thermionic valves because they were convinced that these were too fragile for engineering purposes. In contrast to this outlook, it is interesting to note how many valves are fitted into present-day aircraft: for instance, approximately 400 valves of various types are used in the modern bomber. Because of this earlier opposition, Radiovisor Parent Ltd. expended considerable effort and showed much ingenuity in developing sensitive relays that would operate directly from light-sensitive cells. These relays operated on current changes as small as 30 micro-amps, and some idea of the success obtained is gained from the fact that items of this earlier equipment are still in use to-day, having given continuous service for over 20 years. The first light-sensitive street lighting unit employed these relays, and considerable numbers were installed on lamp-posts all over the country.

To-day, thousands of street lamps are fitted with photo-electric lighting controls which switch on the lighting at dusk and off at dawn.

The company also produced the first industrial smoke-density indicator, the original unit being installed in 1930. Gradually power stations began fitting this valuable aid to combustion efficiency, and units which were installed in the early 1930's are still in use. Now, of course, the smoke indicator is regarded as a standard part of power-house equipment.

To-day there is hardly any industry that does not employ photo-electric equipment, and the reliability placed on this form of control gear is shown, for instance, by the countless number of oil-fired boilers which rely on photo-electric Flamestats for protection against flame failure.

Luton Airport Control Tower

THE decision to construct a new control tower at Luton Municipal Airport was an outcome of the necessity to keep abreast of air traffic control requirements which have resulted from the development of modern aircraft.

The control tower in use before the completion of the new building was found to be too small to give adequate protection and safe landing instructions to the aircraft making use of the airfield. It was also badly sited and did not allow sufficient coverage for landing and take-offs.

The new tower in its present location has a commanding view of the entire airfield and, even more important, gives a full view of the approach to all landing runs. It is four storeys high, has an overall height to roof level of 52ft. 6ins., the height of the control room above ground level being 42ft.

On the third floor is an equipment room where the main V.H.F. R/T equipment is housed. Also in this room is a standby battery plant which comes into operation automatically should there be any failure in the general main supply of power to the control tower.

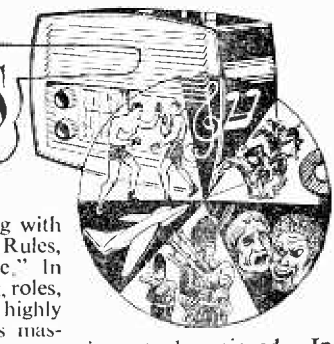
In the control room, at the top, there is transmitting and receiving equipment for V.H.F. R/T, as well as a Marconi AD.200 V.H.F. D/F apparatus, together with telephones, crash alarms, wind speed and direction indicators, all of which equipment has been built into the Control Officer's desk which faces directly on to the airfield.

The building was designed in the Borough Engineer's Department of the Corporation. The control room window is arranged so as to eliminate any possibility of reflection when night flying equipment is in use. By spraying the ceiling of the control room with tinted Pyrok, day glare has been cut down and at the same time provides acoustic insulation.

The wireless aerials for the V.H.F. R/T communication and the equipment for the wind speed and direction indicators have been erected on the roof of the tower. Both services are erected on a steel mast, the aerial leads together with wind speed and direction cables passing through the centre of the mast into the duct provided on the control room floor and equipment room.

From the control room floor, exit doors are provided to each side of a balcony which extends round the entire control room. It is of concrete construction.

Programme Pointers



By MAURICE REEVE

A New Alphabet

THE late Bernard Shaw, amongst many bees kept in his bonnet, had one with a particularly vicious sting in it: a new alphabet, the sole object of which was to save time in reading and paper in writing it. So much so that he left the bulk of his considerable fortune to its launching and establishment, a day which, happily, still seems a long way off.

Shaw's error, it seems to me, was in thinking that these objectives could best be reached by shortening the lengths of most of our words (whilst himself never writing in his new alphabet, he abolished the personal use of the vowel "u" and always wrote "labor," "favor," etc.; a start, perhaps ?), instead of by the much more direct and practical method of drastically pruning what we write, and cutting out all quite useless repetitions and verbiage which only clutters up the printed page and serves no useful purpose whatever.

What a golden chance the BBC has of doing this with the *spoken* word! How greatly our programmes could be jacked-up and given a much-needed added sparkle, individual items lengthened and time even found for extra ones. Weather forecasts repeated four and five times in twenty minutes. And fourteen of a fifteen-minute news bulletin repeated, three hours later, word for word. Also the reciting of endless names—cast, producer, adapter, director, arranger, conductor, etc., etc.—at the end of the shortest production, when a copy of the *Radio Times*, with it all in, rests on practically every radio set in the kingdom. All this undergrowth should be hacked out of our programmes with a billhook as ruthlessly as our fields and hedgerows are every autumn. If it were, we should hardly recognise our broadcast service, so much greater would be the freshness and spontaneity of everything that it put over.

I have raised this subject before, and most likely will again. I do not apologise for being repetitive or for committing a fault I deprecate in others.

Reith Lectures

The Reith Lectures are with us again, and the current series, "The World and the West," given by Arnold Toynbee, looks like coming in a good second to Bertrand Russell's memorable set. Prof. Toynbee's opening address, "Russia," was as brilliant an exposition of objective thinking as one could wish for. All the "undergrowth" of this vexing question was as mercilessly cut away as I have just suggested should be done with programmes generally; consequently we were shown the bare and unvarnished facts of the issue, as rare an experience as it was refreshing.

Plays

It was once more a pleasure to hear Leslie Perrins in two worth while parts, as Judge Bruck in "Hedda Gabler," and as a narrator in the very interesting programme dealing with the McNaughton Rules, "Guilty but Insane." In both, very differing, roles, Mr. Perrins was highly successful. Ibsen's masterpiece is always an experience to be enjoyed. In this case it was the personal choice of Constance Cummings in the "Curtain Up" series, and she sounded wholly delightful in the title role. Hugh Burdon, Elizabeth London and others contributed to the success of the evening.

"Hassan," "The Pelican," "The Liars," "Dolly Reforming Herself" (both these by Henry Arthur Jones), "The Barratts of Wimpole St.," and "The Wind of Heaven" were done in the excellent English Theatre 1900-1950 series. Of them all I preferred "Hassan" and the two Jones's comedies and thought them by far the most worth doing.

"Hassan" is a gorgeous verbal pageant which conjure up the sensuous and exciting Middle East for us in almost every line. How well I can remember Henry Ainley in the original production at His Majesty's. On the present occasion a long cast was headed by Arthur Young with Alan Wheatley, Leon Quartermain, Edmund Willard, Dorothy Primrose and Mary Wimbush in close attendance. Of all our great contribution, as a nation, to the stage in the last 50 years, Flecker's masterpiece would seem likely to be one of the first choice for a similar series 50 years hence.

H. A. Jones was a brilliant playwright, and his comedies are among the best constructed pieces in the repertory. But he wrote not for all time, but for a day; consequently, like his ladies and his sets, he is out of fashion. His peers wrote of the things that last. But if we moved back the clock—a process the great dramatists don't demand of us—and transported ourselves back to Jones's world. "The Liars" and "Dolly Reforming Herself" provided two delightful evenings.

"Rutherford and Son," by Githa Southerby, though not a great play, comes much nearer real life and the fundamental emotions. It is strong meat, of which Frank Pettingell and his fellow workers took full advantage.

Wilfred Pickles

It doesn't seem to me that Wilfred Pickles' "May I come In" series can compare with "Have a Go" for spontaneous wit, warm and cosy atmosphere or general worth-whileness. Pickles was such a master at exploiting the opportunities the "Have a Go" audiences constantly offered him. All that side of his personality has had to be scrapped for the current shows, and a bare, bleak knock on a front door followed by a cold, though pleasant enough "Good Morning, I'm Wilfred Pickles," is no substitute for the roars of laughter that used to overflow from village halls into our own parlours.

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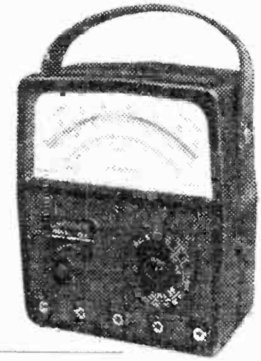

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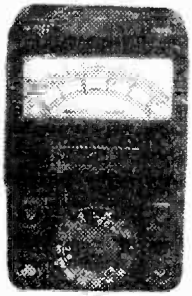

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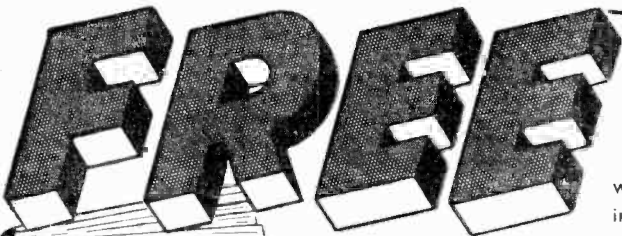

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OPEN TO DISCUSSION

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).

Mini-Four Results

SIR,—Having built several portable wireless sets over the last few years, it was with great interest I read the article in your journal showing the construction of the "Mini-Four." I have since built this portable, with excellent results, and have added the following refinements which may be of interest. I must add, in passing, that these ideas in no way change the wiring or layout of the chassis.

The set was turned through 90 deg. and a small hole (3/16 in. dia.) drilled, level with the hole in the front metal panel, through the wooden case, ¾ in. to the right of the station selector knob. This is plugged with a small rubber moulding, such as can be found in the neck of most small scent bottles. This can hardly be seen against the leather of the case, and is very useful for tuning the coils when the set is built up.

I have found it is difficult to tune the set correctly in the chassis form, as the case can alter the tone quite a lot. Secondly, I have incorporated a small extension aerial in the case. For this I use a 3 ft. metal flexible rule. The metal case is tinned with solder, and a small length of insulated wire attached. This case is insulated by dropping into a small case (a "Ronson" lighter fabric case is ideal) with a small slit for the rule to protrude. This assembly can just be fitted in between the O/P transformer, case and below the battery. A small slot cut in the wooden case to take the rule is now cut and the rule pushed through. A small metal strip can be made to neaten up the case. The wire is now attached to the aerial contact on the coil unit (green). The set is now fitted with an aerial, which can be extended to a full 2 ft. 6 ins. without whip, or shut right down if not needed. This saves having to carry lengths of wire around with the set, and has proved very effective in use.

A little emery and elbow grease applied to the rule will soon remove the figures if desired. I have also a small frame aerial built into the back panel.

I do hope these small suggestions will be of interest as they have proved their worth. I look forward to building your "attaché-case portable" in the January issue, so please extend my thanks to your excellent staff for an interesting design and article.—J. M. ESCOTT (E.5).

Correspondent Wanted

SIR,—I am a regular reader of PRACTICAL WIRELESS and I would like to get in touch with a fellow reader who possesses an ex-W.D. test set No. 18.—JOHN R. EVANS, "Tana," 92, Albert Road, Dalmuir, nr. Glasgow.

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

Audio Problems

SIR,—I feel the writer of "The Audio Problem" in January issue is somewhat off the rails in his references to high-quality amplifiers. One of the most troublesome forms of distortion from the discerning listener's point of view is that of the harmonic variety which manifests itself as a buzz or chatter sounding almost as if the joint between speech coil and cone is faulty. Invariably the better the speaker the more pronounced the distortion with any given receiver. This type of distortion is negligible with amplifiers of the Williamson type, and the addition of tone control circuits in front of the main amplifier enables it to be used under low volume conditions and still satisfy the aesthetic demands of the most critical listener as regards reproduction at the extreme ends of the audio frequency spectrum.

To suggest, however, that an improvement in reproduction may be obtained by removing the furniture, which may be correct in relation to the losses suffered by frequency absorption, is ridiculous when applied to harmonic distortion.

The distortion content of the Williamson amplifier is actually less when working below maximum output.—E. D. BROCK (Birmingham).

Bad Trading

SIR,—A friend of mine recently bought a four-valve battery set from a well-known radio shop. Some time later it developed a fault and, on returning it to the shop, he was told that all four valves had gone and that the cost of replacement would be £4 15s. Naturally, he did not wish to pay this large amount and, knowing I was an amateur, he brought the radio to me.

When I examined it I found that only one valve had gone—total cost eleven shillings. He now has the set back in working order.

Cannot this sort of thing be stopped? It's bad enough with increased prices without being cheated at every corner.—NIGEL RUSH (Thetford).

TV Harmonic?

SIR,—I have a U.S.N. receiver type CRV46156 and discovered that on the 14.3-23 Mc/s waveband, with the tuning condenser at the halfway setting, I get TV reception.

After a few calculations I found the frequency to be 18.65 Mc/s—this is no harmonic of any TV transmissions.

I am wondering if any readers of your grand magazine have any theories about this.

If so I should be glad to hear from them.—J. LAW (Gillingham).

Fair Play for the Customer

SIR,—Immense opportunities now exist for radio service technicians; with the ever-increasing cost in new receivers, coupled with price increases in almost every field, the average listener now realises that his old receiver when repaired by a reliable dealer will assure him of many years' pleasurable listening.

Much vicious propaganda has been circulated (both during and after the war) about the radio repair trade, to the effect that customers are being "taken for a ride."

Whilst it must be admitted that the radio man is in business first and foremost to make money, we all know that once a man or firm gets a reputation of finding that every set passing through the test bench requires new valves and a complete overhaul at a high price—the word does get around and a bad reputation certainly sticks!

Golden rules exist for success in servicing, whether it be on a large or small scale.

1. A sound radio knowledge, preferably obtained by the appropriate course of study to City and Guilds Final Radio Certificate. 2. A good knowledge of metal work and workshop practice. 3. Intelligent work. 4. A sense of fair play and honesty and, above a l, a clean appearance. This goes a long way to help matters and give a good impression of the business.

Should a set be brought in with, say, one valve completely u/s and a further valve past its best, but still working, you should "sell" the second valve to your client, tell him what was wrong and let him hear the set with and without the second valve, advising him that it would be desirable to effect the complete repair. In most cases he will take the set as it is, with the new valve, rather than suffer further inconvenience at a later date, by which time the cost of the second valve may have increased!

There is one thing that sounds sweet to a customer's ear—namely, his own name—even if it is a year or more since he last entered your shop—it's another key to success as people like to do business where they feel their custom is appreciated—above all be sincere.

Honesty and friendliness above even technical knowledge will be your passport to success, you will find that work becomes more pleasant—you will have a bigger concern and a host of satisfied customers.—A. E. COLEMAN (Edinburgh).

Electronic Organ Modification

SIR,—I must thank you for such an interesting article, the PRACTICAL WIRELESS Electronic Organ.

In my opinion I don't think anyone has noticed the most obvious way of extending the keyboard. This is my idea.

Taking the organ as it is with the octave switch in the central position (tenor) we use C5 and C6; when it is switched to bass resistances A to L will now be playing an octave lower through C7 and C8 and, again, when switched to soprano resistances M to X will be an octave higher through C4.

It should now be possible to connect the actual two-octave keyboard (Ra to Rx) permanently to C5 and C6, add another octave (Ra to Rl) to C7 and C8 and Rm to Rx to C4.

That, if I am not mistaken, should produce a four-octave keyboard without the need of the octave switch.

To tune I would start with the soprano octave, then the tenor, and finally the bass, dealing with each section separately but in the manner you give for the original keyboard.—J. E. McGRORY (Aberdeen).

A Comprehensive Signal Tracer

(Continued from page 85.)

should be screened one from the other. The instrument was built to fit into a cabinet measuring 10in. × 7in. × 5in. internally, and the layout, as will be seen from the photographs, is somewhat cramped, and necessitates the use of miniature valves for V1 and V2. With more space at the disposal of the constructor, V1 and V2 could be respectively EF39 or 6K7 and EF50 or 6AC7. The use of a high gm pentode is, in any case, recommended for V2 to permit the gain to be maintained up to higher frequencies.

The general appearance of the finished instrument may be judged from the illustrations. The input test lead is of coaxial cable, and may terminate either in crocodile clips, or in a suitable test prod.

In place of the thermovoltmeter described, it is possible to fit a low-sensitivity moving-iron voltmeter having a full-scale reading of anything from 50 to 100 volts. The resistance of such an instrument will generally be suitably low enough to load the output stage without the addition of any other loading resistor, and the meter may thus be connected in exactly the same manner as the thermal meter specified.

The other alternative is the fitting of a moving-coil milliameter and rectifier. The best method in this case is to construct the meter, using a suitable series resistor and rectifier, to make an A.C. voltmeter reading about 75 volts full scale, and then shunt this meter with a resistor of such a value that the combined resistance of meter and resistor is equal to the optimum load of the output valve. The method of connection is shown in Fig. 2.

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