MAKING A FAULT-FINDER

1/-

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APRIL, 1952

EDITOR:
F. J. CAMM

PRACTICAL WIRELESS

THE
MINI-FOUR
FURTHER CONSTRUCTIONAL DETAILS

IN THIS ISSUE

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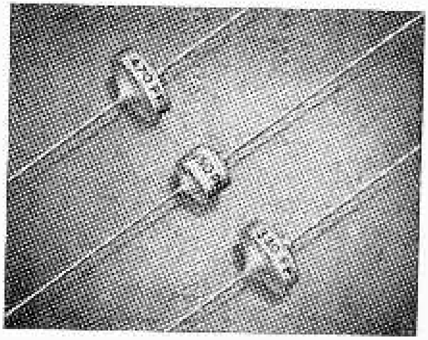
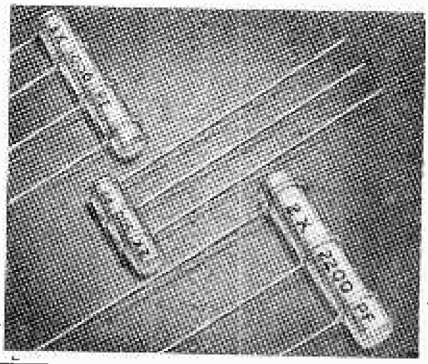
D.C. EQUIPMENT
SURPLUS ACORN VALVES
SHORT-WAVE SECTION
HARMONIC CRYSTAL OSCILLATORS
A SIMPLE PHASE INVERTER





Practical Wireless

EVERY MONTH
VOL. XXVIII. No. 546 APRIL, 1952

Editor F. J. CAMM

20th YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

ENORMOUS DEMAND FOR THE MINI-FOUR

THE demand for last month's issue containing our free 1s. blueprint of the Mini-four midget portable was so great that the issue was completely sold out on the day of publication, notwithstanding a greatly increased printing order. Many readers who failed to place an order with their newsagent, as advised, failed to secure copies, and this has caused many would-be readers to be disappointed. Owing to the paper position reprinting the issue is out of the question, so we have decided to reprint the blueprint of the Mini-four, and also the articles dealing with its construction, and readers may obtain copies of the blueprint, together with the instructions, for 1s.

When this stock has been exhausted the blueprint will take its place in our blueprint list and be sold in the ordinary way.

THE PT "ARGUS"

THE March issue of our companion journal, *Practical Television*, contains a free gift blueprint of a 21-valve television receiver which can be built for approximately £20. It makes use of one of the surplus 6in. cathode-ray tubes which are readily available from our advertisers. This receiver will enable thousands of people who cannot afford to purchase a commercial TV receiver, nor afford to buy the parts for the *Practical Television* receiver described in our 3s. 6d. booklet, to enjoy the benefits of viewing.

IS LISTENING ON THE DECLINE?

THE ever increasing number of viewers has inspired discussion in the daily papers as to whether the number of listeners is steadily decreasing. One newspaper likened the blind broadcast to the steam engine era and to the silent films, but there is nothing to prove that listening is really on the decline. People are still compelled to have both a broadcast receiver and a TV receiver, and whilst it may be true that there is less listening in the evening when a home is equipped with TV, it cannot be deduced from that undeniable fact that less people are listening.

No doubt when a TV network covers the country and people are able more easily and cheaply to purchase TV receivers, there will be some readjustment of the broadcast programmes, and perhaps a diminution in the time allocated to them. But that time is not yet. The financial policy of the country is deliberately designed to make the purchase of a television receiver difficult to all except those in higher wage-earning classes. Purchase Tax of 66⅔ per cent. makes TV something of a luxury. That is why tens of thousands of people are now building their own. Certainly the number of broadcast licences continues month by month to rise, and the number of people interested in set construction is daily on the increase, as the sales of our blueprints show.

STANDARDISATION

ONE of our regular contributors who criticised standardisation in a recent issue has drawn a reply from the chairman of the R.I.C. Standardisation Committee. We have published his letter this month in our correspondence pages. The chairman is of the belief that the people best able to create standards are those engaged in the industry itself. Very true, but they should only be entitled to do so in collaboration with the British Standards Institution. Otherwise what is the purpose of the B.S.I.? If every industry created its own standards the very confusion which the creation of the B.S.I. was intended to remove would reappear. It is not only the radio industry which is concerned in its standards. Supporting industries need to be consulted, too, and the best method of securing liaison between all industries likely to be affected by the inauguration of a new standard is the British Standards Institution. The radio industry is not a self-contained industry, it must be remembered.

If we have any criticism of the B.S.I. at all it is that it does not set a date line on its standards. New standards cannot be adopted by industry overnight and engineering reference books cannot be brought up to date month by month. When a new standard is introduced at least one year should elapse before its adoption.—F.J.C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended December 31st, 1951.

Region	*Number*
London Postal ..	2,364,000
Home Counties ..	1,669,000
Midland	1,759,000
North-eastern	1,956,000
North-western ..	1,654,000
South-western ..	1,081,000
Welsh and Border Counties	738,000
Total England & Wales	11,221,000
Scotland	1,117,000
Northern Ireland ..	210,000
Grand Total	12,548,000

Report Ordered

IN Sunderland recently Mr. Richard Ewart, Labour M.P. for Sunderland South, announced that the Postmaster-General has called for a report and survey on the BBC wavelength which is shared by listeners in the Northern Region and Northern Ireland (261 m., 1,151 kc/s).

When the report has been prepared, a deputation from the Northern Group of M.P.s is expected to be asked to express their views.

The report was ordered after complaints had been received from the North that too large a proportion of the programmes covered subjects of interest only to Northern Ireland listeners.

Cossor Fire

COSSOR, LTD. state that the fire at their Glasgow depot recently has not affected their dealing with all orders and supplies without delay.

There will be a slight hold-up on service work for a time.

E.M.I. Employees' Successes

TWO junior engineers of E.M.I. Engineering Development, Ltd. have achieved distinction in the Higher National Certificate Examination in Electrical Engineering.

The Institution of Electrical Engineers has awarded the Page Prize to E. R. Robson, who is engaged on electrical transformer work. The Page Prize is awarded to the best candidate obtaining distinctions in all the compulsory subjects of the Final year of the Higher National Certificate in Electrical Engineering.

D. H. Pentelow, engaged on the design of specialised test apparatus, has been awarded an Institution Prize by the I.E.E. for outstanding merit in the Final year of the Higher National Certificate in Electrical Engineering.

Drop in Complaints

THERE was a drop of almost 10 per cent. in the number of complaints received last year by the Cardiff area of the G.P.O. Wireless Interference Investigation Service, which covers Glamorgan and parts of Monmouthshire and Breconshire.

The figures were: 1,313 in 1951 and 1,452 during 1950.

About 40 per cent. of the complaints were due to two main causes—bad aerial and earth systems (26 per cent.) and faults in the sets themselves.

Record Radio Export

ALL existing export records for the radio industry were broken last year.

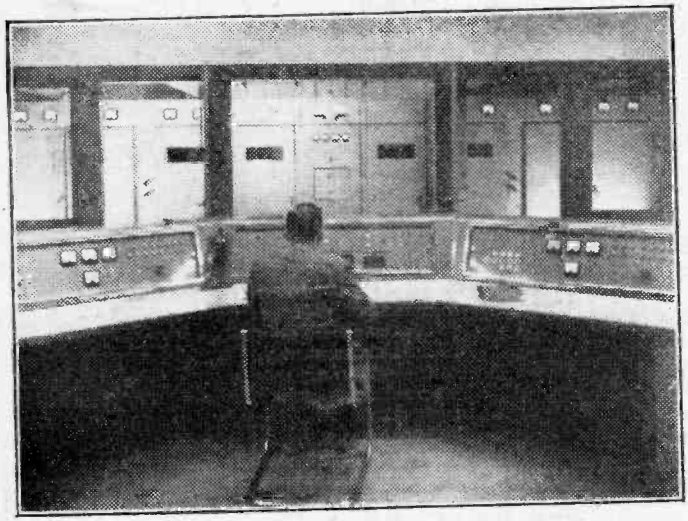
Of the £22,000,000 worth of goods sent abroad during 1951, almost one-third was made up of radio and electronic components.

It is also learned that exports of radio receivers are rising, for the first time since the war.

Pye Radio Exports Up

EXPORTS of radio receivers, report Pye, Ltd., of Cambridge, are increasing rapidly. The quantity exported during the period April/December, 1951, was 93 per cent. up on a similar period in 1950, and 144 per cent. up on the same period of 1949.

Pye report that there has been a steady increase in the demand for their products throughout the world, each year breaking the record for the previous year. The Pye group manufacture a wide range of products, and it is to be noted that this increase in sales and demand has been felt in all their branches: radio, television, transmitting equipment, telecommunications and special products.



The main control desk of the 100 kW transmitting station at Daventry.

Obituary

IT is with deep regret that we record the death of Mr. Gilbert Ashton, of E. K. Cole, Ltd., who passed away on January 20th. Mr. Ashton completed almost 25 years with the Ekco sales organisation and since 1932 has been the radio sales representative for the Midlands area.

It is announced by British Insulated Callender's Cables, Ltd. that Mr. George Barnard died at his Birmingham home on February 7th. He was born on December 14th, 1862, and first became associated with the firm of W. O. Callender & Sons, Ltd., the predecessors of Callender's Cable & Construction Co., Ltd., in 1880. He was appointed an Advisory Director in 1932 and retired at the age of 79 on December 31st, 1941, after 60 years' service with the company.

B.I.R.E.

THE following Institution meetings will be held in March, 1952:

London Section. — Thursday, March 27th, 6.30 p.m. London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1. "The Application of Magnetic Amplifiers to Industrial Measurement and Control," by H. M. Gale, B.Sc.

North-eastern Section.—Wednesday, March 12th, at 6 p.m. Neville Hall, Westgate Road, Newcastle-upon-Tyne. Details may be obtained from the programme secretary, D. R. Parsons, A.M.Brit.I.R.E., 20, Princes Avenue, Gosforth, Newcastle, 3.

Scottish Section.—Thursday, March 13th, at 7 p.m. Natural Philosophy Department, The University, Drummond Street, Edinburgh. "Radar as an Aid to Navigation," by N. J. Donald, B.Sc.

Friday, March 14th, at 7 p.m. (postponed from February 27th). Institute of Engineers and Shipbuilders, Glasgow. "The Future of Broadcasting," by Paul Adorian, M.Brit.I.R.E. (President of the Institution).

South Midlands Section.—Wednesday, March 19th, at 7.15. p.m. Exhibition Gallery, Public Library, Rugby. "The Application of Magnetic Amplifiers to Industrial Measurement and Control," by H. M. Gale, B.Sc.

West Midlands Section.—Tuesday, March 25th, at 7 p.m. Wolverhampton and Staffordshire Technical College, Wulfruna Street. Details may be obtained from the local honorary secretary, R. A. Lampitt, A.M.Brit.I.R.E., 20, Northfield Grove, Merry Hill, Wolverhampton.

The Radar Association

THE above association is holding its Sixth Annual Dinner and Dance on Saturday, March 15th, at "Chez Auguste," Frith Street, W.1.

Tickets at 15s. each may be obtained from 83, Portland Place, London, W.1.

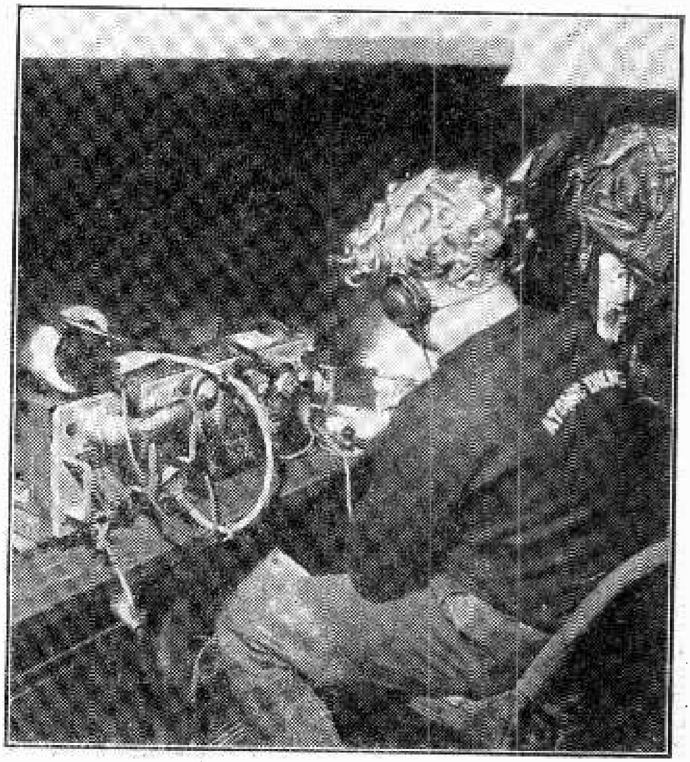
V.H.F. for Pakistan Police

URGENTLY required by the police force in Dacca, East Pakistan, a consignment of valuable Pye V.H.F. radio-telephone equipment was recently flown from this country in a specially chartered aircraft.

The Dacca Police, realising that radio-telecommunication is so essential to the efficient working of public services that it is fast becoming an integral part of their organisation, placed an order with Pye, Ltd., of Cambridge for 100 watt transmitters and associated receivers, 15 watt Mobiles (as installed in London taxis), 15 watt Fixed Base stations, and "Dolphin" (M.H.F.) marine radio-telephones—with a request for expedited delivery.

Fishing for Atoms

A TRIM blue-and-white fishing vessel at Whitehaven forms part of the safety precautions of the Sellafield atomic factory on the Cumberland coast. Each month this craft puts to sea to test the area for radioactivity. The reason for this is that the waste from Sellafield is carried to sea by means of a pipe line. It is not known what effect this may have on seaweed, fish and other materials and accordingly the area was tested before the start of operations at Sellafield, and the monthly tests, which include not only the catching of fish but the dredging up of mud and sediment from the sea-bed, enable a watch to be kept upon the effects of the waste with a view to its diversion should it prove deleterious.



An operator at the radio equipment on the Mary Munro III—*the atomic research ship referred to above.*

The "Modern" Switch-tuned Feeder

ANOTHER TUNER FOR USE WITH THE "MODERN" AMPLIFIER

By R. Hindle

THE "Modern" Amplifier (July, 1950) has proved to be a popular and versatile amplifier and the designs for feeders already given by no means exhaust its possibilities. For those who require a good all-round receiver the Superhet. tuner described in the April, 1951, issue has been found very satisfactory. In that article it was shown how to use this tuner without an R.F. stage, and for those who require a somewhat less ambitious design there is no reason why the tuner should not be made up in the first place without this R.F. stage. There has been a demand also for a feeder that will permit any member of the family, no matter how lacking in technical knowledge, to get the best results of which the amplifier is capable. Very few users of the family receiver require more than the Home and Light programmes plus, possibly, the Third programme. It is desirable that the user under these circumstances should not have to rely on critical tuning. So often it is found that the local station is being listened to with serious distortion caused by the failure to tune to the mid-point. A quality amplifier makes such distortion more distressing, but it is not always easy to persuade the non-technical that this results from their own mishandling and not from any defect in the equipment.

With this idea in mind the present unit was designed. The aim was to produce a unit absolutely foolproof from the users' point of view, but as comparatively few people live under the shadow of a transmitter a reasonable degree of sensitivity and selectivity have been provided. The original unit was intended to be used as an addition to the manual tuner of the "Modern" superhet. type working through the tone control unit previously described into the main amplifier. The radio/gram. switch on the main tuner was replaced by a three-way switch giving manual tune, switch tune and gram. An additional power outlet was fitted to the amplifier which, in this case, had a mains transformer and rectifier capable of giving the necessary extra power. The switch-tuned chassis to be described could be used, if desired, without the manual tuner chassis, in which case an on/off switch would have to be provided to control the mains supply via a five-way cable to the amplifier. For this purpose, a five-way power plug is shown in the circuit diagram. Very likely the tuner will find application in connection with other amplifiers, and preliminary tests were made, in fact, on a simple amplifier consisting of a single pentode only which is wired into the bench test power pack used to supply the chassis whilst under development. Another very suitable application is as the broadcast tuner for use along with a television receiver, playing through the sound amplifier provided for television sound.

Clearly, such a chassis as this must be to some degree individually designed for the circumstances of its use, and it is proposed to suggest variations that might suit individual needs. As originally built, however, the theoretical circuit is shown in Fig. 1. It will be seen that provision was made for three different stations. These were two medium-wave and one long-wave stations. There is no reason, of course, why more or fewer stations should

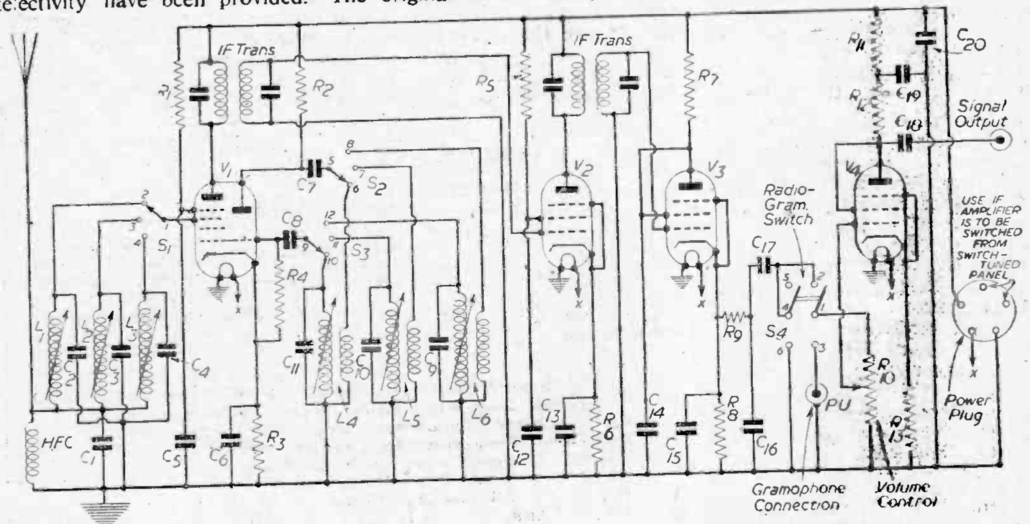


Fig. 1.—Theoretical circuit of the feeder. A list of parts will be found on the facing page.

not be provided, nor why all stations should not be on the medium waveband if so desired. It is only a matter of providing the appropriate number of positions on the switch and fitting coils of appropriate size.

The Circuit

Undoubtedly the best way to obtain satisfactory sensitivity and selectivity under normal circumstances is to use a superhet. circuit. There is little difficulty then in ensuring stability and the greater number of tuned circuits permits better bandpass for a given degree of selectivity, which is desirable in a quality receiver.

It will be noticed that aerial switching is avoided by using bottom end coupling. C1 provides the common impedance for coupling on all switch positions. Any tendency for modulation hum to be introduced as a result of 50-cycle pickup by the aerial is avoided by wiring a high-frequency choke across C1. With the more usual transformer-coupled aerial circuit any 50-cycle pickup by the aerial is taken directly to earth via the aerial winding, which presents negligible impedance at this frequency. The inclusion of C1, which has appreciable reactance to 50 cycles, results in a hum voltage being developed which is applied via the coils to the signal grid of V1 where, by virtue of a slight curvature of the valve characteristic, it is impressed on the wanted signal in the manner of cross-modulation. The high-frequency choke in this unit has a high impedance to the wanted signals (an "all wave" type is chosen) and has no effect as regards those signals. Its self-capacity has no ill effect because it is simply added to C1. On the other hand, this component presents an almost direct short-circuit to hum frequencies and prevents them completely from passing to V1.

V1 is a 6K8 triode hexode in a conventional circuit. A transformer-coupled local oscillator circuit is used and, as there is no question of ganging, padder condensers are unnecessary. All tuned circuits, aerial and oscillator, make use of iron-cored coils and the core adjustment is used for pre-set tuning of the circuits. Fixed condensers of appropriate size are placed across the coils to give the required tuning range.

V2 is an I.F. amplifier with transformer coupling fore and aft. In the majority of cases sufficient selectivity will be obtainable without the use of highly efficient circuits, and, in fact, cheap less-efficient transformers will give better quality. Their bandwidth can be improved by staggering slightly the tuning, if reception conditions permit; preferably the "Q" of the circuits can be reduced to prevent "humping" by means of damping resistances wired across the transformer windings. A subsidiary benefit derived from the adoption of the superhet. circuit is that any measures such as these to obtain optimum bandwidth hold for all tunable frequencies; a straight receiver has selectivity varying over the band, and measures applied to flatten the tuning at one end of the band will not necessarily apply in equal measure at the other. This adjustment in bandwidth is in the nature of an individual adjustment and it is suggested that, in the first instance, the unit be built as described.

No A.V.C.

It is reasonable to expect that, in the majority of cases, the stations chosen for switch tuning will not be subject to fading and consequently A.V.C. is not required. It is as well to avoid A.V.C. if possible because some distortion may be caused thereby and because then it is possible to make use of the "infinite impedance" detector. If in any exceptional cases A.V.C. is essential, V3 could be replaced by the usual double-diode circuit, but the version shown in Fig. 1 is better wherever circumstances will permit.

As no A.V.C. was used in the prototype there was no point in using a variable-mu valve for V2. In actual fact a 6SH7 is used in the I.F. stage as well as in V3 and V4 positions. This is a single-ended valve and therefore no top cap lead is necessary.

R8 is the cathode-follower load for V3, and C15 bypasses R.F. R9, C16 form the filter to eliminate R.F. from the audio signal and C17 prevents the D.C. produced across R8 by the passage of the anode current of V3 from reaching the audio stages. The D.C. across R8 is, of course, the bias that gives an anode bend detector characteristic to V3.

The radiogram switching and audio output is the same as that used on the "Modern" superhet. tuner and it is intended that a tone control panel be interposed between the tuner and the amplifier. If this tuner is to be fed into the superhet. tuner as previously suggested or to any other amplifier

LIST OF COMPONENTS

C1	2,000 pF.	Dubilier type 672
C2, 3, 4, 9, 10, 11	(see text)	,, ,, 635
C5, 6, 12, 13	.1 μF.	,, ,, 460
C7	500 pF.	,, ,, 635
C8	100 pF.	,, ,, 635
C15, 16	300 pF.	,, ,, 635
C17, 18	.1 μF. metal cased	,, ,, 418
C19	8 μF. Electrolytic, wire ends	
C14, 20	8—16 μF. Electrolytic, upright can.	

All these condensers 350 volt working. Types are given to indicate physical sizes that have been allowed for in the wiring diagram.

R1	33K Ω	1 watt
R2, 12	47K Ω	1 ,,
R3, 6, 13	220 ohms	½ ,,
R4	47K Ω	½ ,,
R5	100K Ω	½ ,,
R7, 9, 11	10K Ω	½ ,,
R8	22K Ω	½ ,,
R10	½ Meg. Volume Control	

L1, 2—Osmor Medium-wave Aerial, Type B. Bottom End Coupling.
L3—Osmor Long-wave Aerial, Type B. Bottom End Coupling.
L4, 5—Osmor Medium-wave Osc., Type C. Aperiodic.
L6—Osmor Long-wave Osc., Type C. Aperiodic.
Sw. 1, 2, 3 4-pole 3-way Yaxley (see text).
Sw. 4 2-pole, 2-way Yaxley.
H.F.C. All-wave H.F. Choke.
V1 6K8. V2, 3, 4 6SH7.

incorporating pre-amplification and tone correction, V4 and probably the radiogram switch will be omitted and the output lead connected direct to C17.

Although the coil switching makes use of only three arcs the switch used was of the four-pole type. Two possible uses of the fourth pole were in mind. Firstly, it may be desired to arrange some kind of signal lamp device to indicate the station to which the unit is switched and the spare arc could be used for this purpose. Another possibility is that in some localities the stations selected may vary considerably in strength and consequent switching from a weak to a strong transmission without A.V.C. will be unpleasant. The spare arc could then be used to introduce an equalising arrangement to reduce the strongest signals. This could be in the form of a resistance switched into the cathode circuit of V1 to increase its self-bias. The size of resistance would have to be decided by experiment or maybe it will be thought worth while to incorporate preset resistances for adjustment when the tuner is under test. If these ideas are to be adopted it will be necessary to wire them in at an early stage in the construction because the spare arc is later inaccessible.

Construction

This unit is quite suitable for construction by those with little previous experience in superhet. work and consequently more constructional detail is given to help them. The relatively inexperienced will be wise, of course, to follow the instructions carefully and not to attempt to introduce the variations that have been suggested for the benefit of the more experienced who will know what liberties they can take in the way of modification of layout.

Fig. 2 shows the layout of the chassis as viewed from underneath. They must be provided with cut-outs for valves and electrolytic condenser. The I.F. transformers are mounted above the chassis. The type used has four flying leads out of the bottom and these are passed through the three holes shown, the grid lead (usually green) through hole C, the anode lead through hole A and the earth and H.T. leads (black and red) through the middle one. Note the direction of mounting the valve holders, indicated by the spigot hole, and the soldering tags and tag boards mounted under the holding-down bolts. Ensure good contacts wherever there is a metal-to-metal contact for earth purposes by rubbing the metal surfaces bright. This applies for each of the earthing tags and also between the I.F. transformer screen and chassis, and between the coaxial sockets used for aerial/earth and gramophone inputs and chassis. The earth connections of L4, L5 and L6 are not made to the tag on the adjacent board which is in contact with the chassis but to the floating tag, which is tied to earth by connection to the soldering tag under the holding-down bolt of V1 socket as shown in the wiring diagram. The station selector switch is mounted so that two of the arcs are at the top and the other two are near the chassis. The dimensions given suit the components originally used, mounted on a chassis 10in. x 6in. x 2in. deep, but it will be as well to make sure that the com-

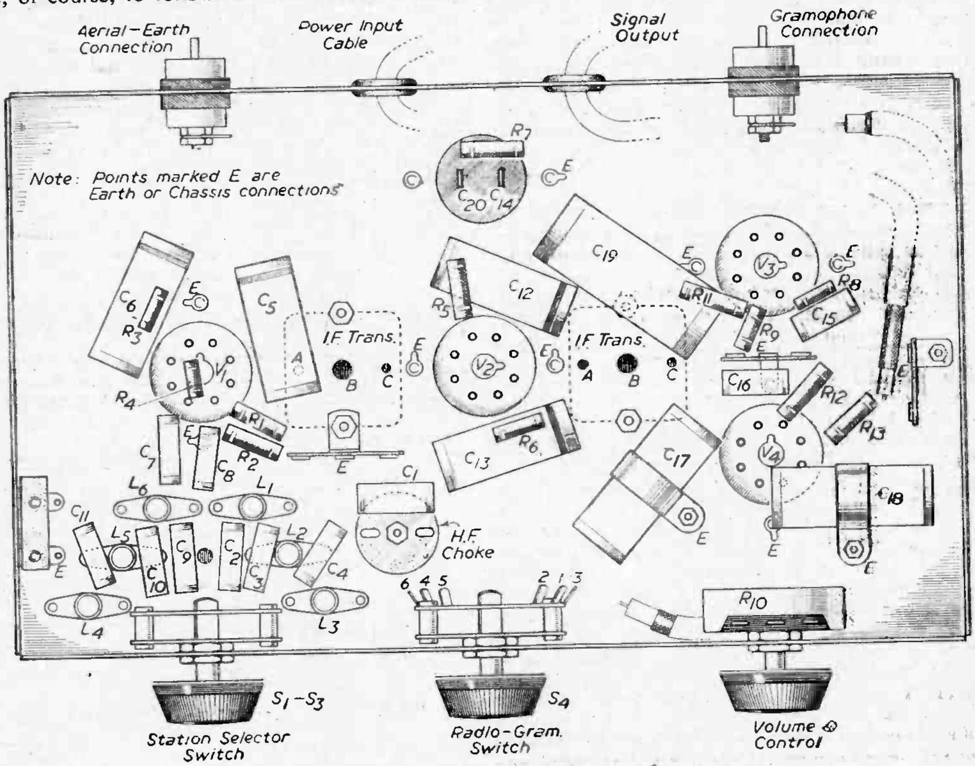


Fig. 2.—Details of the under-chassis layout of components.

ponents to be used are of the same physical size before drilling.

Wiring

The wiring is carried out in 24-gauge tinned copper wire enclosed in sleeving, except for the signal leads which are in coaxial cable and the coil connections which use the coil lead-out wires themselves. The medium-wave aerial coils are wound with Litz wire and no attempt should be made to shorten the leads as great difficulty will be experienced in cleaning and retinning the ends. All the strands must be connected. The other coils are wound with single wire and these can have their connecting leads shortened, if required. Careful handling is necessary to avoid damage. The ends of the wires should be scraped clean with a piece of old smooth emery cloth and tinned before attempting to solder to the switch tags. Fig. 3 will serve to identify the switch connections.

In the prototype L3 and L6 were the long-wave aerial and oscillator coils respectively, and 300 pF condensers were used for C4 and C9 to tune to the long-wave Light programme. 50 pF was used for C11 and 100 pF for C2 to tune the Third programme on 194 metres. These values will probably be needed for wavelengths up to the Light programme on 247 metres. 150 pF for aerial and 100 pF for oscillator covered the next band up to 300 metres and 220 pF, 300 pF, respectively, up to about 400 metres. For North Regional on 434 metres 220 pF was used for oscillator with 300 pF for aerial, and was found just to cover the wavelength. On another model it may be necessary to increase these sizes to the next step, 300 pF for oscillator and 400 pF for aerial, which values should cover up to the Third programme on 464 metres. It is emphasised that these sizes depend somewhat on the construction and the above values are given only as a guide, to be wired in for preliminary tests.

Setting Up

A signal generator is useful for setting up the chassis, but it is not as necessary as it is for setting up a manually tuned superhet. to a standard commercial dial. In the first place the exact I.F. is unimportant so long as the circuits are in tune with each other. In the second place each circuit is individually tuned and it is easy enough to set these up on the regular transmissions.

When the fixed condensers across the tuning coils of the size suggested for the stations required have been wired in and the chassis carefully checked it should be connected up to the amplifier and switched on, with aerial connected ready for tuning. If a signal generator is available first set up all I.F. adjustments to maximum signal on 465 kc/s. If a generator is not to be used set all I.F. adjustments at a similar point, i.e., with cores projecting equally and about midway on their range of adjustment or with trimming condensers screw fully home and then slacken off one complete turn. Set the volume control at maximum gain and switch the station selector to the position at which the strongest signal to be received is to be found. Now tune through the range of core adjustment on the appropriate oscillator coil to select the station required. If the required station is not picked up but an alternative transmission is heard, identification of the station received will indicate whether more capacity (the station tuned being lower in wavelength than the one required) or less capacity is required and the appropriate condenser can be changed as necessary. It is worth remembering that if the circuit will not quite tune down to the wavelength required the range in that direction can be extended by removing the iron core and screwing in a short piece of brass rod threaded 0BA.

Supposing that the chassis has been checked and is in order but no station can be received by means of the oscillator adjustment. It may be that the stations cannot force their way through the off-tune aerial and I.F. circuits. The aerial tuning can be made flatter by temporarily connecting the aerial direct to the grid (i.e., top cap connection) of V1 until the transmission is received. An attempt can also be made to tune the I.F. adjustments for maximum valve hiss as heard in the loudspeaker. These two measures, followed by further careful search using the oscillator core, should ensure reception of the wanted transmission.

Having heard a transmission adjust the I.F. transformer for maximum signal. The aerial coil core of the selected circuit can now be adjusted to maximum signal strength. If a maximum is obtained with core right out a smaller capacity is required, or, as already suggested, a brass core can replace the iron core. Care should be taken that a false maximum is not selected. If the core will not quite tune up to the required wavelength there will be an apparent maximum where the core fully enters the coil and which will be very flat and will begin to fall off as the core passes out of the other end of the windings. If this condition is experienced increase the size of the condenser across the coil and retune. Both oscillator and aerial circuits (the latter with the aerial connected to the proper aerial input) should have quite sharp tuning if everything is in order.

One station being satisfactorily tuned in attention can be turned to the other stations, selecting the appropriate circuits by the station selector and proceeding as before except that the I.F. adjustments are now left untouched.

The effect of slightly detuning the I.F. adjustments to improve bandwidth, if receiving conditions will permit the resulting decrease in selectivity, can be tried at leisure, remembering that this will probably require the introduction of damping resistors across the tuned circuits to prevent double-humping if transformers of high "Q" are used. Leave the first I.F. transformer adjustment as it is and turn the adjustment of one core or condenser on the second transformer slightly (say a half turn) clockwise and the other adjustment of the same transformer equally anti-clockwise.

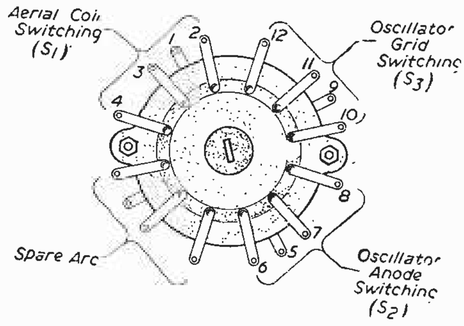


Fig. 3.—Details of the switch connections.

A Simple and Improved Phase Inverter

A PUSH-PULL FEEDER USING A 6SN7 VALVE

By D. W. Mynett

A VERY popular phase-splitting circuit is shown in Fig. 1, and it is frequently encountered in commercial receivers and amplifiers which incorporate push-pull output stages. This circuit has a great deal to recommend it for simplicity. It suffers from the inherent limitation, however, that the stage can never give a gain greater than two, no matter how large the two load resistances are made. This is due to the heavy negative feed-back introduced by the unbypassed cathode load resistance.

The component values shown in Fig. 1, were taken from an actual commercial receiver in my possession. The input was from the triode section of a 6Q7 D.D.T. and the output was fed to two 6V6s in class AB_1 push-pull, giving a nominal output of 14 watts on full volume. There was in practice a noticeable lack of brilliance and contrast in the sound reproduction, and investigation led me to believe that there was insufficient input reaching the grids of the 6V6s to bring out the weak transients, except at an unbearable general volume level.

As the chassis was already crowded, an extra L.F. stage was impracticable and there was even insufficient room under the chassis for the extra components required to install a twin-triode, such as a 6SN7GT, in place of the 6J5. Each section of the 6SN7 is identical with the 6J5, and this fact suggested that if they could be used in push-pull before the output stage, the extra amplification would be available. But the problem was to get the phase inversion necessary to drive the 6SN7 in push-pull without using another valve.

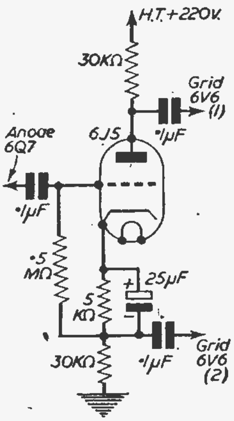


Fig. 1.—*Normal single-valve phase splitter.*

Fortunately there is a circuit which enables this to be done within the 6SN7 itself, and in addition the circuit requires only the same number of components as are needed for the circuit of Fig. 1. In fact, in my case, I used the actual components which were in the original circuit.

The Circuit

The rearranged circuit is shown in Fig. 2. It turned out that, with the values indicated, the bias was the required 9 volts, so the 25 μF bias decoupling condenser was not used. If in other cases the bias voltage on the cathode is too high, it is only necessary to split R_1 into two parts, returning R_2 to the junction as in Fig. 1, while if it is too low R_1 should be increased until the required voltage is obtained. In all cases the value of R_1 should be kept as high as possible as the drive for the second section of the 6SN7 is derived from it. In effect, this section of the valve acts as a grounded-grid amplifier, the input being fed to the cathode instead of the grid. As the grid is earthed, the final result is the same as in the normal method of feed to the grid and earthing the cathode.

The circuit works as follows. The voltages across R_1 and R_3 of Fig. 2 are in phase with each other, as both resistances form part of the anode circuit of the first half of the 6SN7. Assuming the voltage on Grid 1 causes a fall in the current through R_1, in section 1, the anode potential rises and the cathode potential falls. This fall reduces the bias of the second section, allowing an increased flow of current. The voltage drop across R_4 increases and the anode volts fall. Therefore the voltages appearing at the anode ends of R_3 and R_4 are 180 degrees out of phase with each other, which is just what is required to drive the two output valves.

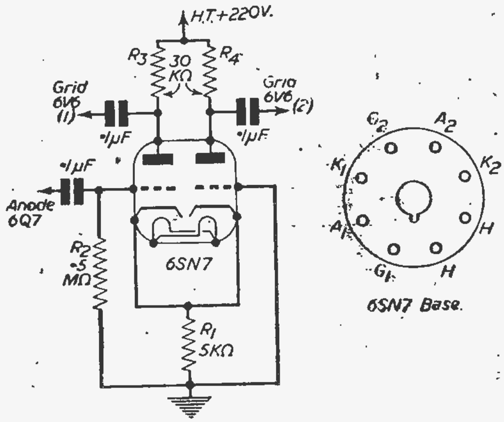
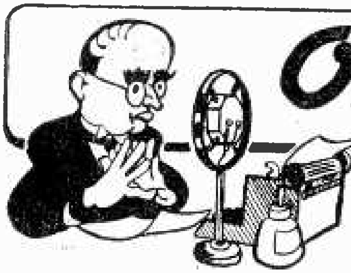


Fig. 2.—*The circuit suggested by the author, and valve-base connections for the 6SN7.*

Referring once more to the high value required for R_1 of Fig. 2, there is a further reason for keeping it at a high value. The negative feed-back introduced by this resistance has four effects :

1. It increases the internal resistance, or R_P, of the valve.

(*Concluded on page* 186)



On Your Wavelength

By Thermion

Unauthorised Frequencies

I WAS very surprised to learn from a "Guide to Broadcasting Stations" that despite efforts of international bodies and representations from individual governments the congestion in the long- and medium-wave broadcasting bands in Europe is eased but very little.

There are at present nearly two hundred stations working unauthorised frequencies. I wonder what is the value of international conventions and agreements when nations refuse to carry out the recommendations made as a result?

Technical Writing

THE idea of encouraging those employed in the radio industry to write articles for the technical press appeals to me. It is very true to say that only few people with technical knowledge are gifted with the power of calligraphic expression. Premiums of 25 guineas each, up to an average of six a year, are to be awarded to the writers of published articles which, in the opinion of the judges, deserve to be commended by the industry. Full details are available from the Radio Industry Council, 59, Russell Square, W.C.1. The awards will be made for articles published at home or abroad in papers or periodicals which can be bought by the public on the bookstalls or by subscription. Articles in trade journals, house journals and the privately published journals of professional institutions or learned societies do not qualify. Any writer is eligible who is not paid a salary mainly or wholly for writing and is not earning 25 per cent. or more of his income from fees for articles or from book royalties. The writer of an article which he wishes to be considered for an award can take no action until the article is published. On publication he should write to the address given, enclosing five copies of the journal, or the relevant pages or proofs or reprints, enclosing a signed declaration that he is eligible under the terms of the competition. The judges will take into consideration the value of the article in making known British achievements in radio and electronics, originality of subject, technical interest, presentation and clarity.

A Carping Critic

I HAVE received a letter from a critic residing in London, S.W.6, in which he refers to my comments on the cacophony (accent on the phony!) of dance bands. He imagines that I always wear black clothes and that I have a solemn outlook on life, and that the B.B.C. should only radiate programmes to suit me, and not the other eleven million listeners. What I have said I emphasise, namely, that far too much programme time is devoted to dance bands; that few people if any ever dance to the so-called music composed and written by the Als, Eds, and Lews, of Tin-Pan Alley and injected into the ether apparently for the delectation of half-wits. My waspish critic before penning his bilious letter should have taken the trouble to read what I really did write. Apparently the cause of his soured outlook is the arrival of his copy of PRACTICAL WIRELESS with the wire pins in the wrong position! He wants me to sack the printer for it!

And Another

ANOTHER reader, who hails from Cambridge, who enjoys reading his journal in a free public library, proceeds to look a gift horse in the mouth by telling me what we should provide for his free fare. He is a beginner in radio and wants the journal entirely devoted to articles of an elementary nature. He has only been reading the journal in his library for six months, and is therefore unaware of the fact that every year we run articles designed especially for the beginner. No one realises more than I that a new generation of radio amateurs comes into existence every year, and that they should not be forgotten in the pages of a technical journal. This reader, as he patronises his free library, might also take the trouble freely to dip into the large number of technical books on radio specially written for beginners which he will find on the shelves and which have been issued by the publishers of PRACTICAL WIRELESS.

Magnetic Recording

I HAVE been playing round recently with a home-made magnetic recorder and have spent some interesting evenings. Many readers have written in the past regarding the facilities for home-recording and many seem to prefer the disc apparatus. One point which interested me very much with the magnetic apparatus is the facility which it offers for "dubbing," or dual recording. By this arrangement it is possible not only to make a duet of yourself, but on one occasion I made no fewer than eight separate recordings of a single soloist on a single piece of tape, with almost as much ease as making a single recording on disc. It would be interesting to hear from readers who may have experimented with this type of equipment in order that we may gain an idea as to the popularity of this new form of recording, with a view to giving some constructional details if they are warranted. The question of expense is, I believe, one of the main drawbacks to this equipment, as at a minimum two heads are required and for good results two or three separate motors, in addition to a rather elaborate amplifier, in which it is not an easy matter to make valves serve a dual purpose.

Radio Receiver Design at V.H.F.—6

MORE ABOUT VALVE NOISE

By G. P. Lowther

(*Continued from page 104 March issue.*)

JUST as the heat radiated from a hot body, e.g., a poker, is proportional to the temperature and is due to vibration of the molecules, so the noise voltage produced by the passage of an electric current through a conductor due to random electron movement is dependent upon the temperature. The noise spectrum extends from zero to infinity, and so the noise voltage is also proportional to the bandwidth.

Actually $E^2=4.k.T.R.\delta f$

where E = noise voltage in volts
k = Boltzmann's constant
R = total effective input resistance
δf = bandwidth in cycles 3 db. down
T = absolute temperature.

It should be noted that a tuned circuit at resonance behaves like a resistance, and the effective input resistance is this value in parallel with the input resistance of the valve and any other damping that may be present. Since at V.H.F. valve damping is very considerable, this figure alone is usually sufficient to determine the input resistance approximately, provided the tuned circuit is not damped in any other way. If an input transformer, or its equivalent, is present, this does not affect the calculated noise voltage as reference to Fig. 24 will show.

If the primary resistance is R_P and the secondary resistance is R_S. Also if the voltage step-up ratio is n times $E_S=n.E_P$ and $R_S=n^2R_P$

the noise voltage $E_P{}^2 =4.k.T.R_P.\delta f$

$$=4.k.T.R_S.\delta f \div n^2$$

$$=\left(\frac{E_S}{n}\right)^2$$

Hence $E_S{}^2=4.k.T.R_S.\delta f$, the value that would be obtained in the absence of an input transformer.

The bandwidth δf is that of the audio-frequency output since higher frequencies will not be audible except for a small degree of inter-demodulation in the presence of a carrier.

If the temperature is taken to be 63° F,

then $E=1.25\times10^{-10}\sqrt{R.\delta f}$ volts.

If in addition the audio bandwidth is taken as 6.4 kilocycles

then $E=\frac{\sqrt{R}}{100}\mu V$.

Thus an input resistance of 10,000Ω will produce a noise voltage of 1μV. Even if the receiver is noise free this will set a lower limit to the magnitude of the signal than can be distinguished, but since the input resistance at V.H.F. is usually nearer 1,000Ω than 10,000Ω valve noise usually determines the sensitivity of the receiver.

(b) *Valve noise.* Just as the flow of electrons through a conductor is not absolutely even, so the emission of electrons from the cathode is subject to "bunching" and produces a noise voltage. If the cathode emission is voltage limited, i.e. the cathode is small or the temperature low so that electrons are "dragged off" by the other electrodes, the noise is greater than if the emission is temperature limited i.e. more than sufficient electrons are released by the cathode, surplus ones being repelled by the negative charge (space charge) round the anode. The reason for this is that the space charge acts as a cushion, smoothing out irregularities in the electron stream. Since the amount of "cushioning" is somewhat indeterminate it is difficult to form an accurate estimate of valve noise.

It is particularly important when working at very high frequencies that the filament voltage is not below the rated figure or the noise output may increase. Since thermal noise is calculated from a knowledge of the grid resistance it is convenient to quote valve noise by giving the value of the resistor that, if placed in series with the grid, would produce the same noise in the anode circuit. Approximate formulae for the equivalent grid resistances are:

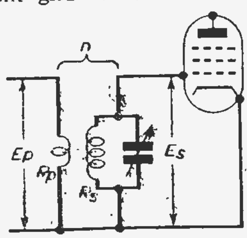


Fig. 24. — Transformer coupling showing the effect on noise.

for a triode $3{,}000\div G_m$ ohms (where G_m is in mA/V)

and for a pentode $\frac{I_a}{I_a+I_{sg}}\left(\frac{2.5}{G_m}+\frac{20.I_{sg}}{G_m{}^2}\right)$ ohms

where I_a and I_{sg} are anode and screen currents respectively, in amps. and G_m is in amps/volts.

Where possible, however, manufacturers' figures for the equivalent noise resistance should be used as those obtained from the formulae are sometimes far from accurate, e.g. in the case of a Mullard RL16 triode, calculated value = 460Ω. Actual value = 310Ω. With an RL7 pentode, calculated value = 711Ω. Actual value = 700Ω. Typical values of equivalent noise resistance are:

for a triode 200Ω-500Ω.
for a V.H.F. pentode 700Ω-2,000Ω.
for a beam tetrode 4,000Ω-5,000Ω.
for a normal H.F. pentode 10,000Ω-50,000Ω.
for a frequency-changer 20,000Ω-80,000Ω.

Since "transit time damping" has the same effect as that of a resistance across the grid circuit it will act as a source of noise. It has been found experimentally, however, that the noise produced is approximately five times that which would result were a carbon resistor across the grid circuit.

This means that every care must be taken to minimise "transit time damping" in the first stage, otherwise it may be the overriding source of noise. Fortunately, it is reduced by normal cathode compensation. Since the value of the grid resistor or dynamic impedance of the tuned circuit sets a minimum noise level, this figure should, if possible, be greater than the equivalent noise resistance of the valve to ensure reasonably noise-free amplification. It is found by analysis that the damping due to the cathode lead inductance does not cause any deterioration in the signal-to-noise ratio, so that only damping due to transit time affects matters so far as noise is concerned.

When the noise level approaches that of the signal, a receiver is normally useless, and since valves are inherently more noisy at V.H.F. it is very important that one should not only be able to measure or estimate the sensitivity when the apparatus is working, but be able to calculate it reasonably accurately before it is built. This rules out the empirical method of noise estimation by means of the "detune ratio."

Even if a receiver were completely noise free, the signal-to-noise (S/N) ratio would not be infinite since noise is necessarily associated with the input voltage from the aerial or an oscillator as these are resistive. In practice this upper S/N limit is always reduced by receiver noise and, clearly, for a given bandwidth and input impedance, the smaller the difference between the maximum theoretical (which assumes the receiver to be noise free) and the actual S/N the smaller the signal voltage that can be distinguished and, therefore, the more sensitive the apparatus. This difference when expressed as a numerical ratio, or in decibels, is known as the "noise factor" of the receiver. S/N can, of course, be expressed on either a voltage or power basis, but if the latter is used and converted into decibels the formula is:

$$\text{decibels} = 10 \log_{10} \frac{S}{N}$$

Thus if the S/N (voltage) = 20 times, the S/N (power) = [S/N (voltage)]² = 400 times.

S/N (voltage) = 20 $\log_{10}$ 20 decibels = 26 db.

S/N (power) = 10 $\log_{10}$ 400 decibels = 26 db.

Let the input signal = E.

Let the input resistance = R (Resistance due to aerial only.)

$$\text{Then S/N (voltage) at input} = \frac{E}{\sqrt{4.k.T.R.\delta f}}$$

$$\text{Therefore [S/N (voltage)]}^2 \text{ at input} = \frac{E^2}{4.k.T.R.\delta f} =$$

S/N (power).

In calculations involving Noise Factors, signal-to-noise ratios are expressed on a power basis to avoid the square root sign.

Thus, if the S/N (power) at the aerial = S_1 and if the S/N (power) at the grid = S_2 the Noise Factor of the receiver = $S_1 \div S_2$.

This may be given in decibels as 10 $\log_{10}$ ($S_1 \div S_2$).

Actually the N.F. = S/N at the aerial ÷ S/N at the output, but by using the system of equivalent noise resistances, all noise may be referred back to the first grid.

The great advantage of expressing the sensitivity of a receiver in terms of the Noise Factor, is that the S/N need not be measured (though this provides a useful cross check when it can be done), but can be calculated from the simple approximate formula: N.F. = 1 + 5 + 4 ($R_{eg} \div R_t$).

Where R_{eg} = the equivalent noise resistance, and R_t = "transit time damping."

The proof of this formula, though not particularly difficult, will not be given here as it is of only indirect interest. It is, however, worth mentioning that the first term represents aerial noise, the second "transit time noise," and the third valve noise.

When designing an amplifier for use at V.H.F., it is evident that the first valve must have a low equivalent noise resistance and a high input resistance in spite of "transit time damping." Since this can be increased by compensating circuits, its value cannot be assessed accurately, but a reasonable estimate may usually be made. Strictly speaking noise produced in succeeding stages should be referred back to the first grid, but provided the gain of the first stage is not less than about 20 db. and frequency-changer loss is not appreciable, the equivalent noise resistance may be taken as that of the first valve alone.

Three simple examples will now be given of N.F. calculations. In each case it is assumed that the input circuit is matched to the aerial and that the gain of the first valve is sufficient to prevent noise produced in subsequent stages from causing a deterioration in the overall S/N.

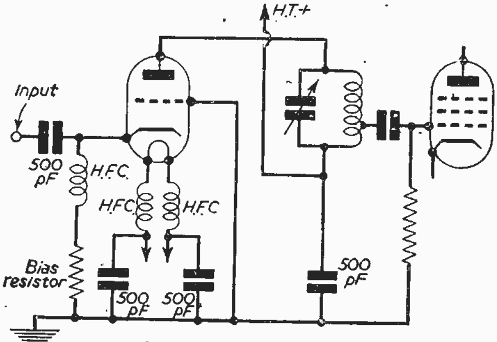


Fig. 25.—A grounded grid input stage, to reduce noise.

(a) Suppose f = 10 Mc/s and that an SP.41 is used without compensation.

The manufacturers give the input resistance as 2,300 Ω at 45 Mc/s.

$$\text{Input resistance at 10 Mc/s} = 2{,}300\left(\frac{45}{10}\right)^2 \Omega = 47{,}000\Omega.$$

Equivalent noise resistance is approx. 900Ω.

N.F. = 6 + 4 (900 ÷ 47,000).
= 6.08 times or 7.8 db.

(b) f = 50 Mc/s, an EF50 being used with cathode compensation as in Fig. 22.

From the valve curves, the input resistance at the normal operating point = 19,000Ω.

The noise resistance is not given but using the formula:

$$R_{eg} = \frac{I_a}{I_a + I_{sg}} \left(\frac{2.5}{G_m} + \frac{20.I_{sg}}{G_m{}^2}\right)\Omega$$

it is evaluated as 1,390Ω.

Therefore the N.F. = 6 − 4 (1,390 ÷ 19,000).
= 6.29 times or 8.0 db.

(c) f = 200 Mc/s with an RL7 and no compensation. Manufacturers' curves give the input resistance as 700Ω.

The equivalent noise resistance is stated to be 700Ω also.

N.F. = 6 + 4 (700 ÷ 700).
= 10 times or 10.0 db.

In the third example the calculated Noise Factor gives the following information:

Since the input resistance is 700Ω, the thermal noise associated with it=

$$\sqrt{4.k.T.R.\delta f} = \sqrt{4.k.T \times 700.\delta f}$$

Suppose T=63 deg. F, then as already stated:

$E = 1.25 \times 10^{-10}\sqrt{R.\delta f}$

Let δf=8 kilocycles.

Then E $1.25 \times 10^{-10}\sqrt{700 \times 8{,}000}$ volts.

$= 0.3\ \mu V$.

Since the Noise Factor = 10, the actual noise voltage will be $\sqrt{10} \times$ the thermal noise since S/N (voltage)=$\sqrt{S/N}$ (power).

Thus, total noise=$\sqrt{10} \times 0.3\mu V = 1\mu V$ (approximately).

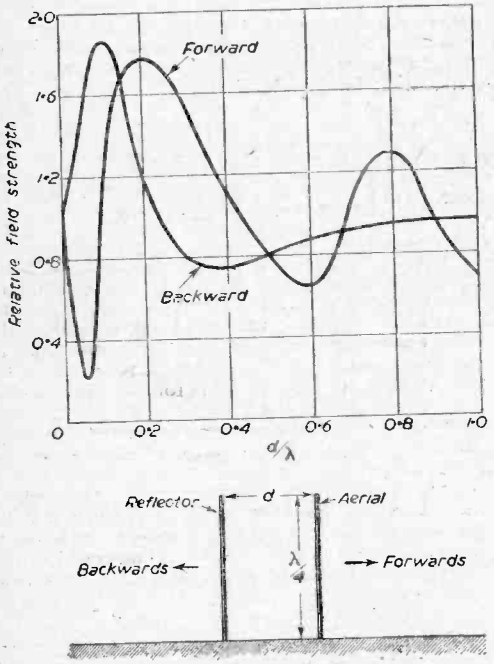


Fig. 26.—Graph showing variation in gain with aerial design.

Hence, it will be just possible to distinguish a signal of 1μV, provided there is sufficient amplification in the succeeding stages. Normally, such a signal would be useless as reception would be too noisy. If the output signal-to-noise ratio were desired to be, say 40 db. or 100 times—a reasonable figure—the receiver location and aerial array would have to be such that the signal level at the receiver input was 0.1 mV.

The following table relates reception conditions with S/N.

Perfect quality (sound), 60-80 db.
Good quality (sound), 40-50 db.
Intelligible reception (sound), 10-30 db.
Good quality (television), 40 db.
Tolerable picture, 20 db.
Recognisable picture, 5 db.

In order to reduce the Noise Factor and therefore improve the absolute sensitivity of a receiver, a grounded-grid triode is sometimes used in the first stage. The presence of an earthed screen between the cathode and anode prevents the valve from oscillating, the signal being applied to the cathode which is not decoupled. As a result, a portion of the signal in the anode circuit appears between cathode and earth, but 180 deg. out of phase with the input signal. This causes a reduction in gain, but the N.F. is improved as valve noise is considerably reduced by using a triode, as is "transit time noise." A typical circuit is reproduced in Fig. 25. The cathode and anode circuits should be screened from each other.

The H.F. chokes consist of 5-10 turns of fairly thin wire on a ¼in. former. Filament chokes are necessary due to the high cathode filament capacity. The input impedance is about 100Ω and so a 75Ω line can be taken directly to the cathode without appreciable mis-matching.

6. The physical construction of valves to be used at very high frequencies is by no means a simple matter. Due to the high mutual conductance and therefore, close spacing of control grid and cathode, the electrode assembly must be very rigid and in some cases manufacturers advise mounting the valve in a vertical plane.

Although the assembly is small, the cathode emission must be generous, while the valve must be capable of withstanding considerable heat since in order to realise the maximum gain it is usually run fairly hard.

Since long leads to valve pins are inadmissible, the pins are usually sealed directly into the glass pinch, there being no valve base in the accepted sense of the word. This not only makes for very short leads and consequent low inductances, but obviates the use of any insulating material other than glass. Some valves for use at V.H.F. are adapted for line circuits, the electrodes being brought out at opposite ends, but since so far as amateur work is concerned this is unnecessary and necessitates more involved methods of mounting, they will not be discussed further.

The radiation resistance increases with the length of wire in wavelengths, and with the height, but for a dipole above two or three wavelengths from the ground, is approximately 72Ω.

The simple half-wave dipole just described can be built into arrays to increase the gain and/or to improve the directivity and back-to-front ratio. Most of the shortwave arrays can be adapted for use at V.H.F., but such arrays are not usually necessary, and considerable trouble is often caused by wire stays resonating. Simpler types of design usually give better results, at any rate, above about 60 Mc/s.

A simple dipole may be used with either a driven or a parasitic reflector.

Fig. 26 shows the variation in forward and backward field strength, with varying spacing of antenna and reflector (normally λ/4).

Fig. 27 illustrates a driven reflector; the field to the right cancels out, while that to the left is doubled.

The reflector may be parasitic, i.e., not connected to the transmission line, and, in fact, this is the method of choice. Reference to Fig. 26 indicates that with spacings of the order of 0.1 λ high backward fields are obtained. Thus, by placing the reflector *in front* of the radiator (in which position it is termed a director) a high forward field results.

(*To be continued*)

D.C. Mains Equipment

HOW TO MODIFY STANDARD DESIGNS FOR D.C. OPERATION

By W. J. Delaney (G2FMY)

THE complaint is often made that we do not cater sufficiently for those who have only D.C. mains supplies as a power source. It is true that we do not often publish a complete D.C. receiver design, but the main reason is that there are not so many readers on D.C. supplies as on A.C. or without mains power at all, and also that D.C. mains supplies vary. In the case of A.C. it does not matter in a design whether the receiver is to be used in an area where the mains are 200 volts or 250 volts, as the difference is covered by the tapped mains transformer primary which is a standard in all mains transformers. In a D.C. receiver, however, it is not practicable to design a model which may be used on both 200 volts and on 250 volts as the difference of 50 volts may make a considerable difference to the performance, or changes must be made so that the same performance may be obtained on the two supplies. To simplify the above statement, take an output valve which may be used on a standard receiver, and ignore the resistance of the speaker primary (which will, in most cases, be quite low in value). On 200 volt supplies the anode will receive that voltage, at which the bias is probably, say, 10 volts. On 250 volts, however, it may be found that the bias is 12 or 15 volts, and if this is obtained by a cathode resistor, a different value would be needed in each case. It is, of course, possible to overcome this difficulty, but the illustration has been given to show one of the important difficulties in putting out a design which may be used on any D.C. supply—as compared with the A.C. receiver.

Circuit Design

From the above it is clear that most A.C. receiver designs could be modified to suit individual cases, provided the constructor knows the anode voltage at which the receiver is intended to operate. In most modern receivers, the anode circuits of each stage, except the output valve, carry a decoupling resistor in addition to the normal anode load, and where the H.T. line is designed to be 250 volts it may be possible to use a lower value decoupling resistor if only 200 volts is available. This may result in instability. The heater supply is not difficult to overcome, and the following details are offered to assist those with D.C. supplies to see how an A.C. design may be modified so that they can build it. Firstly, the power section should be examined to see what total H.T. voltage is available. In some receivers it will be found as high as 350 volts or so, and in such a case the anode loads should next be studied. If a single load resistor is used then it will probably not be desirable to try and alter that circuit as the designer no doubt relied upon the high anode load to provide a definite degree of amplification, and the lowering of the load to cope with a lower H.T. will reduce the efficiency of that stage and no doubt of the entire receiver. Similarly, if the decoupling resistor of any stage is found to be 5k Ω or less, then the inference will be that the anode load is high and the same remarks apply—the reduction of such a low decoupling resistor probably leading to instability.

Valves

Where, however, it can be ascertained that load and decoupling resistors may be reduced without seriously impairing efficiency—for instance, where the power pack delivers only 250 volts, then it is probable that the receiver may be modified for D.C. use. Most modern receivers for A.C. (or A.C./D.C. use) have the 6.3 volt heater type of valve, and with all the American valves, at least, these are also available in a 12-volt range. Thus the popular frequency-changer, the 6K8, is also available as the 12K8, and so on. Output valves also may be obtained with high heater voltage ratings, and as is already well known, the D.C. receiver has the heaters wired in series with a resistor or line cord to dispose of the excess voltage. This takes care of the heater winding in the A.C. receiver, and the secondary and valve rectifier are ignored, fitting the smoothing choke and condenser, of course, as the average D.C. mains supply is too rough to be used as a direct H.T. supply. Fig. 2 shows part of a typical A.C. mains circuit, the broken lines indicating the parts

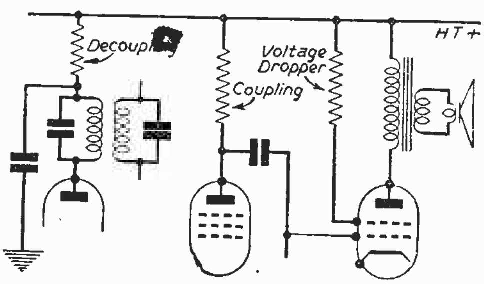


Fig. 1.—Essential H.T. feed components in an A.C. receiver.

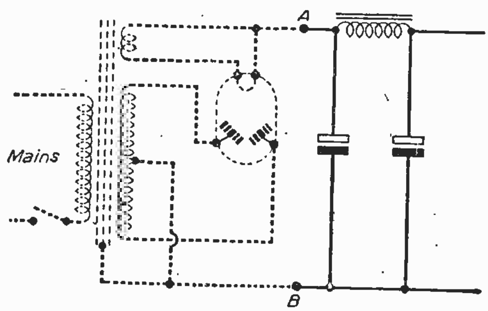


Fig. 2.—The broken lines show the A.C. portion of a power pack which may be omitted for D.C. operation.

which are ignored, the input from the D.C. mains being taken to A and B. As mentioned above, however, this is only a practical proposition where the mains transformer is of the 250 volt (or less) type.

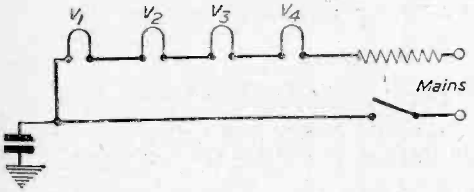


Fig. 3.—Heaters are wired in series on D.C. as shown here.

Heater Supplies

For those who are not familiar with D.C. design it may be repeated that the heaters are wired in series (instead of in parallel as in A.C. practice) and that the valve which is most susceptible or critical from the hum point of view is on the "earthy" end of the chain. This is usually the detector stage. The mains dropping resistor, or line cord resistance, is on the "live" end of the chain, and it must be emphasised that all valves must be of the same *current* rating, unless it is possible to connect odd valves in parallel to bring up two or more to the current rating of the remainder. This is because a steady current flows through the entire chain and if a valve of another current rating were to be included, it would either be over-run, or it would upset the voltage drop across other valves and result in their being over-run. Remember, that to calculate the value of the dropping or line cord resistor required, the voltages of the separate valves are added together, deducted from the available mains voltage, and the resistance value calculated by dividing the difference by the current rating of *one* of the valves. As an example, suppose you wish to make a 4-valver using three of the 12 volt .3 amp. valves with an output valve rated at 30 volts .3 amp. Three valves at 12 volts gives us 36 volts, plus the 30 volts of the output valve, makes a total of 66 volts. If the mains supply were 250 volts, 66 from 250 leaves 184 and this, divided by .3, gives 613 ohms (approximately). Line cord is available at .2 and .3 amps. rating and at so many ohms per yard, so it is not difficult to buy the required amount and obtain the necessary resistance value.

Precautions

Before leaving the subject of converting a design it is necessary to stress again the personal safety factor. On D.C. supplies the H.T. negative line of the circuit is "live" to one side of the mains supply and thus anything connected to the negative line is similarly "live." This means that the variable condenser and probably other controls must be so arranged that it is impossible for the user to make contact with the metallic parts of them. Grub screws in control knobs should be below the surface and it is worth while filling up the screw holes with wax (sealing or cobbler's will do). Also, the chassis which is usually connected as the H.T. negative line must not be earthed, and in place of the direct earth used in an A.C. design any external earth lead must be taken to a reliable condenser (say, .1 μF), the other side of which is joined to the chassis. If pick-up sockets are provided on the design a pick-up should have a similar condenser connected in each lead for a similar reason, and when placing the

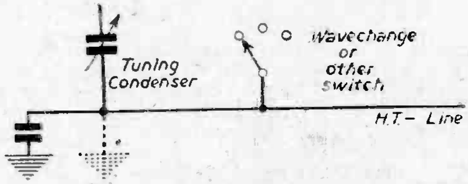


Fig. 4.—Note that all components joined to the H.T.— line are "live" to the mains.

receiver in the cabinet make certain that any screw or bolt heads which are on the outside of the cabinet do not have any chance of coming into contact with any part of the receiver.

Railway Yard Sound Equipment

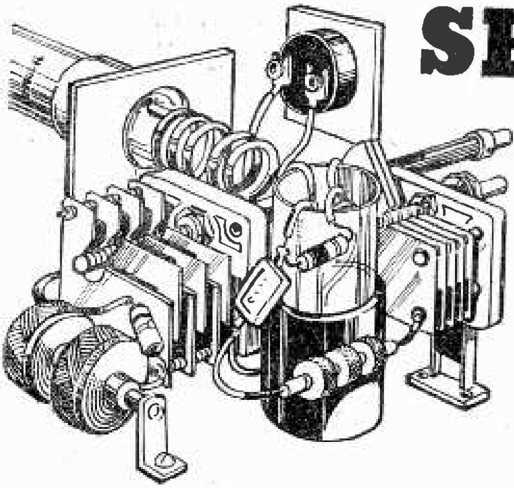
ONE of the largest railway marshalling yards in the British Isles, the "up" yard at Toton in Nottinghamshire, has recently been reorganised and mechanised. Included in the new equipment is an extensive system of loudspeaker communication designed and manufactured by the General Electric Co., Ltd.

The yard, which extends over 1½ miles, can deal with 3,000-4,000 wagons each 24 hours. Wagons are shunted over a hump and allowed to run downhill to 37 sidings, but the setting of the points and the braking of the wagons is done remotely from control buildings which overlook the yard. Such a complex organisation naturally requires a special communications system. It has been found that the microphone and loudspeaker provide a most effective method of issuing instructions throughout the yard, assisting the quick passage of wagons, since instructions can be received without the recipients leaving their posts to answer a telephone.

The sound equipment consists of 25 microphone control positions, 15 amplifiers of various power outputs up to 60 watts, and 40 loudspeakers, mostly outdoors. Grouping of the circuits is such that 13 two-way communications can be carried on between various points.

Briefly, the loudspeaker network is so arranged that the Hump Control Room has two-way communication with the signal-boxes, the ground staff dealing with incoming trains and the main Central Tower. The Control Tower is also able to communicate with staff in the area around the remotely controlled wagon brakes and the inspectors and foremen responsible for the two separate exits at the southern end of the yard, where the newly sorted wagons depart after being made into fresh trains.

Each of these inspectors has two-way communications to the signal-box concerned and also to their ground staff in order to facilitate the departure of those trains.



SHORT-WAVE SECTION

A TUNED R.F. AMPLIFIER FOR USE WITH R1116 AND OTHER S.W. RECEIVERS

By A. W. Mann

THE single-stage tuned radio-frequency amplifier here described should be of interest to users of the R1116/R1116A type double superheterodyne receivers. Tests carried out prove that it has much to recommend it for use in conjunction with the above types and also with the average regenerative combinations.

As the advantages of R.F. amplification are well known and appreciated, it is not proposed to dwell on the subject.

This model is not in any way regarded as the ultimate in R.F. amplifiers for use with the receivers mentioned, but rather as a tentative approach towards the design and construction of others more ambitious and efficient.

Before dealing with theoretical details, I wish to emphasise that this amplifier is a totally screened unit, the screening of which is equally a part of the receiver as are the individual components.

Some readers may have to hand a standard screening box as used by the writer. Some variation is, however, allowable in this respect, but in order to obtain the utmost in efficiency the unit should be screened.

A foil-lined wooden box of suitable dimensions could be used, if tin or copper foil is available. The box dimensions will be governed to some extent by the total height of the S.G. valve when fitted in the valveholder.

The Theoretical Circuit

The theoretical circuit is shown at Fig. 1, and follows on conventional lines with one important addition—the aerial resonance tuning circuit. Pre-war readers will perhaps remember that I have long favoured this type of tuner. When correctly used it is very effective with regenerative receivers, the T.R.F. and superheterodynes.

The additional signal gain and improved signal-to-noise ratio I have always found to justify its use.

Coils

The main tuning coils as used in the model are pre-war type four-pin of Eddystone make. Similar types of different make could be used effectively.

The aerial resonance tuner coils which are also of the four-pin plug-in type, consisting of a single coil wound on discarded valve bases, are cheap to make and efficient.

A Difficulty

When using additional units in conjunction with commercial and ex-Service receivers, the main difficulty is to match the band-changing arrangements so that a change of coils in the unit at the mid-way point of the receiver tuning is avoided.

In this case it is somewhat difficult, but has been overcome by using a tuning condenser of suitable capacity in the unit, which makes a good compromise.

Readers are strongly advised to fit slow-motion tuning dials to both condensers. While a plain knob could be used in the case of the resonance tuner, the resonant point is much more positive and easier to define when this type of drive is used.

It may be that at times the resonance tuner is adjusted in the interests of selectivity, and here again the reduction ratio will prove to be an asset.

Output/Input

The R.F. unit is capacity-coupled to the receiver by a .00005 μF pre-set condenser. A small-capacity condenser is also included in the R1116/R1116A receivers. The latter, if found desirable, can be shorted out. It has not been found so in the writer's case.

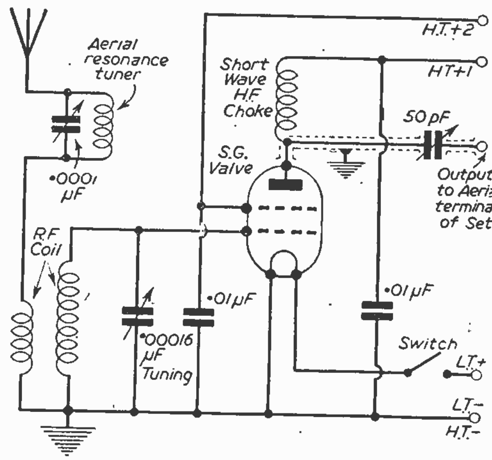


Fig. 1.—Circuit of the pre-amplifier described here.

Where it is desired to use the unit with a number of different receivers the user can carry out the slight modifications necessary to suit his own convenience.

The H.F. choke used in the model is the well-known and efficient Eddystone 1010. The bypass condensers are of the non-inductive type of T.C.C. make. These are marked towards the earthy end with a black ring and the capacity is 0.01 μF in each case.

Component Layout

Fig. 2 shows the component layout. The screening box used is of aluminium sheet with a ¼in. thick baseboard faced with thin-gauge aluminium.

The valve and coil holders are of Eddystone baseboard type. With further reference to the layout it should be noted that the base plate is earthed via the screening box while the bypass condensers can be earthed to either.

Insulation

While the .00016 μF tuning condenser is mounted directly on the panel, this does not apply to the aerial resonance tuning condenser. An insulating bush should be used in this case, and in addition some suitable material (thin card will do) should be fitted between the condenser and screening box face.

If this is not done it is possible that the condenser will be short-circuited to the screening box via the stator bolt heads.

Insulating bushes are also required in the case of the aerial and output terminals respectively. The earth terminal should be fitted direct to the screening box.

Resonance Aerial Tuner

Coil Data

The formers used in this case are all discarded valve bases of the four-pin type. All coils are close wound with 30 gauge copper enamelled wire.

20 Metre Band—8 turns.
40 Metre Band—13½ turns.
80 Metre Band—25¾ turns.

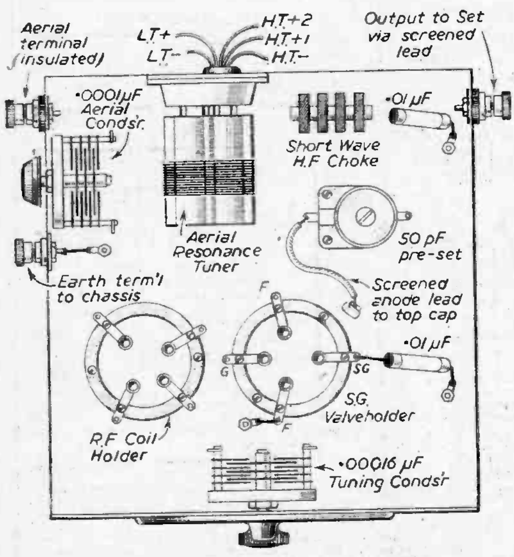


Fig. 2.—Suggested chassis layout.

Bottom of winding to grid pin.
Top of winding to anode pin.

These coils, of course, cover also, and within limits, adjacent frequencies.

Operation

With the amplifier coupled to the set and using common H.T. and L.T. supplies, and the appropriate coils fitted, set the aerial resonance condenser at half mesh. Follow by tuning the calibrated dial of R1116/R1116A at the same time, as in T.R.F. operation.

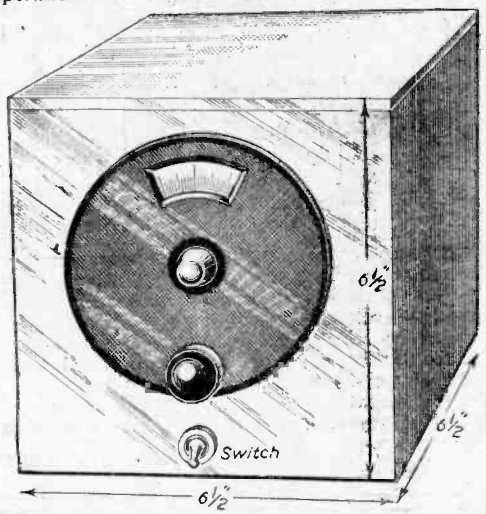


Fig. 3.—Panel layout and general dimensions.

As soon as the desired transmission is heard, tune the aerial tuning condenser (green faced) of the set, and the amplifier for maximum output, and follow up with tuning the aerial to resonance.

Reading the foregoing paragraphs may create the impression that tuning is rather complicated. This, however, is not so. Once having grasped the procedure it is very simple, and calls for but slight adjustment of the resonance tuner over any band.

Advantages

Correctly used, this unit will provide a very useful measure of additional signal gain, with improved signal-to-noise ratio, and in addition contribute to some degree in the partial elimination of the repeat point effect on 3.5 and 11 Mc/s bands common to some of the R1116 receivers but not all. In the writer's case it is most effective and the problem is to be further investigated.

The plate voltage to the S.G. valve should be the maximum obtainable from the H.T. supply and the screen voltage starting at 30 volts should be varied, 70 volts being used by the writer on the screen, and 120 volts on the plate.

The tests carried out by the writer under the thoroughly bad conditions prevailing during the winter, especially on 14 Mc/s, proved the efficiency of this unit by the snappy action of the resonance tuner and its ability to lift DX signals from below the prevailing noise level which made them inaudible when using the receiver alone.

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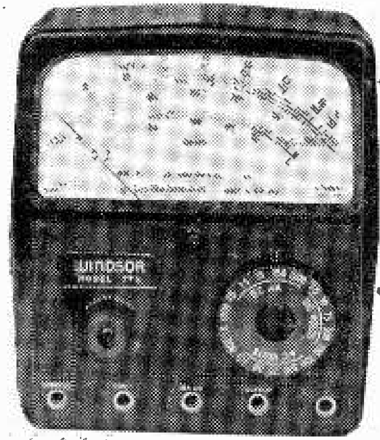

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For the Transmitter

Harmonic Crystal Oscillators—2

CRYSTAL CIRCUITS AND OTHER DETAILS FOR THE EXPERIMENTER

By G. Elliott

(*Concluded from page* 109 *March*, 1952 *issue*)

THE shunt capacity across the crystal in a conventional oscillator circuit may be 30-40 pF and there is a large ratio of shunt capacity to equivalent capacity of the crystal at resonance. When the anode circuit of the oscillator is tuned to 30 Mc/s the equivalent capacity and inductance of the crystal both decrease to one-third, while the effect is to place 3 x 35 pF across the crystal at the fundamental (assuming the shunt capacity to be 35 pF). Thus the ratio of effective shunt capacity to equivalent crystal capacity is very much higher. Similarly, at 50 Mc/s the equivalent crystal capacity is one-fifth of the value at 10 Mc/s, while a shunt capacity corresponding to 5 x 35 pF at the fundamental appears across the crystal. Therefore, as the frequency is raised the impedance of the grid circuit becomes lower and lower, and less and less output can be obtained, until the crystal refuses to oscillate.

A circuit operating on high order overtones must have a high grid circuit impedance. The circuit shown in Fig. 4 makes use of the ability of the crystal to appear as a capacitative impedance when energised at a frequency below the series resonant frequency. The crystal combines with the inductance L1 to give an anti-resonant grid circuit of high impedance at the required overtone. The crystal is operated in the capacitative condition (below the natural frequency) to avoid spurious oscillations, which are generated in some AT and BT cut crystals when operated in the inductive condition (above the natural frequency). The circuit values given in Fig. 4 are for a 72 Mc/s oscillator, using an 8 Mc/s crystal. The value of the inductance in the anode circuit will vary with the type of coupling to the following stage and the input capacity of the following valve. The tuning procedure is to adjust C5 to obtain grid current, using a meter plugged in the jack J, for various settings of the trimmer C1, until maximum output is obtained. With a power input of 1.8 watts, this circuit should give 0.3 watts of R.F. at 72 Mc/s. For use in crystal-controlled receivers useful output can be obtained up to the fifteenth overtone at least. All that is required in each case is that the grid inductance L1 shall resonate with the crystal to roughly the operating frequency, the final trimming being done by C1.

This circuit has certain advantages over triode oscillators of the Squier type apart from the generation of higher overtones. The grid-anode capacity of triodes, such as the 6J6 or 6C4, can provide excessive feedback in overtone circuits, causing crystal heating as a result of the high R.F. voltages across the plates. As previously pointed out, overheated crystals in the Squier circuit produce frequency drift and sometimes sudden jumps in frequency. Much less heating is experienced in the pentode circuit, resulting in higher stability.

The Butler Crystal Oscillator

The generation of high overtones in a crystal using a cathode-coupled oscillator, has also been described by Butler and independently by Goldberg and Crosby (Radio Division, Bendix Aviation Corp.). The basic circuit is shown in Fig. 5. A high-slope twin triode is generally used, the first section acting as a grounded grid amplifier, and the second section acting as a cathode follower. The outputs from both the G.G. amplifier and from the cathode follower are in phase with the respective inputs, and so it can be seen that if the circuit amplification overcomes the small circuit losses, an oscillating system will be set up. The quartz crystal, presenting a low impedance at series resonance, serves to couple the two halves of the circuit together. In practice, to make the crystal oscillate at a desired frequency the load R2 of the first triode is replaced by a tuned circuit resonating at the correct overtone. An interesting application is shown in Fig. 6, which is a crystal-controlled frequency changer stage for 145 Mc/s. High-slope twin triodes, such

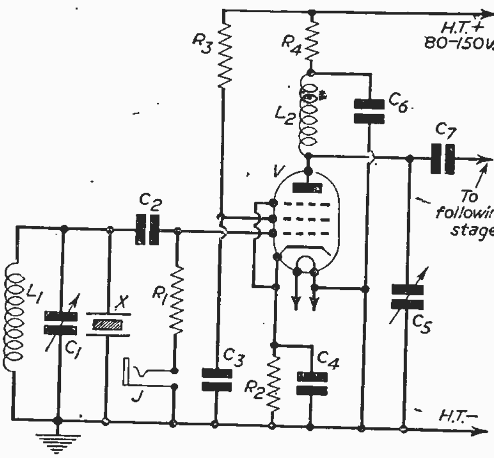


Fig. 4.—A high grid circuit impedance is a feature of this circuit.

COMPONENTS (Fig. 4)

X—8 Mc/s or other suitable X-tal.

R1—10 KΩ ½ watt.	C3—0.001 μF mica.
R2—270 Ω ½ watt.	C4—5 pF ceramic.
R3—5 KΩ ½ watt.	C5—20 pF air spaced.
R4—2 KΩ ½ watt.	C6—500 pF mica.
C1—10 pF air trimmer.	C7—300 pF mica.
C2—50 pF ceramic or mica.	J—Grid current jack.
	V—6AK5 or 717A.

L1—0.15 μH (16 S.W.G., 3 turns, ⅜in. diam., ⅜in. long).

L2—About the same as L1, but depending on loading of following stage.

as the 12AT7 or 7F8, are suitable in this circuit. The anode of the first triode section is connected to two parallel-tuned circuits in series, the first being tuned to the oscillator frequency and the second to the signal frequency. An output transformer at the intermediate frequency is inserted in the anode of the second triode. A 7 Mc/s crystal is used, operating at its nineteenth overtone of 133 Mc/s to give an I.F. of 12 Mc/s at 145 Mc/s signal frequency. As the first triode is strictly a grounded grid stage, the signal source should be of low impedance, such as an 80-ohm line, or a single-turn coupling to the anode-tuned circuit of the preceding

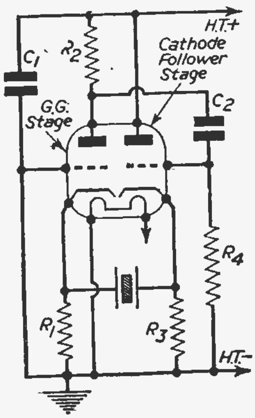


Fig. 5.—This circuit, of American origin, utilises a twin triode, with the first section functioning as a grounded grid amplifier.

R.F. amplifier. This circuit has been operated up to signal frequencies of 270 Mc/s.

A useful two-valve transmitter for 30 Mc/s is shown in Fig. 7, based on information given by Goldberg and Crosby. In this case the grounded grid stage is a tetrode, a 6L6, and the cathode follower section of the oscillator is formed by the cathode, control grid and screen grid of the P.A. tube. The anode circuit of the P.A. works independently, via electron coupling within the tube. The anode circuit of the 6L6 is tuned to 30 Mc/s and the crystal is connected between the two cathodes in the usual manner. The crystal may be in the 9-10 Mc/s range, operating at its third overtone, or in the 5.5-6 Mc/s range, operating at its fifth overtone. A full 150-watts input can be used on the 813, without excessive crystal current or overheating, working at 1,000-1,500 volts at 100-150 mA, and the output can be 100 per cent. modulated with only slight distortion or frequency deviation.

Crystal-controlled V.H.F. Receivers

With the use of overtone circuits, the production of a crystal-controlled receiver on the 2-metre and 70-cm. bands becomes quite simple. Fig. 8 shows a three-valve unit which will provide ample mixer injection for both a 2-metre and 70-cm. receiver or converter. A pentode overtone oscillator (717A) using, say, a 6,100 kc/s crystal, gives a frequency of about 42.7 Mc/s on the seventh overtone. The output is coupled to one triode section of a 6J6 acting as a tripler to 128.1 Mc/s. The second section of the 6J6 can be used as the mixer of the 2-metre receiver, the I.F. section being tuned from about 15-17 Mc/s to cover the band 144-146 Mc/s with injection at 128.1 Mc/s. The output obtained is also used to drive the final 6J6 as a push-pull tripler to 384.3 Mc/s, which is suitable to give a first I.F. of 50 Mc/s in a 70-cm. receiver (for example, the ASB8).

COMPONENTS (Fig. 7)

X—Crystal in range 9-10 Mc/s or 5.5-6 Mc/s.
R1—10 KΩ, 1w. R2—250Ω, 1w. R3—100Ω, 1w. R4—20 KΩ, 1w.
C1—0.005 μF. C2—50 pF air spaced. C3—0.001 μF. C4—0.005 μF. C5—50 x 50 pF split stator, air spaced. C6, C7—0.01 μF.
L1—0.5 μH. L2—1.0 μH.
RFC1—Double-wound choke, 2 lengths 16 S.W.G. closely interwound, 30 turns on 1 in. diam. former (winding length about 2in.).
RFC2—1.5 mH choke. V1—6L6G. V2—813.

Commencing signal generation on high frequencies enables one to avoid the production of large numbers of harmonics throughout the frequency scale. These harmonics frequently cause trouble by falling within the range covered by a V.H.F. converter, giving false signals. They may also cause television interference, although on a lesser scale than transmitters. With

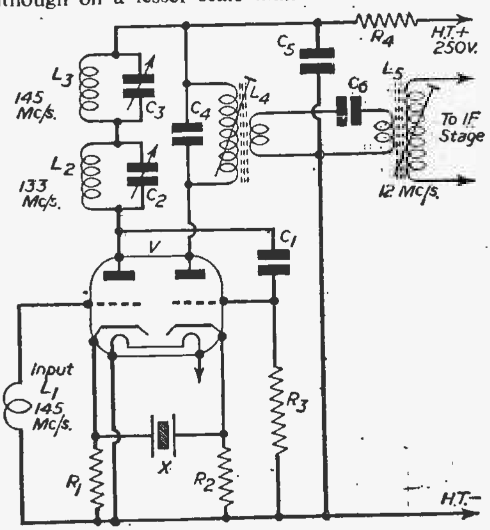


Fig. 6.—A crystal-controlled frequency changer for 145 Mc/s.

COMPONENTS (Fig. 6)

X—7 Mc/s crystal.
R1—150 Ω.
R2—150 Ω.
R3—20 KΩ.
R4—4,700 Ω.
C1—20 pF ceramic.
C2, C3—10 pF air trimmers.
C4—30 pF ceramic.
C5—500 pF.
C6—30 pF ceramic.
V—12AT7 or 7F8.
L1—Single turn, low impedance link for 145 Mc/s input.
L2, L3—0.1 μH (16 S.W.G., 3 turns, ⅜in. diam., ½in. long).
L4, L5—Double-tuned I.F. transformer for wide-band output on 12 Mc/s.

T.V.I. in mind, it is advisable to choose the crystals and the overtone used in the oscillator so that the signal does not fall within the local television band. For example, in the London area one would not use the seventh overtone of a 6,100 kc/s crystal (42.7 Mc/s) for trebling to 128.1 Mc/s, but instead use the ninth overtone of a 7,100 kc/s crystal (63.9 Mc/s) and double to 127.8 Mc/s for use in a 2-metre converter. For transmission in the London area, it is advisable in a 145 Mc/s transmitter to avoid the generation of 24 Mc/s in the first stage, as the second harmonic of this may be radiated on 48 Mc/s near the television band, even if the next stage triples to 72 Mc/s. It is preferable instead to generate the fifth overtone of a crystal in the 7.25 Mc/s region (36.25 Mc/s) and then double to 72.5 Mc/s, doubling again to 145 Mc/s. In the Birmingham region there is no objection to the 24 Mc/s stage, of course, as a 48 Mc/s signal falls well outside the local television band.

COIL DATA (Fig. 8)

- L1—0.3 μH (16 S.W.G., 4 turns, ½in. diam., ½in. long).
- L2—0.7 μH (16 S.W.G., 8 turns, ½in. diam., ¾in. long).
- L3—0.15 μH (16 S.W.G., 3 turns, ½in. diam., ½in. long).
- L4—1 turn coupling, ½in. diam., interwound with L3.
- L5—Line of 12 or 14 S.W.G. wire, 2½in. long, spaced ⅜in., tuned by shorting bar.
- L6—1in. long coupling loop, close to L5.
- RFC—18 turns, 30 S.W.G. wire on ¼in. former, close wound.

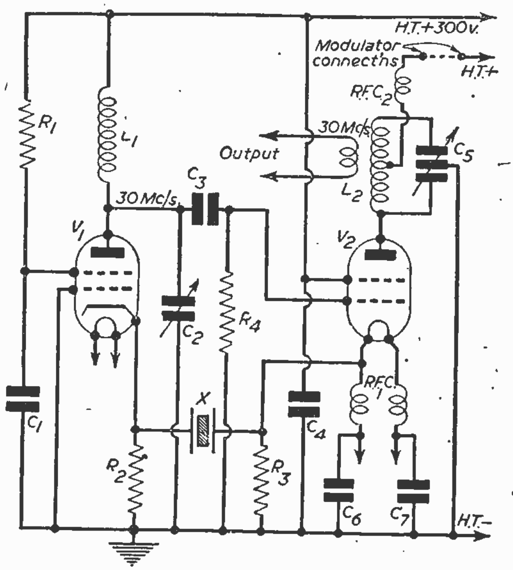


Fig. 7.—A two-valve transmitter circuit for 30 Mc/s.

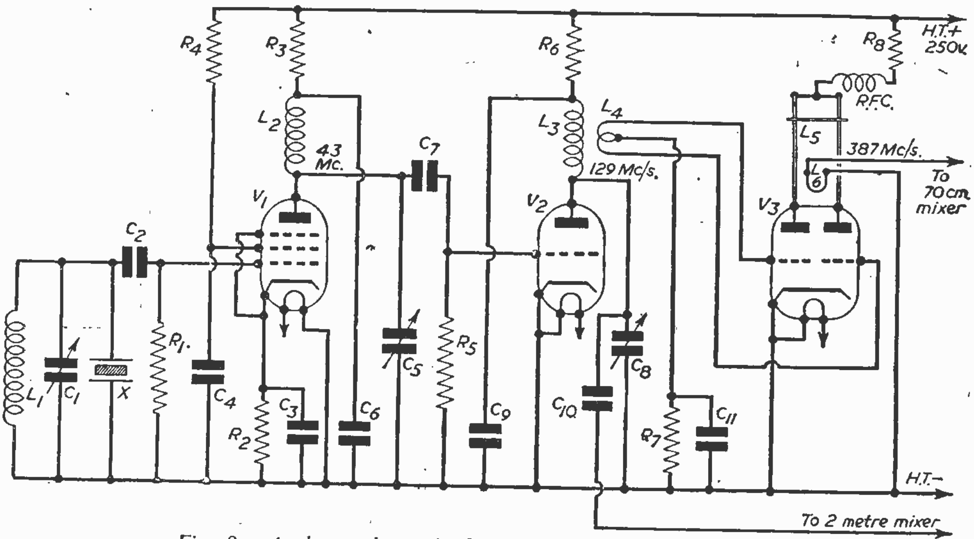


Fig. 8.—A three-valve unit for the 2-metre and 70-cm. bands.

COMPONENTS (Fig. 8)

- X—6,100 Kc/s or other suitable crystal.
- R1—10 KΩ ½w.
- R2—270Ω ½w.
- R3—10 KΩ 1w.
- R4—47 KΩ ½w.
- R5—47 KΩ ½w.
- R6—10 KΩ 1w.
- R7—100 KΩ ½w.
- R8—4,700Ω 1w.
- C1—10 pF air trimmer.
- C2—50 pF ceramic or mica.
- C3—5 pF ceramic.
- C4—0.001 μF mica.
- C5—30 pF air trimmer.
- C6—500 pF mica.
- C7—25 pF ceramic.
- C8—10 pF air trimmer.
- C9—300 pF mica.
- C10—2 pF ceramic.
- C11—300 pF mica.
- V1—717A or 6AK5.
- V2—½ of 6J6 or 12AT7.
- V3—6J6 or 12AT7.

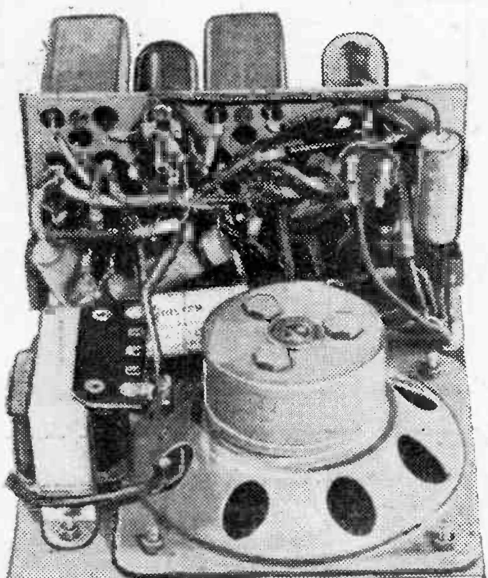
THE MINI-FOU

FURTHER CONSTRUCTIONAL DATA OF OUR L

ALL-DRY PORTABLE

LAST month we gave the preliminary lining-up data for this novel receiver, and if you have got so far you may find that the station was easily tunable with the temporary aerial lead attached to the yellow tag. If so, the aerial should be taken back to the green tag. Now adjust the aerial trimmer (upper hole), until the station is at its maximum volume, following this by a very careful adjustment of the I.F. trimmers for maximum volume. They should need only a very small movement, so do not turn them too far and then find that you are unable to obtain the original settings. A slight adjustment of each, going from one to the other, should enable you to get the maximum performance, and then the other coils should be similarly aligned. This completes the tuning and it should be found in most localities that the temporary aerial may be dispensed with and two or more stations may be tuned without any aerial lead—the coils themselves acting as small frame aerials.

In some localities, however, and perhaps in some types of buildings in good areas, it may be found that the actual signal available is too weak to provide a satisfactory signal and it will in such cases be necessary to use an aerial. This may take several forms and it will be necessary to adopt that type which the local conditions call for. In the extreme case of a very weak signal, up to 30ft. of thin, flexible wire should be attached to the aerial tag (green). Take this through a small hole or gap cut in the back of the cabinet and drape this in the room—running it along the picture rail or perhaps just taking it up to a picture hook or nail, so that it has as much of a long, straight run as possible. In some cases it may be possible to coil up the wire so that only a foot or two is outside the cabinet, the coil also acting as a frame aerial.



A general view of the completed receiver, showing wiring arrangement.—The Vidor L.5504 is a suitable alternative battery.

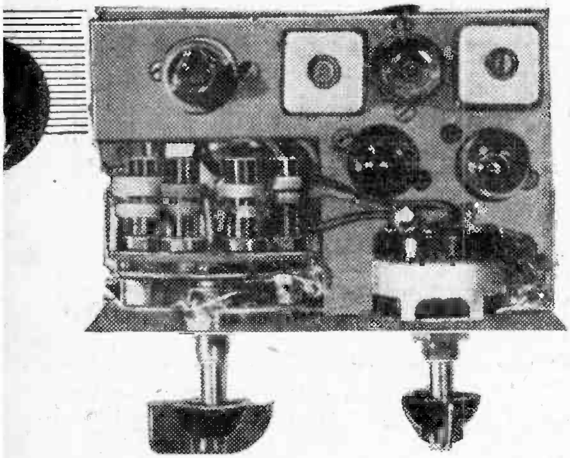
Carrying this idea still further, the wire may be wrapped round the entire receiver and battery for two or three turns, and left inside the cabinet. For this arrangement the best idea is to cut two strips of cardboard slightly less than 6in. in length and to stand these up at the sides of the receiver in line with V3 and V4. Cut small slots at the top and bottom edges of the strips and wind the aerial round the receiver, allowing the wire to be held in the slots and thus giving a firm foundation for the frame thus wound. The end of the wire may be attached to the cardboard by means of a small piece of Scotch tape, and the receiver and battery, together with the aerial, may then be handled as a complete unit and easily inserted or removed from the cabinet.

Controls

A few queries have been raised by readers who are constructing their first receiver and these will now be dealt with. First, the volume control is generally supplied with a spindle 3in. or less in length, and this has to be cut down to match the coil turret spindle. To avoid damage to the control the *end* of the spindle (not the control itself) should be clamped in a vice and the spindle sawn off with a hacksaw to the required length, the control being held in the hand to avoid excessive vibration and to prevent it from falling when the spindle has been cut through. This might sound an unnecessary instruction, but we are informed by the manufacturers that they often receive complaints from constructors who fail to appreciate that the component will be damaged if it is clamped in a vice, or that it is not a good thing for it to drop to a stone floor.

Earthing Tag

Another point, which is not apparently clear, concerns the earthing tag to which condensers C1 and C7 and other leads are joined. In order to produce the wiring diagram as a complete illustration, it will have been noted on the blueprint that the coil turret has been taken off the front panel and the tag above it is shown as being on the actual chassis. It is, of course, as may be seen from the illustration on page 107 of last month's issue, attached to the front panel and its position is not critical. A hole to accommodate the fixing bolt may be drilled anywhere between the coil turret and the top of the loudspeaker, or if desired, the top fixing bolt of the loudspeaker may



itself be used to accommodate the earthing tag, and this will avoid drilling a further hole.

In the case of some of the tubular condensers it will be found that there is either a black ring round the case towards one end, or the letters "O.F." are printed on one end. Both of these indications are that the outside foil is connected to the lead at that end of the condenser, and it is desirable that that lead should be connected to the "earthy" end of the circuit. The mica condensers do not, of course, have to be connected in any special manner, and neither do the fixed resistors.

The actual components used in the original model were listed, as already stated, on the blueprint, but in the event of any shortage in the supply of particular items there should be no objection to the use of alternatives, provided, of course, that the physical characteristics are the same. In this connection, and in reply to several queries, the Vidor type L.5504 is a suitable substitute for the specified battery.

One or two readers have queried the working voltages of the condensers as listed, and have asked why such a high voltage rating should be necessary. As already pointed out the components were, in most cases, chosen for their physical characteristics, but wrongly chosen condensers can be a prolific source of trouble and it was decided to use the ratings selected to guard against any premature breakdown. Slightly smaller components may be obtained with a lower voltage rating, but having decided upon the size of the battery and loudspeaker, it is not worth while cutting down on other items. Incidentally, the electrolytic condenser is rated at only 150 volts and not 250 volts.

Battery Life

One reader did complain after reading last month's article that the receiver was of little use as he was only interested in the longer types of programme. It must be emphasised, however, that small batteries such as are employed in these miniature personal receivers cannot be expected to give prolonged high-rate discharge, and they are not intended for such use. The prototype, was, however, kept in use for over three weeks, being switched on two or three times a day and left in two or three instances for the whole of Worker's Playtime. As pointed out, however, this type of receiver is for use when items such as News Bulletins and similar short items are being broadcast, or as a stand-by if the power fails or for those who are still using a battery receiver with an accumulator supply, for use whilst the latter is being recharged. For periods of long listening the receiver itself may still be used but a battery designed for a larger discharge rate must be employed. There is no reason, of course, why an external battery, or even a pair of batteries should not be used in such cases, but then the portability and the main feature of the small design will be lost. When using larger batteries for long listening periods it will probably be found that the L.T. section runs down more quickly than the H.T., and it is desirable to use separate batteries for each purpose. The four-pin plug would then have to be replaced by two separate plugs to suit the sockets fitted to the batteries which are chosen.

Another query concerns the operation of the receiver from a vibrator power pack, and this problem is being investigated with a view to designing a suitable power unit which may be used to replace the battery and thus provide for the operation of the receiver from the mains supply.

Kits of Parts

Finally, we have been asked where it is possible to obtain a complete kit of parts for this receiver and the cost of it. The total cost of the specified parts is just under £10 (including valves), and about £6 10s. excluding valves. Messrs. Stern Radio can supply any of the parts or a complet kit. As mentioned last month, the cabinet is supplied by Messrs. Tallon and Sons, Ltd., of Manor Works, Manor Road, Rugby, price 13s. 6d.

MINI-FOUR BLUEPRINT

Reprints of the above and the relative constructional details are now available for 1/- from the Publishers, George Newnes Ltd., Tower House, Southampton St., Strand, W.C.2.

FREQUENCY MODULATION

CONCLUSION OF THE PRINCIPLES OF DESIGN

By J. F. Golding

(*Continued from page* 112, *March* 1952 *issue*)

LAST month we concluded the main details of the receiver design, culminating in the general features of the A.F. amplifier. The circuit of a suitable amplifier is reproduced again below from which it will be seen that it is a four-valve arrangement, the input comprising a triode valve followed by a self-balancing phase inverter, which in turn feeds two tetrodes in push-pull. One particular advantage of this circuit is the fact that it is not by any means necessary to match the anode loads of the phase inverter. By virtue of the fact that the second section of this double triode is operated by the A.F. voltage across the cathode resistor, the cathode becomes effectively self centring so that the instantaneous A.C. voltage drops across each triode section are always equal and opposite.

Negative feed-back is taken from the secondary winding of the output transformer and applied to the grid of the first amplifier so that the whole of the circuit is included.

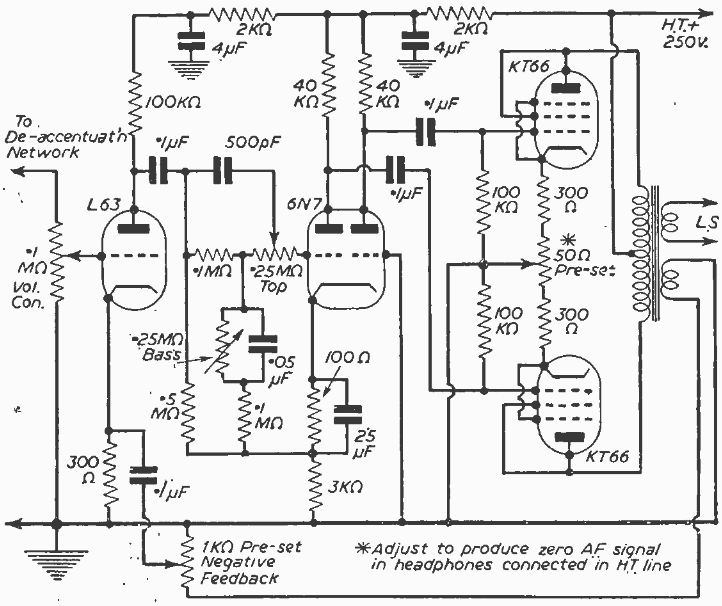
Separate tone controls are used for the high- and low-frequency response and the time constants of the C.R. coupling networks are such that the overall response of the amplifier is sensibly flat from 50 c/s to 15 kc/s.

Components

The most important component in an amplifier of this type where high-quality is being reproduced is the output transformer. A small transformer is easily saturated and an ample inductance figure should be aimed at if good L.F. response is required. The transformer is of the type having a separate winding for negative feed-back, but if you wish to try out the amplifier with an existing transformer, or perhaps have an expensive output transformer which you wish to use, it is possible to adopt the circuit for this by connecting the existing secondary in the following manner: one side of the secondary should be joined to earth, and the other side through a low-value fixed resistor to the cathode of the input valve. There is an optimum value for this resistor and there is also only one way round for the connection of the secondary winding. If, when connected up, there is a loud howl, the earth and feedback connections to the secondary winding should be reversed. The actual value for optimum results may be calculated from the formula 1,200 $\sqrt{s}\ \Omega$, where s is the speech coil resistance.

Wrotham Transmissions

For those who wish to listen to some F.M. transmissions it may be pointed out that the BBC transmit daily from Wrotham on 91.4 Mc/s (25 kW.) ±75 kc/s; the Light programme on Monday to Thursday from 11 to 12 and from 2.30 to 4.30. The Third programme is transmitted on Monday, Tuesday, Thursday and Sunday from 6 p.m. to close down, and the Home programme on Wednesday and Saturday from 6 p.m. to close down.



Circuit of the complete A.F. amplifier.

A THREE-WATT AMPLIFIER

MODIFYING THE A1135A EX-SERVICE UNIT

By K. Berry

THIS amplifier was designed to act as a record reproducer for any common make of pick-up, crystal or magnetic, where reasonable quality was required comparable to normal broadcast reception. It was desired to keep both cost and size small. The basis of the amplifier is the ex-Government amplifier Type A1135A.

This is a three-valve intercommunication amplifier, the line-up being EK32, EBC33, EL32. The EL32 will give an output of 3.6 watts with 250 volts on plate and screen; it also has the advantage of an economical heater, 6.3 volts at .2 amps.

Circuit of the Amplifier

The first stage is an EBC 33, a double-diode-triode used as a straightforward voltage amplifier, the diodes not being used are strapped to the cathode. The output of this stage is fed to an EL32 output pentode, which develops a maximum output of 3.6 watts.

The circuit is a semi-A.C./D.C. circuit using no transformer for H.T. supplies, these being obtained from a metal rectifier run straight off the mains input. The heaters of the valves are run off a bell transformer supplying 3, 5 or 8 volts. The nominal 8-volt tapping is used and does not overrun the valves. This method of running the heaters restricts the set to A.C. only; if, therefore, it is required for A.C./D.C. use, the valves must be wired in series and a dropper or linecord used as shown alternatively in the circuit.

One point to note is the earthing of the secondary of the output transformer; this should not be overlooked as without it the amplifier may oscillate.

Construction

If an A1135A amplifier is purchased, the first thing to do is to strip it. It will be found that the

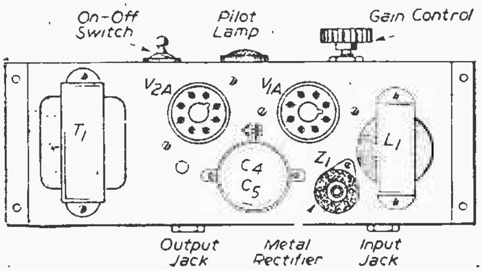


Fig. 1.—View of chassis from above.

sides of the chassis are hinged and by removing the six B.A. screws the sides can be opened out, thus facilitating the removal of the components.

It cannot be stressed too much that great care must be taken in removing the components. It is often better to snip the components out rather than unsolder them, as too often the leads are threaded through the tags and by the time the wires have been untwisted to enable the component to be removed, the paint is burnt off and the wax is running everywhere; and when a resistor has suffered that treatment it is better thrown away as its value will have changed.

Whilst on the subject of damaged components, caution must be exercised in using capacitors stripped from the A1135A or any ex-Government apparatus.

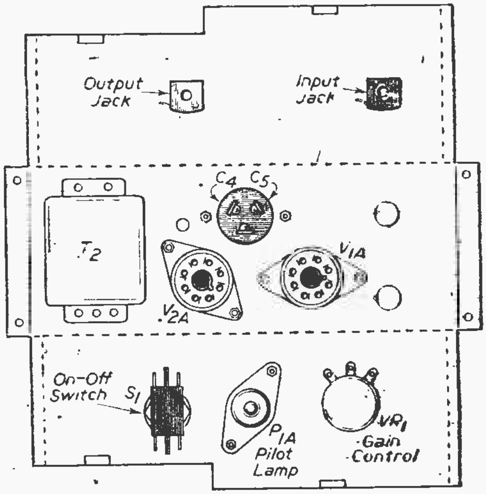


Fig. 2.—View from underneath, with sides of chassis opened out.

Mica condensers are usually all right, but paper or electrolytic condensers are very often "leaky" or short-circuited even when used.

The best way to test condensers (greater than .5μF capacity) is to charge them up to about 250-350 volts D.C., then see if they take further charges when put across the supply, i.e., see if they continue to spark. If they do then it shows that they have lost some of their charge and are thus faulty. These condensers should be thrown away as to use them in some future apparatus is asking for trouble.

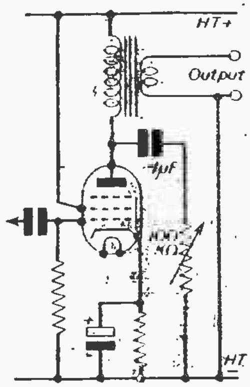


Fig. 3.—Tone control circuit.

Should the constructor have purchased an A1135A in order to construct this amplifier, he can effect a certain economy by using the large transformer on top of the chassis as a smoothing choke, using terminals 3 and 4. As a matter of interest, the transformer matches an EL32 to low-impedance (120/150Ω) 'phones; thus it is quite useful.

The top-side view of the amplifier can be seen in Fig. 1, and the under-chassis view is given in Fig. 2. The exact layout of the components is not critical, the usual conventions being observed, i.e., short grid and anode leads wherever possible.

In the case of the A.C./D.C. version it is suggested that the output transformer be positioned under the chassis in the space left for the bell transformer. The dropper can then be put in place of the output transformer.

Precautions

When completed the amplifier should work quite satisfactorily as no difficulties have been encountered in the circuit shown. Points to watch for instability are failure to earth the screen of the EBC33, or insufficient or lack of screening on the input circuit. Attempts to put the jack in the anode circuit of the EL32 instead of in the secondary of the output transformer may also lead to instability, owing to the long anode leads. Apart from this, if the anode is left connected, by some accident, the screen will rapidly get red-hot and "finish" the valve.

It is recommended that a loudspeaker not less than 6in. in diameter be used, otherwise there may be undue bass loss. It may also be desired to attenuate the high-frequency response of the amplifier. This may be done by connecting a condenser of suitable value (about .02μF) from the anode of the EL32 to earth, the exact value of the condenser being found by experiment as the degree of top-cut is purely a matter of taste. Alternatively, variable top-cut may be provided by connecting a .1μF

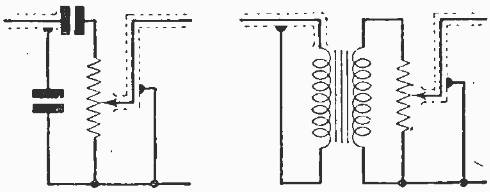


Fig. 4.—Volume controls for R.C. and transformer coupling.

condenser in series with a 100kΩ rheostat from the anode of the EL32 to earth; this may be preset, adjustment being made by a screwdriver, or it may be brought to the front panel for full adjustment. (See Fig. 3.)

It should be noted that, as is usual in A.C./D.C. practice, one side of the mains is connected to the chassis, therefore, under certain conditions the chassis will be at mains potential and so consequently will the pick-up. This is particularly undesirable as the pick-up is continually being handled and it constitutes a real danger—not so much to the constructor but to others who may use it. This snag can be overcome by the methods shown in Fig. 4, i.e., by putting two large capacity condensers in the leads or by interposing a transformer of low ratio, 1 : 1 to 1 : 5, in the leads. (An inter-valve transformer is suitable.) The former method is not

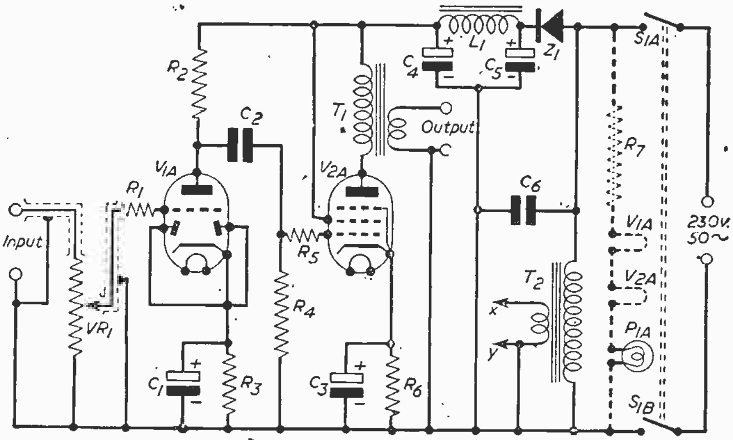


Fig. 5.—Theoretical circuit as modified.

to be recommended as with A.C. the condensers will pass enough current to give a fatal shock.

LIST OF COMPONENTS

VR1—500 KΩ volume control.	C4, C5 — 16 μF 250 V.D.C.W.
R1—10 KΩ ¼ watt.	C6—.05 μF 500 V.D.C.W.
R2—100 KΩ ¼ watt.	S1A, S1B — D.P.S.T. switch.
R3—2,000 Ω ¼ watt.	Z1—250 V. 50 mA. Metal rectifier.
R4—250 KΩ ¼ watt.	
R5—10 KΩ ¼ watt.	
R6—360 Ω ½ watt.	T2—Bell transformer.
R7—1,100 Ω .2 A. Line cord or dropper.	T1—Output transformer.
	V1A—EBC33.
C1—25 μF 25 V.D.C.W.	V2A—EL32.
C2—.05 μF 500 V.D.C.W.	L1—Choke, 10 henrys, 40 mA.
C3—25 μF 25 V.D.C.W.	

Radio D.F. Stations

RADIO Research Special Report No. 22, "The Siting of Direction Finding Stations," recently published by H.M.S.O. for D.S.I.R., price 1s. 6d. (40 cents U.S.A.), by post 1s. 7½d., explains that many radio direction finders now available have a precision of less than one degree. As a result the accuracy of bearings is limited only by imperfections of the station sites, even when these are the best available in agricultural country of the type found in this country. Much care is therefore necessary in the choice of sites if full use is to be made of the potential accuracy of a direction finder.

Information on the effects of various site imperfections such as trees, buildings, hills and other sources of interference is scattered throughout the literature of the subject. The report presents this information in a single publication.

Surplus Acorn Valves

DETAILS OF CIRCUITS AND VALVE TYPES

By E. G. Bulley

THESE valves, like their namesake are physically small and are to-day obtainable upon the surplus market. Their use is mainly at U.H.F., and it is common knowledge that at this frequency the reduction of stray capacities and inductances is an important factor. The prevention of such is to a great extent carried out by the valve itself.

The construction of the acorn valve ensures that the inductance of the leads, as well as the inter-electrode capacitances, are kept to an absolute minimum. It will be noted, therefore, that the more-or-less conventional valve stem is dispensed with, and one can, therefore, suppose that the acorn valve was the forerunner of the B7G based valves that are being made to-day.

The leads are brought out through the circumference of the bulb, upon which the various electrodes are assembled. This method of construction does eliminate any possible capacity existing between lead wires and because of their fairly large diameter and short length the inductance is also taken care of. Reference to Fig. 1, will indicate to the reader the method by which these leads are brought through the bulb.

It is as well to mention, however, that on no account should circuit connections be directly soldered to these leads. Failure to observe this warning, will only result in the heat of the soldering iron travelling along the wire and cracking the hermetic seal.

Advantages

Valves of this nature have many advantages, including that of an extremely short transit time, an essential requirement at U.H.F. Another great advantage is that of size, because, owing to this, a compact circuit design can be created thereby keeping capacitances and inductances at a very low figure.

The grids of these valves are knotched and swaged, the reason being that spot welding would, no doubt, oxidise the grid supports which, in turn, may create grid emission. Furthermore, the electrodes are usually assembled between mica baffles so that the complete assembly becomes rigid. The manufacture of such valves is carried out to very tight tolerances; this can be appreciated when one realises that the clearances between the grid and the cathode are something in the order of .005in.

The peculiarities of the acorn valve have now been briefly described, but before proceeding it is as well to mention that these valves are obtainable as diodes, triodes and pentodes. The latter types are more readily available at a very low figure. Types generally on sale are the VT120, VT121, VT238 and the VT237. Table I is included so that the reader can identify their commercial equivalent, whereas Table II provides the static characteristics of each valve.

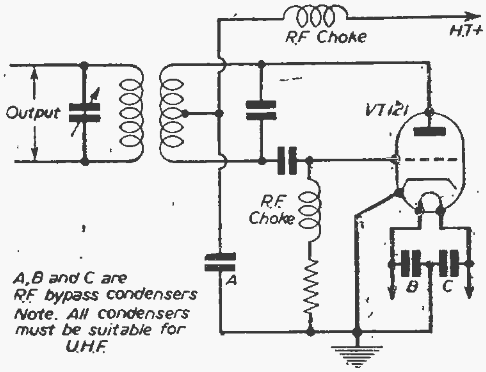


Fig. 2.—Basic Hartley oscillator circuit.

The VT121 is perhaps the type most well known to the radio amateur, and this is a triode which can be used as a detector, amplifier or oscillator. This valve is suitable in the Hartley oscillator which is shown in Fig. 2. One must not forget, however, that to obtain best results at U.H.F., the grounding of R.F. by the use of condensers is essential if the valve is to satisfy the requirements of the experimenter. Furthermore, this valve can be used in the well-known Colpitts oscillator with great success, as

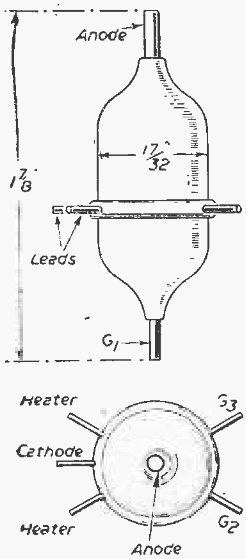


Fig. 1.—Details of the 954 valve and its connections.

TABLE II

Type	Class	Fil. V	Fil. Current	Anode Voltage	Screen V	Impedance	Slope mA/v
954	Pentode	6.3	.15 amps.	250 max.	100 max.	1.5 mΩ	1.4
955	Triode	6.3	.15 amps.	250 max.	—	11.4kΩ	2.2
956	Pentode	6.3	.15 amps.	250 max.	100 max.	700 kΩ	1.8
957*	Triode	1.25	.05 amps.	135 max.	—	20.8 kΩ	.65

* Directly heated. Others indirectly heated.

TABLE I

U.S.A. Com. No.	British Com. No.	British Surplus No.	U.S.A. Surplus No.
954	ZA2 & 4672	VR95	VT120
955	HA2 & 4671	VR59	VT121
956	—	—	VT238
957	—	—	VT237

Table of the more popular Acorn valves to be found in the surplus lists.

well as the push-pull, tuned-anode-tuned-grid oscillator circuit. It does, therefore, lend itself to a large number of applications for the experimenting amateur.

R.F. Amplifier

A basic circuit incorporating the VT120 is shown in Fig. 3, whereby this valve is used as an R.F. amplifier, or, if one so desires it, the grids can be strapped to the anode and the valve used as a diode for frequency changing or detection.

Acorn valves operate successfully at frequencies of several hundred megacycles per second, and are best used in line resonating or coaxial line circuits. However, whatever type of circuit is adopted, it is advisable to include suitable R.F. chokes in the various feeds and ensure that all connections are kept as short as possible.

These valves are suitable for inclusion in such equipment as valve voltmeters and field strength meters. Once again their physical size does enable the constructor to incorporate the valve in the probe of the valve voltmeter, and in the case of the latter piece of equipment, the size enables the field strength meter to be fairly compact.

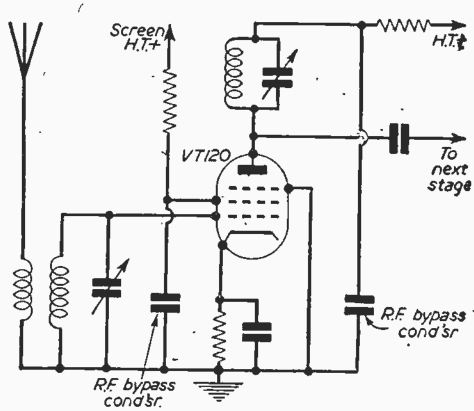


Fig. 3.—Typical R.F. stage using Acorn pentode.

New Multicore Factory

AS from February 25th the head offices of Multicore Solders, Ltd., manufacturers of Ersin and Arax Multicore Solders, were moved to the company's new factory at Maylands Avenue, Hemel Hempstead, Herts. The offices at Mellier House, Albemarle Street, are being retained only as London West End executive offices.

The new factory, built by the Government Development Corporation, is claimed to be the world's largest specially built for the manufacture of cored solder. It will be officially opened by the Mayor of the new town of Hemel Hempstead in a few months time when the transfer of plant from the Multicore factory at Slough is completed.

Three Moves

Owing to the rapid expansion of home and export sales of Ersin Multicore Solder the location of Multicore production has moved three times in twelve years and the new works is eleven times the size of the original works at Walthamstow.

Owing to the current high value of the metals used in the manufacture of Ersin Multicore Solder an intricate burglar alarm system has been installed which is connected by a private G.P.O. telephone line to the police station three miles away.

Staff from the Slough works, London offices and workers from London boroughs associated with the new town are shortly moving into new houses and flats built by the Development Corporation.

Export

"We believe," said Richard Arbib, Multicore's managing director, "that our new factory will enable us to greatly expand our export sales, particularly to the U.S.A., where for a long time imports of Ersin Multicore Solder were limited solely by our production capacity. The new plant which we will be installing during the next few months will make it possible for us to introduce many interesting developments in cored solder production, thus ensuring that Britain maintains the world lead she has held for so long."

Ekco Airfield Approach

BEFORE an invited audience of around 100 people from various parts of the world, a new Ekco airfield approach aid was demonstrated recently at Southend Airport. This new development was shown to be capable of bringing in an aircraft to land under conditions of visibility which would normally make a landing dangerous or even impossible and it is operated on the ground by only one person. It is intended for use at aerodromes where the cost of installing and operating the type of equipment used at such places as Heath Row, etc., would not be economically justified and in fact it is likely to find application at large numbers of smaller airports throughout the world.

Mr. E. K. Cole, chairman and managing director of E. K. Cole, Ltd., welcomed the guests, after which the company's chief engineer, Mr. A. W. Martin, gave a technical description of the equipment in which he explained that the basis of its design was the combination of a 3 centimetre radar installation with a V.H.F. D.F. receiver. Mr. B. Collins, the airport manager, described the way in which the equipment was operated and said that he had been operating an experimental prototype installation since 1949 and had successfully brought in a wide variety of aircraft, including jets. A senior pilot of the air line company operating from Southend Airport gave the equipment high praise from the pilot's point of view.

Guests at the demonstration included, in addition to representatives of the press and technical journals, high-ranking officials from the Air Forces of the British Commonwealth, America and Europe, together with representatives from B.O.A.C. and a number of air lines and charter companies.

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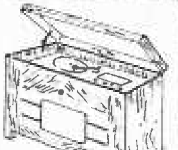

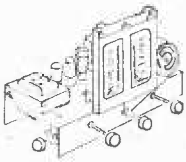

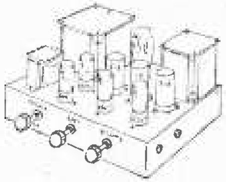

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1A.I

A FAULT FINDER

A MULTIVIBRATOR ARRANGEMENT SUITABLE FOR INTERMITTENT FAULT FINDING

By J. S. Kendall

[T is probable that the multivibrator is the most useful single piece of apparatus for fault finding, as it is capable of providing a test wave that is ɔ full of harmonics that it can with a 1 kc/s ındamental be picked up at 10 Mc/s. With a good ɛceiver, the output impedance can be so low that it an be used to buzz test a low-impedance speaker!

The basic circuit is very simple, consisting of two alves, usually triodes or pentodes strapped as riodes, coupled so that the output of one is fed ıto the input of the other so the Schotte noise is mplified by one valve and the resulting output again mplified. This amplification of noise continues ıntil both the valves overload, when they settle lown to oscillating in a fairly steady flip-flop manner. 'he simplest circuit is shown in Fig. 1, but this simple ircuit has the disadvantage that it stops working if oo large a load is applied. The frequency of oscilla- ion is dependent on the time constants of the two ;rid circuits, and is given approximately by the ormula $f=\frac{1}{R_1C_1+R_2C_2}$. The anode resistors can be ılmost anything so long as they allow the valves to ımplify. The writer has found 30 kΩ for low- mpedance valves, to 250 kΩ for high-impedance types uitable.

The ideal output for any piece of equipment is a ow-impedance output, and the best of these for ›verall frequency response is the cathode follower. The introduction of this type of output is simple ınd the circuit is shown in Fig. 2. To give an example 'or the practical man of the impedance of the output vith various valves a high-impedance triode will be 700 to 800 ohms, medium-impedance ones such as he 6C5, 6J5, MH4 types are about 500 to 600 ohms, whilst H.F. pentodes strapped as triodes such as ƎF50, SP41, SP61, are as low as 90 to 100 ohms, depending on the H.T. volts used. The best all-round cathode resistor for the output of the cathode follower in this case is a 10 kΩ potentiometer, the output being taken from the moving part. The output terminal should, of course, be fed through a condenser. If the output is for general use, including buzz testing speakers, it will have to be of very low impedance and will require a capacity of 1 μF. A paper tubular would be the best, but as these condensers have an amount of self-inductance it should be shunted by a small moulded or silver mica condenser of about .002 μF. To the beginner in radio this may seem silly, but if it is tried out first with, then without, the condenser, on the short wave of a radio receiver the improvement will be noticed.

In the original unit there are four SP41s strapped as triodes (three for the multivibrator and one in a thermionic relay circuit).

Components

Most of the components used were surplus, with the exception of the condensers. The writer has found that it is always best to buy new, as so many surplus ones have a fairly low insulation value (values as low as 1,000 megohms can cause a lot of trouble when used for intervalve coupling). Another point to watch concerns surplus potentiometers. Very many have the moving contact taken to the spindle with the result that if they are used in conjunction with a metal panel, which is essential for screening, half of the track gets shorted out and the output earthed with dire results to the valve. The mains transformer used was an old 250-volt output with a 4-volt winding out of an old commercial set. It had no rectifier winding so a metal one was used; the smoothing has no special points and just consists of an old choke and two 8 μF. condensers.

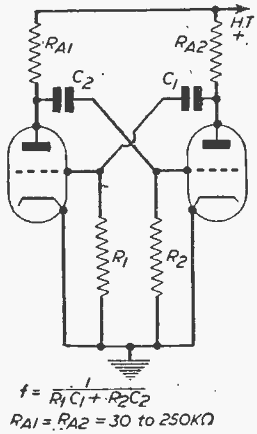

Fig. 1.—Basic "flip-flop" circuit.

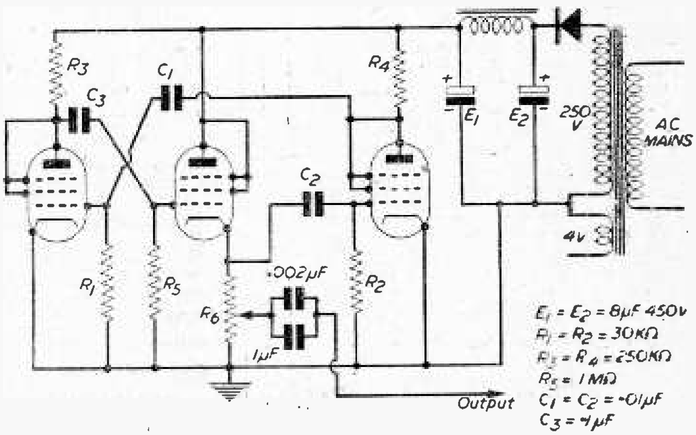

Fig. 2.—Circuit of the Fault Finder.

The components listed are those used by the writer but they are not in the least critical ; if, however, the values of C1, R1, C2 and R2 are altered, the note of the output will be altered. The values given will produce about a 1 kc/s note.

Using the Unit

The unit when finished can be used for fault finding in the following way : the receiver under test is first switched on and then the output of the multivibrator is injected into the grid circuit of the output valve, and if there is no signal the anode circuit should be tried. If a note is obtained the fault is in the valve

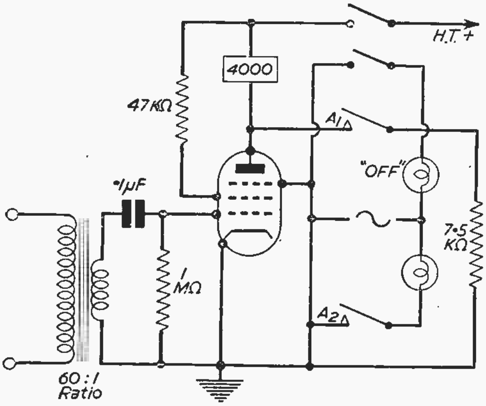

Fig. 3.—The relay stage.

circuit, but if not, try the output across the speech coil. If no results here, the speech coil is faulty, but if the signal is O.K. the fault is in the transformer. The fault is always between the last point that the signal is found and the first that it is not, no matter whether it is in the L.F. or H.F. section of the receiver.

Whilst it is not suggested that the multivibrator should replace the signal generator for alignment work it definitely has advantages over it for the padding and tracking of the oscillator section of a receiver. The method is, first align the I.F.s to the correct frequency with the aid of a signal generator ; this done, connect the multivibrator to the aerial and earth socket. Tune the receiver to the high-frequency end of the band and adjust the oscillator trimmer for the maximum signal ; then tune to the low-frequency end and adjust the padder. Do not bother about the frequency on the dial of the receiver, but just turn the tuning control to the limit, then, when the trimmers are checked, by adjusting them a second time exactly the same condenser positions are obtained. No matter how far out of track the receiver is it can be quickly adjusted with a multivibrator with the absolute minimum of trouble, and that is more than can be said of the signal generator.

The writer mentioned earlier in the article that he had used four valves in the circuit and that he had used the other for a relay circuit which is shown in Fig. 3. This is essentially a leaky-grid detector with an output transformer connected so as to give a 60 : 1 or more step up. The switch used for the H.T. of the relay was an ex-W.D. one with two contacts, so arranged that when one is made the other is broken. These were used to show when the H.T. was off and to switch on the H.T. to the relay. The relay in the anode circuit of the SP41 was of the 2,000 type with one break and a change-over contact the total coil resistance was 4,000 ohms. The circu is used in conjunction with the multivibrator for th detection of intermittent faults, the method being t inject a signal from the multivibrator to some poin in the middle of the receiver circuit ,switch on th relay (due to the action of the grid as a diode th valve will be biased well past cut-off when the signa is applied from the output of the receiver) and leav both the receiver and the tester running. If an audibl signal is required, an alarm bell can be connecte across the " FAIL " light. When the fault occur it will bring on the " FAIL " light and lock th relay over the hold resistor. The location of a intermittent fault is a slow one, but by finding the tw points between which the receiver fails and does no fail, and making a close examination of the com ponents between these two points the fault will b found. One point to remember is to check whethe or not the fault is connected with fluctuation of th mains voltage, if it is, then it is probably due to th frequency changer valve going low on emission.

200 kW Transmitter for Denmark

A £90,000 contract for a high-power broadcasting installation has been placed by the Danish Directorate-General of Posts and Telegraphs with Marconi's Wireless Telegraph Co., Ltd., through their Danish agents, Sophus Berendsen A/S. The new station, which it is hoped will be opened in Kalundborg at the end of 1953, will be one of the highest power in the world and will be completely air-cooled.

Marconi's have previously completed two 100 kW stations—one at Kalundborg and the other at Skive —which now carry the Danish Number Two programme. The new 200 kW installation will carry the Number One programme. The complete Danish high-power broadcasting system will then be Marconi designed and installed.

It will consist of two Marconi 100 kW transmitters with paralleling equipment, capable of an output of 200 kW. These are the highest power air-cooled transmitters yet designed, and they eliminate the usual large reservoir and pumping apparatus needed for water-cooling systems.

Similar installations have been ordered by the Argentine and Norway, and some months ago the BBC started broadcasting their Third Programme from Daventry with such a 200 kW transmitter system.

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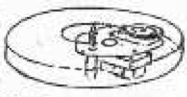

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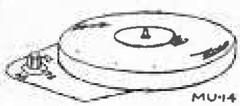

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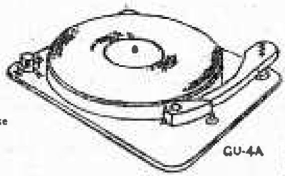

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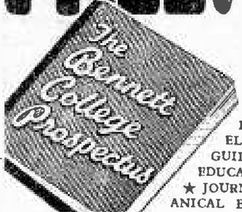

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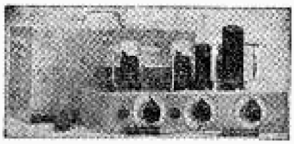

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MODEL AC8C. 5-valve chassis with p/pull output of 10 watts. For record or radio reproduction. Output to 3, 8, 15 ohms. H.T. and L.T. supply for feeder. **£10-10-0.**
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For use with the above amplifiers. Sold separately if desired, Rothermel D104 Crystal Microphone. **£5-5-0.** Acos 22-1, 22-2, **£6-6-0.** Collaro Record Players (A.C. only) with motor, turntable pick-up and auto-stop. Magnetic. **£6-9-6** ; Crystal. **£6-15-6.**
SPEAKERS. Rola 10in., **35/-** ; 8in., **30/-**. Grampian 12in., **£7.** Goodmans 12in., **£8-12-6.** Microphone cable, **1/6** yd. Stylus needles, play 6,000 records, **6/6.** Jack plugs, **1/9** each.
COILS. Denco L.M. wave, T.R.F. with reaction, **6/6** ; Wearite "P" coils, **3/-** each ; Weymouth "H," **3/6** each ; Weymouth I.F.s, **15/-** pair ; Wearite standard, **10/-** each ; Miniature, **10/6** each.
TRANSFORMERS, ETC. 2 x 350 v., 0-4-5v. 2a., 0-4-6v. 4a., **19/6** ; ditto, 2 x 250v., **18/6.** Speaker Transformers, 6V6 to 3 ohms, **4/3** ; 6V6 p/p to 3, 8, 15 ohms, **19/6.** 1S4/3S4 Miniature type, **5/3.**
CHOKES. 60 m.a., 15 hy., 300 ohms, **5/3** ; 100 m.a., 20 hy., 400 ohms, **16/6** ; 150 m.a., 10 hy., 200 ohms, **16/6** ; 90 m.a., 10 hy., 180 ohms, **13/6.**
VAR. CONDENSERS. Solid dielectric, .0003 or .0005, **4/-** each.
FIXED CONDENSERS (only 1951 stock offered). 8—8, **4/9** ; 8—16, **7/3** ; all 500v. 50 mfd. 50v., **2/3** ; 25 mfd. 25v., **2/3.** .0001, .0002, .0003, **8d.** ; .0005, .001, .002, .005, **9d.** ; .01, .05, .1 mfd., **10½d.**
MISCELLANEOUS. 6K7, 6J7, 6J5, all **7/6** ; 1S5, 1S4, 3S4, 1T4, 1R5, all **9/6** each ; .3a. droppers, 800 ohms, **4/6** ; .2a., 1,000 ohms, **4/6.** B7G bases, **9d.** Linecord, .3a. 60 ohms, ft., **7d.** ft.
All goods new. Post paid over £1. C.W.O. or C.O.D.

Programme Pointers

A MONTHLY CRITIQUE BY MAURICE REEVE

THE presentation of radio programmes to the public has ever been very similar to the format long since adopted by the newspapers. Why this should necessarily be, I cannot think. But necessary it apparently is, if long usage be the criterion. Seldom original, and nothing if not thoroughly conventional, a day's broadcasting is a very similar experience to turning over the pages of any good daily newspaper where we can find the leading article, the gossip column, the financial or sporting pages, etc., etc., always in the same places on the same pages every day, and year after year.

Thus we have symphony concerts, "Ray's a Laugh," "Woman's Hour," "We Beg to Differ" and what you will, at precisely the same hour on the same day of the week so long as they shall live. Nowhere is this more noticeable than in the news bulletins, which are set out in primary and secondary headlines followed by the "article" on the events, the whole arranged in what is deemed to be their order of importance, just as in a paper.

Thus, I suppose, it has come about that the period commencing at 9.15 on a Sunday evening—a quarter of an hour—together, perhaps, with the hour that follows, would seem to be the most important, the most illustrious and the most elevated of broadcasting periods. Sometimes, as when devoted to the Reith lectures, it extends to half an hour. But the holding of these lectures at this particular time confirmed them in their dignity and splendid isolation. Not even the loftiest music or the weightiest drama has succeeded in breaking in. Neither has religion or politics. Only philosophy, and a philosophical view of some kindred subjects, such as Fred Hoyle's series.

At present it is occupied with a collection of "Letters to Posterity," in which a number of public figures are writing to their successors in the same positions and offices as they now hold, in 2052. On the whole, the series is rather disappointing and seems to have missed its mark, though of considerable interest and enlightenment. Rather than for the warden of a college or a scientific lecturer to write to his successor a hundred years hence about conditions and opinions in his particular sphere here to-day (all of which his successor will be able to obtain for himself from the works of history and reference which will be at his elbow, and with which we, listening, are all too familiar), would it not have been more apposite and certainly more entertaining for the successor to have written to the present incumbent telling of things as *he* was finding them? This would have given the correspondents at the current microphone the opportunity of ranging over the field of prophecy covering the next hundred years. Will there be an Oxford College? Will there be a House of Commons? Will there be a British Empire? Will there be any broadcasting? But perhaps these interesting thoughts are stored up for us in a future series.

"Wozzeck"

In the musical world, the two most important events of recent weeks were "outside" broadcasts, the long awaited production of Alban Berg's opera "Wozzeck" from Covent Garden, under Erich Kleiber, and John Gardiner's first symphony, done by the Hallé Orchestra under Barbirolli at a Royal Philharmonic Society concert. "Wozzeck" is a masterpiece: the symphony an excellent work of the greatest promise.

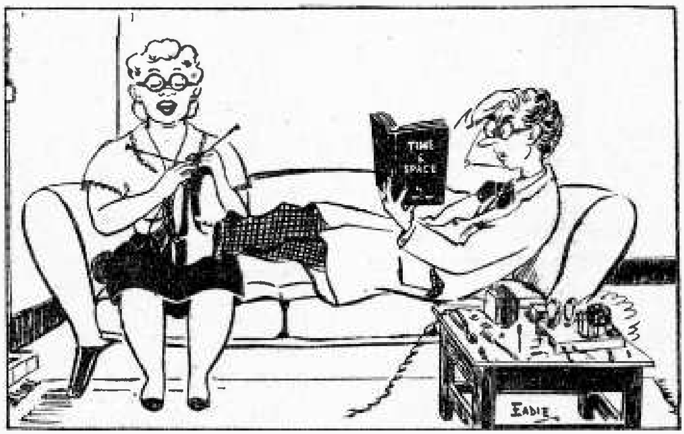
The opera, written a little over 20 years ago in modern musical idioms, is the setting of a story over a 100 or more years old. Its author, Büchner, died when about 30, and this masterpiece—one of the saddest of stories of a demented soldier murdering his unmarried wife from jealousy and then committing suicide—is now encased in music which will ensure its place in the repertory. Sad? Sordid? Yes, but so were Othello, Macbeth and a host of others.

The Gardiner symphony is taut, lean, spare yet powerful and moving music. It seems to hold out at least as much promise as Walton's first, and so far only, symphony did. Both works received rapturous ovations.

Serials

The two current serials are both Dickens adaptations, namely "A Tale of Two Cities" and "Oliver Twist." Both are very much the better and more effective for being minus the tedious and boring "narrative" which has so clogged up recent productions in this genre.

PROFESSOR BOFFIN



"I sometimes wonder if you still care, Henry Boffin!"

Cor de Groot

Whilst in the musical world, I must not forget to mention the name of a very accomplished young pianist, Cor de Groot, and to record the opinion that the announced intention—decision—to disband the Opera Orchestra is much to be deplored.

Newsreel

The speed and address with which Radio Newsreel brought out the story of the *Flying Enterprise* was to be highly commended. It was probably the best thing of its kind one can remember. Being free from all the inhibitions and restraints of "script" and "production," it sped along with fine gusto and drama.

Drama

"Man and Superman" was the chief dramatic event of the immediate past, first divided into three bites of the cherry, on three different evenings, and then the whole cherry over again, in one glorious mouthful. Sebastian Shaw, as Tanner, tended to emphasise the wit and pungency of the individual lines at the expense of dramatic continuity. "The Damask Sword," "The Franchise Affair" and "Happy Ever After" were some of the other theatrical efforts of the period.

News from the Clubs

WARRINGTON AND DISTRICT RADIO SOCIETY

Hon. Sec.: S. Woods (G3EZX), 12, Thelwall Lane, Latchford.

THE Society's annual general meeting was held on January 15th, Mr. A. Monk presiding. Mr. G. Leigh (G2FCV) was elected to the chair.

Meetings are held on the first and third Tuesdays of each month at the King's Head Hotel, Warrington, 7.30 p.m., the first Tuesday being, wherever possible, lecture evening.

ECCLES AND DISTRICT RADIO SOCIETY

Hon. Sec.: G. Gray, "Woodlea," 2, Egerton Road, Monton Green, Eccles.

AT the A.G.M., held on Monday, January 21st, Mr. G. Gray, of "Woodlea," 2, Egerton Road, Monton Green, Eccles, was elected secretary for the coming year, Mr. E. Rayson, the late secretary, being unable to continue as he is shortly leaving for Australia.

BIRMINGHAM AND DISTRICT SHORT-WAVE SOCIETY

Hon. Sec.: A. O. Frearson, 66, Wheelwright Road, Erdington, Birmingham, 24.

IT is hoped to expand the social activities of the society. Following the very successful annual dinner, which was followed by a visit to a show, the committee has decided to arrange more events which will include YLs, XYLs and friends. The first of these will be a coach party for a day's excursion towards the end of April. It is hoped that the final details will be available next month.

DOWNHAM MEN'S INSTITUTE (RADIO CLASS)

Hon. Sec.: Mr. W. H. F. Wilshaw, 4, Station Road, Bromley, Kent.

THE club meets every Wednesday evening, at 8 p.m., under the instructor, Mr. G. V. Haylock (G2DHV) (club chairman), at Durham Hill School, Downham. Lectures are given on "Servicing at Home," and general radio theory. Practical work is undertaken by the building of the various chassis of the "Williamson Amplifier," an oscilloscope and an all-band superhet radio receiver.

Lectures and film strips recently given to the class include: "Valve Theory," "History of Radio" and "Cathode Ray Tubes." Five members of the class recently visited a B.B.C. studio broadcast. Morse classes are held regularly.

LEICESTER RADIO SOCIETY

Hon. Sec.: A. L. Milnthorpe (G2FMO), 3, Winster Drive, Thurmaston, near Leicester.

THE New Year was commenced in fine style with the Society's annual dinner and dance, being held on Friday, January 11th, 1952, at the Empire Hotel, Leicester.

During the dinner Mrs. Ridgeway, wife of the president, presented the "Ridgeway Trophy" to Mr. K. Chapman (G3AFZ) for achievements in transmitting during the past six months, and Capt. H. V. Thomas (G2CUR) officially handed a new trophy ("Thomas Trophy") to G2RI, the society's president, to be awarded for outstanding achievements by non-transmitting members of the society; the rules and regulations of the contest will be formulated by the contests organiser, Mr. Mervin Storey (G4BB).

A cordial invitation is extended to any interested radio enthusiast to come along to the meetings, which are held every first and third Monday in the month at the club room, Holly Bush Hotel, Belgrave Gate, Leicester.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: W. A. Launder, B.Sc.(Eng.), G3FHI, 15, Cambridge Road, St. Marychurch, Torquay.

"AERIAL Couplers," was the subject of a talk given by G2GK (F. J. Wadman) at the last meeting. Efforts are being made to hold a dinner before Easter. Forthcoming field day matters were considered.

G3AUS (R. Hope) will give his talk, "Propagation," at the March meeting (March 17th).

The society meets at 7.30 in the Y.M.C.A., Castle Road, Torquay, on the third Saturday in each month.

Interested visitors are invited.

EDINBURGH AMATEUR RADIO CLUB

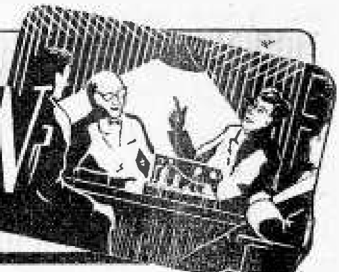
Hon. Sec.: C. L. Patrick, 19, Montgomery Street, Edinburgh.

THE club continues to meet weekly on Wednesdays at 7.30 p.m. in Unity House, Hillside Crescent, Edinburgh.

Intending members or visitors should either contact the secretary, telephone Edinburgh Central 3960, or come to a meeting on a Wednesday.

LEICESTER RADIO SOCIETY'S ANNUAL DINNER. Seated at the top table, left to right: A. L. Milnthorpe (Hon. Sec.); Mrs. Penniston; L. Ridgeway (G2RI); Mrs. Ridgeway (donor of the Ridgeway Trophy); C. Penniston (chairman) (G3GVK).

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).

R1116 and R1116A

SIR,—With reference to readers' queries re the above. According to a firm who overhauled and sold these receivers, some were prone to produce 14 Mc/s harmonics on 11 Mc/s and 7 Mc/s harmonics on 3.5 Mc/s. This I put down to a fault in design. Those on 7 Mc/s can be eliminated by a signal frequency trap in series with the aerial using .0001 μF tuning capacity. The same idea will work on 11 Mc/s. Now certain writers appear to associate this trouble as entirely due to the 1,700 kc/s first I.F. My own idea is that it is due to spurious harmonics produced perhaps by the two frequency changers 1,700 kc/s and 100 kc/s plus signals of various frequencies combining. Incidentally, a single R.F. stage ahead of the frequency changer, whilst not a complete cure, certainly helps. I have carried out a test with a modulated signal from Avo oscillator fed direct to set input. I find that while one can receive 14 Mc/s signals on 11 Mc/s, one can also receive 11 Mc/s signals on 11 Mc/s.—A. W. MANN (Middlesbrough).

TR/9 Conversion

SIR,—May I clear up the difficulty Mr. B. Pickrell raises in the February issue regarding my conversion of the TR/9 receiver. The coils wound as described tune from approximately 18-42 metres, not 18-24 metres (the exact figure depends on stray capacity). I am glad to see from his letter that he has obtained most satisfactory results. If Mr. Pickrell wishes to try other bands, 5 turns can be used on the grid coil for 12-30 metres and 22 turns for 40-100 metres. (The latter turns will have to be more closely wound to accommodate them, with 22 to 24 S.W.G. wire.)

As regards Mr. P. A. West's letter in the January issue (the GP Amplifier), I pointed out in the text that all components and leads wired to the chassis would also be common with one mains lead. A condenser must *not* be connected between the earth end of the volume controls and H.T. negative line, as he suggests—this would cause an open grid circuit and prevent proper operation. A condenser of about .1 to .5 μF or so *may* be wired in each lead to the pick-up or microphone transformer; this, however, has been dealt with before. This snag (which is present in almost all A.C./D.C. apparatus) is less serious than it may theoretically appear; no shocks will arise unless the circuit is *completed* through the person, and the "grounded" main is seldom at a very high voltage respective to earth. No one could point out the *possibility* of shocks, with mains apparatus, more pointedly than I have done, from time to time, in the past.—F. G. RAYER (Longdon).

SIR,—I have just been looking through your "Open to Discussion" page in the February issue. I, like Mr. B. Pickrell, have also done the TR/9 conversion as in last year's April issue. It was the first receiver I had ever made, and it works very well. I don't use it for DX much, but I did hear a transmission from Barbados. I have also converted the telesonic receiver as in the PRACTICAL WIRELESS, and it is working very successfully here in Sevenoaks.—J. PHILPOTT (15, Sevenoaks).

Push-pull Detection

SIR,—In a recent issue of PRACTICAL WIRELESS a very interesting article on push-pull detection appeared, using crystal detectors.

I have been toying with this idea for a long time for use in valve sets and I wonder if any reader has tried it, and if so would they kindly pass on their opinions to me, either direct or through the medium of this journal.

I intend using battery valves of the HL2 type.—DAVID H. COLLINS (Hanham).

Lining Up a Superhet

SIR,—The biggest snag most amateurs come across when dealing with superhets in the absence of a signal generator, is to set the I.F.s at the usual frequency of 465 kilocycles. Padders and trimmers can be lined up by utilising existing stations, but lining up the I.F.s at 465 kilocycles is apt to be a "hit or miss" affair.

If access can be had to an ordinary commercial, or home-built, for that matter, superhet with a known I.F. of 465 kc/s, it can be used as a very effective signal generator as follows:

Tune it in accurately to a reasonably loud station, then take a lead from the top grid cap of the I.F. valve via a .0005 μF isolating condenser, and obviously you have a modulated signal at 465 kc/s available for alignment purposes. Turn the L.F. volume control right off, or mute the speaker by some other method.

Put the two sets close together and short circuit the oscillator grid, of the set to be aligned, to earth. Connect the lead to the top cap of the I.F. valve and tune the last I.F. transformer to maximum volume; then transfer the lead to the signal grid of the frequency changer and set the first I.F. transformer likewise. The I.F.s are then set at the correct frequency.—J. THOMAS (N.W.2).

Mains Transformers

SIR,—It is not generally realised that currents may be induced in the fixing bolts which pass through holes or slots in the lamination stack of a mains transformer. Tests show that the voltage induced varies with the type of transformer and may be between .0001 and .01 v R.M.S. An A.C. ammeter connected between the ends of the bolt may indicate a current of from .01 to .2 amp. If a mains transformer is mounted flush, i.e., lamination stack flat on the chassis, and an earthing wire is connected to the end of the fixing bolt remote from the chassis, this wire is effectively connected to a point of supply of up to .01 v R.M.S. To illustrate how serious this may be, assume the lead to be a grid or cathode lead in an amplifier whose gain is 10,000—two pentode valves will easily give this. If the unwanted voltage is .002, this represents about 15 per cent. of the maximum available output voltage if the supply H.T. is 200 volts. A moving coil or ribbon microphone, or low impedance gram pick-up, may easily give an output voltage lower than that which is induced in the transformer bolt, so that if the transformer bolt is used as a chassis connection for any of the above transducers the hum output will be greater than the signal output.

If the transformer is mounted upright, i.e., lamination stack at right angles to chassis, currents may find a path from the lamination stack bolt, via the mounting brackets and the chassis itself. If the chassis is of non-magnetic material, e.g., copper or alloy, do not make a connection to chassis between the bolts which secure the transformer brackets. When a steel chassis is used the transformer may actually magnetise the steel, and hum currents may be found in almost any part of the chassis. Thus it is safest to insulate at least two of the fixing bolts.

When tracing hum in newly constructed or altered amplifiers, make a routine check of earthing wires and move any which are on the mains transformers and return them to some other point.—F. R. PETTIT (Herne Bay).

Standardisation

SIR,—My attention has been drawn to the remarks on Standardisation, by Thermion, in your January issue, and I should be grateful if you could spare sufficient space to publish the following notes, which, I hope, will correct some misapprehensions under which Thermion appears to be labouring and remove some of the disparaging thoughts that may have been created amongst your readers by the article in question.

During 1947, the Radio Industry, the Services and B.S.I. wished to standardise radio components and those three bodies discussed the whole problem. The Services had a large number of component specifications which could have been published by B.S.I., but as they had been prepared during the war, and catered for the needs of service equipments only, they took no note of the very much larger number of components required for normal domestic, commercial and industrial radio and electronic apparatus. It was, therefore, agreed by those three bodies that the right course was for the Radio Industry to prepare its own requirements and then, in consultation with the Services and B.S.I., prepare and issue national standards which it was hoped would cover about 90 per cent. of the radio components produced in this country.

It was agreed that in the interim period it might be necessary for the Radio Industry Council to issue its own specifications privately, withdrawing them as the B.S. documents were issued. Work has progressed as rapidly as possible on those lines and it is interesting to note that the first two specifications will be issued by B.S.I. for comment, by all concerned, in the very near future.

The first of the Industry documents was published in January, 1949, and 20 others have been issued at intervals since, each with a certain amount of publicity in all the technical press and even some daily papers. They have also been advertised at all the radio exhibitions. It is, therefore, amazing to know that Thermion has only just realised this fact.

Whether Thermion considers the Radio Industry capable of preparing standards or not is immaterial as they are the only people who can do it, and even had the job been turned over to B.S.I. in the first place the Radio Industry would have provided the major interest on any committee. Further, the documents published so far have been extremely well received all over the world and far from being "monstrosities" are recognised as well conceived documents. The only real criticism so far is that the standards may be too high.—P. D. CANNING (Chairman, Radio Industry Council Technical Specification Committee).

A SIMPLE AND IMPROVED PHASE INVERTER

(*Concluded from page* 154)

2. It increases the effective value of the input impedance of the stage, sometimes to as high as 10 times the nominal value of R_2, thus reducing the A.C. shunt effect on R_L of the previous stage.

3. It reduces the amplification factor of the valve.

4. It reduces the harmonic distortion generated in the stage.

Point three is the one to be watched particularly. It will be remembered that the circuit of Fig. 1, can never give a gain greater than two. Now, the original output stage of the set has been designed with this in mind and unless care is taken it will be heavily overloaded owing to the greatly increased amplification possible from a prior push-pull stage. In normal R.C. amplifier circuits, using the R_L of 30,000 ohms, the amplification factor of each section is about 12. Two sections in push-pull would give at least 24 for the overall stage again. The value of R_1 shown in Fig. 2, reduces the gain to about three or four per section, which means at most an overall improvement upon the circuit of Fig. 1, of about five times. Fig. 2 gives the octal-base connections of the 6SN7.

No originality is claimed for this circuit and readers are warned that it may be protected by patents.

The results obtained fully justified the odd hour or so taken to effect the alterations. There was a marked increase in brilliance of reproduction and the bass and upper registers were as prominent as could be desired even at the lower volume levels.

News from the Trade

Osmor Coils

THE coil pack produced by Osmor Radio is now well known to our readers, and the manufacturers are also producing a range of single coils for those who wish either to make up their own packs or include miniaturised coils in any other design. These coils are about 1in. in height and have the usual powdered iron core, and are available in over 30 types suitable for straight or superhet circuits. An improvement noted in this particular new design is the provision of an insulated disc mounted at the top of the coil to which the ends of the windings are anchored by soldering to small metal tags, and this greatly facilitates the inclusion of the coil in a circuit as compared with the older system of having to cut off surplus wire and bare the ends with no anchoring point to which they could be attached. The coils cost 4s. each, and leaflets are available from the makers describing the various types.

In addition to the coil there is also now available a frame aerial for the small " mains personal " type of receiver. This consists of a flat oval spiral of 24 s.w.g. wire with overall dimensions of 4½in. by 3½in., the adjacent turns being cemented and providing a rigid assembly. This costs 2s. 6d.—**Osmor Radio Products, Ltd., Bridge View Works, Borough Hill, Croydon, Surrey.**

Lufbra Fly-cutter

THE cutting of holes in stout chassis sometimes presents a problem, and with the large variety of valveholders and other items requiring round holes now available, it is desirable to have a single tool which may be used for any size of hole. The Lufbra fly-cutter has now been re-designed and is available in a number of sizes, all of which have a locking adjustment and parallel movement of the cutter. The maximum capacities are from 4½in. up to 10in., and the tool is available with round shank or square-tapered shank for use in an ordinary carpenter's brace. The cutters are replaceable, and in addition to simple hole cutters a special type is available which cuts rings or washers at one operation. This is, of course, only suitable for use in a drilling machine or lathe. The square-tapered tool for up to 4½in. holes costs 13s. 6d., and the model RS10 for a maximum capacity of 10in. costs 19s.—**Ludfry, Ltd., 189, Wardour Street, London, W.1.**

Advance Components

THE following revised prices are now in force for the Advance Constant Voltage Transformers (as from February 1st, 1952):

Type MT189	—Maximum rating 10 watts	£4 10 0
,, MT281	,, ,, 30 ,,	£7 3 0
,, MT161	,, ,, 60 ,,	£8 0 0
,, MT140	,, ,, 150 ,,	£12 2 0
,, MT267	,, ,, 250 ,,	£16 10 0
,, MT262	,, ,, 500 ,,	£23 0 0
,, MT266	,, ,, 1,000 ,,	£38 0 0
,, MT269	,, ,, 1,500 ,,	£50 8 0
,, MT285	,, ,, 2,000 ,,	£63 16 0
,, MT286	,, ,, 3,000 ,,	£99 10 0
,, MT290	,, ,, 6,000 ,,	£157 10 0

—**Advance Components, Ltd., Back Road, Shernhall Street, London, E.17.**

Edison Swan Clix

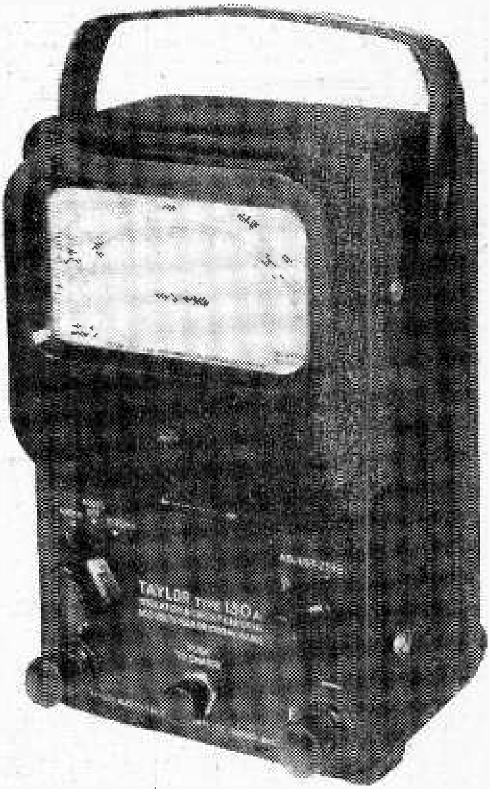
THE Edison Swan Electric Co., Ltd., has acquired The General Accessories Co. and British Mechanical Productions, Ltd., and both of these companies are now operating as subsidiaries of Ediswan.

Electrical and radio products formerly marketed by these companies are now being sold through the Ediswan sales organisation under the name " Ediswan Clix." All future enquiries for these products should be addressed to the head office or any branch office of **The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.**

Taylor Insulation Tester

IN response to requests from the radio and electrical trade at home and abroad, Taylor Instruments have re-introduced Model 130A Insulation Tester.

This mains-operated ohmmeter covers insulation and medium values of resistance and is suitable for workshop tests or for routine checking of components, such as resistors, etc. A robust moving-coil meter is used, fitted with a 4in. scale and knife-edge pointer.—**Taylor Electrical Instruments, Ltd., 419/424, Montrose Avenue, Slough, Bucks.**



The Taylor Type 130A Insulation and Circuit Checker.

BOOKS

I.P.R.E. TECHNICAL PUBLICATIONS: 5,500 Alignment Peaks for Superheterodynes, **5/9**, post free. Data for constructing TV Aerial Strength Meter, **7/6**. Sample copy The Practical Radio Engineer, quarterly publication of the Institute, **2/-**; membership and examination data **1/-**. Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8

ALL MAGAZINES.—We can arrange subscriptions to any British or foreign wireless and TV magazine. Send to-day for our free booklet giving details and prices. WILLEN LTD. (Dept. 40) 101, Fleet St., London, E.C.4

GREAT LAST-CHANCE OFFER.—To clear last stocks, which will not be reprinted, we offer our famous books, "Personal Portables" and "A Portable Televisor," if ordered together, at only 4/- for the pair, post paid; definitely last chance. BRADBOOKS, Sennen, Penzance, Cornwall.

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 65, inclusive, or a woman between the ages of 18 and 60, inclusive, unless he or she is excepted from the provisions of the Notification of Vacancies Order, 1952, or the vacancy is for employment excepted from the provisions of that order, or unless the advertisement states that application should be made to a Ministry of Labour and National Service local office or scheduled employment agency.

PILOT RADIO, LTD., Park Royal Rd., N.W.10, require immediately experienced Fault Finders and Testers for radio and television alignment. Five-day week with good rates of pay. Application should be made to a Ministry of Labour and National Service Local Office or scheduled employment agency.

RECEIVERS & COMPONENTS

R1155A, modified (top band) for 200-250v A.C., **£16/10/-**, c.p. Television with VCR97 and 15 valves, circuit, etc. (not in working order), for 240v A.C., **£9/10/-**, c.p. Valves, ARP12, APT4, AR8, VR18, 5/6, p.p. R. BOLTON, 42, Siward Rd., Tottenham, N.17.

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

TR9 Transmitter and Receiver with 9 valves less crystal. 5 minute conversion and over 50 stations may be heard. **20/-** post paid; details **1/-**. AUTOREX MOTORS, New Whittington, Chesterfield.

FOR SALE, 1155 Receiver, in very good working order, and clean; cheap; carriage extra. Apply Box No. 215, c/o PRACTICAL WIRELESS.

MAKE YOURSELF A RADIO.—AC/DC, med. and long T.R.F., **£5/5/-**; Superhet, **£6**, complete with all valves, cabinet, etc.; concise Book of Instructions with point-to-point wiring of both receivers, **1/6**; Brand New Midget I.F Trans., 465kcs, cans 7/8in. sq., **7/9** pair; Electrolytics, 8 mfd. 500v, alum. can, guaranteed, **1/9** ea., **18/-** doz.; .1 x 350 Tub., **2/9** doz.; Paxolin Octal Valveholders, International or Mazda, ex equip.; used but in perfect condition, **1/9** doz.; thousands of components available; latest list 3d. stamps. SUSSEX ELECTRONICS, LTD., Princes Works, Brighton.

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