AN EXPERIMENTAL 5-VALVER

1/-

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EDITOR:
F.J.CAMM

PRACTICAL WIRELESS

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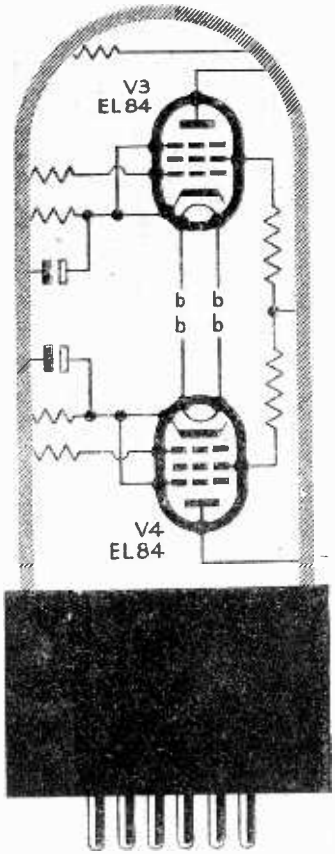
A NEW HI-FI AMPLIFIER
BEGINNER'S GUIDE TO RADIO
TUNERS OR RECEIVERS ?
A SIMPLE RADIO CONTROL DEVICE
BUILDING COMMUNICATION RECEIVERS
AMPLIFIER DESIGN
PI-NETWORK FAULTS



These are the valves for the Mullard 5 valve 10 watt High Quality Amplifier.

MULLARD EF86
MULLARD ECC83
MULLARD EL84(2)
MULLARD GZ30
or EZ80

The MULLARD 5 valve 10 watt High Quality Amplifier Circuit

Mullard have designed a new high quality 10 watt audio frequency amplifier circuit around five Mullard valves. It follows conventional lines and comprises a high gain input stage (Mullard EF86), a cathode coupled phase-splitter (Mullard ECC83) and a push-pull output stage employing two Mullard EL84 pentodes.

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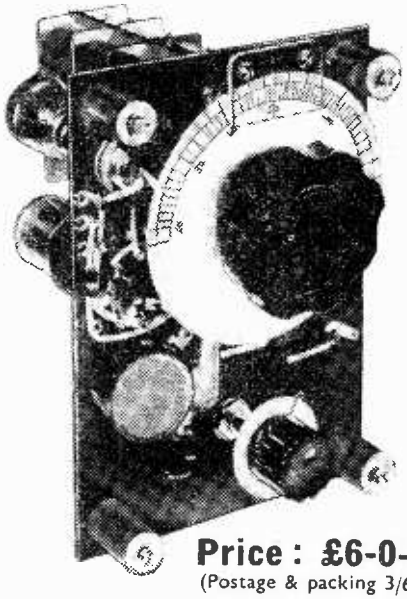

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Practical Wireless

EVERY MONTH
VOL. XXX, No. 576, OCTOBER, 1954

Editor: F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

The Radio Show

THE 21st National Radio Show opened at Earls Court on August 25th. It was the world's largest and most ambitious demonstration of the technique of broadcasting in sound and television. At least 55 sound and television programmes went on the air from the show and there were continuous television programmes on the closed circuit serving 409 receivers. Fifteen television cameras from the small industrial types to the roving eye complete with its own transmitter and power supply were in operation. There was also a full-sized BBC studio of the latest design for sound and television programmes and over 40 manufacturers exhibited sound and television receivers including the multi-channel sets for the forthcoming commercial TV programmes. Trade orders were larger than last year and record the improvement in the National economy. No doubt, the relaxation of hire purchase has loosened the national purse strings.

Great interest was evinced in our new edition of the "Fury Four," constructional details of which will commence shortly.

GROWTH OF HI-FI

ONE of the outstanding developments of the past few months has been the growth of interest in high fidelity. Some years ago, a well-known company put out the design for the Williamson amplifier which set a new standard in reproduction. Another company has recently released details of a high quality amplifier for home constructors and details of it appear elsewhere in this issue. This announcement was speedily followed by another from the sponsors of the Williamson amplifier, giving circuit details of a high quality amplifier designed for use in connection with their metal cone speaker. A well-known firm of radio manufacturers have been giving special high-fidelity demonstrations. We shall publish details of these amplifiers in successive issues. Others, we understand, are on the way.

But the most important developments are the high fidelity tape recordings now available, which are copies of the master tape used for transferring recordings to the standard gramophone disc. The company responsible, H.M.V., have developed the process which has made this possible. These high fidelity recordings will enable owners of tape recording machines to listen to recorded music free from distortion and what is more important with a constant quality of reproduction. The two first releases have playing times of 40 and 60 min., and will cost three guineas and four guineas, respectively. They comprise recording of Menhuin and Solomon. A second series of tapes with similar playing times are of light music and dance music and will cost 73s. 6d. and 55s. each. The tapes are played on a dual-track reproducer with a speed of 7½in. a second.

HIRE-PURCHASE RESTRICTIONS ENDED

THE general public will welcome the rescinding of the hire-purchase restrictions, which enforced a deposit of one-third of the total value and for the balance to be repaid over a period of 18 months. This is bound to result in an increased demand and for easier deposit and H.P. terms. The restrictions undoubtedly caused a drop in the sale of both radio and television receivers, and this to some extent has affected licence fees, which, from the TV point of view, should be much higher even than they are.

FOREIGN VALVES

SOME of our readers have been mystified by the fact that some valves they have purchased have been marked "foreign made" but yet include the stamp of the British Radio Valve Manufacturers' Association. This matter was recently taken up in Parliament, and the reply given was that Section 16 of the Merchandise Marks Act requires that goods imported into the United Kingdom must be accompanied by an indication of the country in which the goods were made. It is quite in order for a British manufacturer's name to appear on an article made abroad. It was also made clear that any firm may import radio valves originating in and consigned from Western Europe and certain other countries without further specific authority, beyond the Open General Licence. Large numbers of valves and television tubes, as already announced in this journal, are now being imported because the British valve industry is unable to keep pace with the demand for receivers.
—F. J. C.

Round the World of WIRELESS

By "QUESTOR"

Battery Demand

NEARLY twice as many battery-operated radio sets were sold in 1953 as in 1952. Most of them were portables, sales of which again this year are surprising some of the manufacturers. This demand has given encouragement to the battery industry, which was already suffering from the transition to all-mains radio well before the war and which was even more apprehensive about the advent of TV.

The popularity of ordinary radio is becoming dependent on mobility, as people now listen in their kitchens, bedrooms and even their bathrooms.

New Manager Appointed

THE appointment is announced of Mr. Albert John Locke as manager of the Hong Kong service depot of the Marconi International Marine Communication Co., Ltd. He has been a member of the Hong Kong technical staff for some time, and takes over his new post immediately.

Mr. Locke, who is a native of Aston, Birmingham, joined the Marconi Marine Company in 1936.

While You Wait Car Radio Fitted

BECAUSE radio dealers have no space in which to take in cars for sets to be fitted, Pye Telecommunications, Ltd., are launching a new 3-unit car radio, which enables the size of the tuning unit to be kept small, and makes installation easier and neater, thereby relieving the retailer of all installation problems.

New Premises

WE are informed by Watts Radio (Weybridge), Ltd., that they have opened new premises at 8, The Apple Market, Kingston-on-Thames, Surrey.

They have conducted business at that address since August 20th.

Appointments to Directorship

THE Plessey Company, Limited, announce the appointment of Mr. John Hilton, O.B.E., M.I.Mech.E., and Mr. C. D. H. Webb, A.I.E.E., A.I.Mech.E., as executive directors of the company.

Mr. Hilton, who was formerly chief engineer of the Hoffmann group of companies and director of Hoffmann Tweedales, Ltd., joined the Plessey Company in 1949, and Mr. Webb, who is general manager of the Aircraft Electrical Division, in September, 1939.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound receiving licences issued during the year ended June, 1954. The grand total of sound and television licences was 13,512,275.

Region	Number
London Postal ...	1,613,198
Home Counties ...	1,439,872
Midland	1,241,227
North-eastern	1,608,718
North-western... ...	1,251,950
South-western ...	1,007,807
Wales and Border Counties	625,047
Total England and Wales	8,787,819
Scotland	1,090,045
Northern Ireland ...	223,365
Grand Total	10,101,229

"The Archers" in Book Form

OSCAR-WINNING programme. "The Archers," has at last gone into book form, and it looks as though the novel will be as popular as the radio feature. It is written by Geoffrey Webb and Edward Mason, and published by the publishers of this journal at 8s. 6d. net.

On publication day, Dan and Doris Archer, played by Harry Oakes and Gwen Berryman, appeared in person at Hudson's bookshop in Birmingham to autograph copies. Hundreds of fans met them in the course of the morning and went away proudly carrying the new book.

Temporary Power Reduction

IN order to allow maintenance work to be carried out on the main aerial of the Third Programme transmitter at Daventry on 464 metres it was necessary to withdraw this aerial from service

Radio star Al Read (left), who bases his scripts on real life people and incidents, mingles with the crowd in a London café in the hope of gleaning new material for his next radio show. Light Programme listeners heard him in an excerpt from his stage revue "You'll Be Lucky" on August 16.

for a few days, beginning Wednesday, August 4th. The purpose of the work was to restore the full anti-fading characteristics of this mast radiator in order to improve reception near the fringe of the service area.

During this period the transmitter was operating at reduced power with a reserve aerial and this resulted in some reduction in its range.

Selenium Shortage

IT is announced that there is a shortage of selenium in the U.S.A. and that one well-known manufacturer of rectifiers has announced a scheme for purchasing burnt-out units. It is estimated that during the past five years 400,000 pounds of selenium have accumulated in old rectifiers in the U.S.A.

Clinical Thermometer

ANOTHER use for the thermistor is announced from the U.S.A. A very small carboloy thermistor is mounted on the end of a stainless steel probe and this is connected to a mercury cell through a length of flex lead. The thermometer is quicker, unbreakable and, it is claimed, more accurate.

B.I.R.E.

THE London section will hold a meeting at the London School of Hygiene and Tropical Medicine, at Keppel Street, Gower Street, W.C.1, on September 29th, at 6.30 p.m. The subject will be "Computing Circuits in Flight Simulators," and the speaker, A. E. Cutler, B.Sc., Ph.D., of Redifon, Ltd.

Mr. J. Clarricoats an Alderman

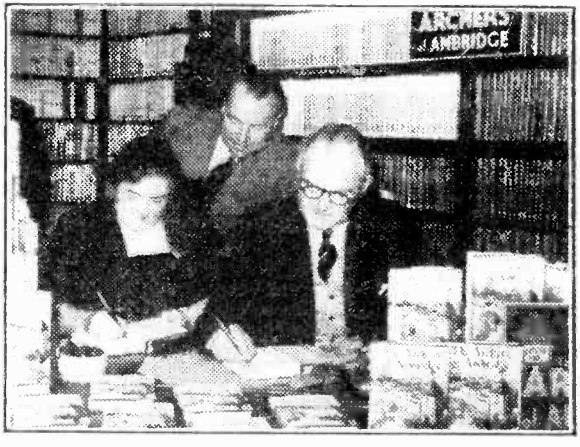
THE General Secretary of the R.S.G.B., Mr. J. Clarricoats, a post which he has held for the past 24 years, has now been elected an Alderman of the Borough of Southgate. Since 1945 he has served on the council as a member.

British Radar for Egyptian Navy

RECENTLY at the Marconi works at Chelmsford, England, an important contract was signed between the Egyptian Assistant Air Attaché in Britain, acting on behalf of the Egyptian Government, and officials of Marconi's Wireless Telegraph Co., Ltd.

Under the terms of the contract Marconi's are to supply navigational radar equipment, radio transmitters, receiver and associated test equipment for use aboard five warships of the Egyptian Navy. The vessels to be fitted are the *Tarek*, *Aboukir*, *Damietta*, *Rashid* and *Ibrahim*.

Each ship is to have an installation consisting of a Marconi Radiolocator IV and a Transarctic transmitter/receiver. There will also be a further complete Radiolocator IV supplied to assist in training and maintenance. In addition, eight Marconi communications receivers of various types will be supplied for allocation among the ships. The associated test equipment is to be supplied by Marconi Instruments, Ltd.



Dan and Doris Archer, in real life Harry Oakes and Gwen Berryman, autograph copies of "The Archers of Ambridge," watched by Mr. Clark Ramsay, Sales and Publicity Manager of George Newnes, Ltd.

Radio Amateurs' Examination

ONCE again Grafton Radio Society have made arrangements with the Islington L.C.C. Men's Evening Institutes for an official course of instruction for the Radio Amateurs' Examination to be held during the coming winter months at the Grafton L.C.C. School, Eburne Road, Holloway, N.7 (one minute from the "Nag's Head") in conjunction with the society.

Classes, with Morse instruction to the required speed, will be held on Monday evenings at 7 p.m. to 10 p.m., commencing Monday, September 27th (enrolment week September 20th to 24th)—instructor Mr. A. Perry (G3DKX)—fee 10s.

Application in the first instance should be made to the Grafton Radio Society, Hon. Sec. Mr. A. W. H. Wennell (G2CJN), 145 Uxendon Hill, Wembley Park, Middlesex.

New Gecalloy Publication

SALFORD ELECTRICAL INSTRUMENTS, LTD., has prepared a publication on the Gecalloy range of materials. Entitled "Gecalloy Low Loss Cores and Micropowder Magnets," the publication describes, with coloured flow sheets, the production and use of various kinds of Gecalloy material. It gives full technical specifications of Gecalloy magnets and low loss cores, and includes graphs showing the performance of these products under varying conditions. There is a section describing suitable designs of low-loss cores and magnets for various applications. The publication also includes a comparison between Gecalloy and other materials, and gives details regarding stability.

R.S.G.B. Convention

A NATIONAL Convention of the Radio Society of Great Britain is to be held in Bristol on September 17th, 18th and 19th. This will be the first time that an event of this size has been staged in the West Country and only the second time that the Society has held a National Convention outside London, the previous occasion being at Manchester in 1949. The Lord Mayor and Lady Mayoress will be among many notable guests at the Convention Dinner to be held in Bristol's Victoria Rooms on September 18th.

The MULLARD 5 Valve 10 Watt Amplifier

AN INTERESTING NEW CONSTRUCTOR DESIGN FOR A FIVE-VALVE TEN-WATT Hi-Fi Unit

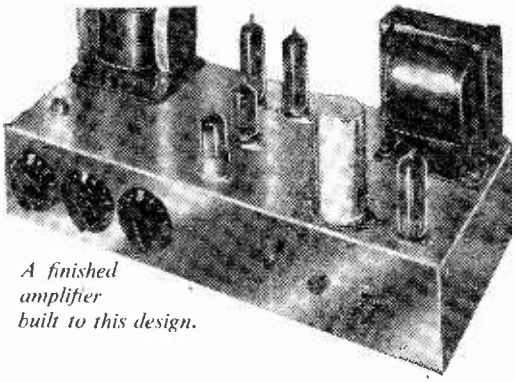
IN accordance with the Mullard policy of providing valve users with comprehensive technical information on valve applications Mullard have designed a five-valve 10-watt high quality amplifier circuit. This circuit enables the fullest advantage to be taken of the latest Mullard audio valves.

There is a rapidly growing enthusiasm for high quality sound reproduction, and this circuit will enable home constructors and equipment manufacturers to build a high-performance amplifier at a comparatively low cost. Messrs. Mullard do not, of course, supply parts or complete units—they have only designed the circuit to make use of their valves. We had the opportunity of hearing a sample built by Messrs. Mullard and were very impressed by its performance.

Although only four amplifying valves and one rectifying valve are used the amplifier is sufficiently sensitive to be driven by many popular gramophone pickups without recourse to expensive pre-amplifying stages. Circuits for tone control and for the compensation of recording characteristics have been developed. Harmonic distortion has been kept to a very low figure—less than 0.4 per cent. at 10 watts output. The frequency response is extremely wide and level, being almost flat from 10 to 20,000 cycles per second.

The Circuit

The circuit of the amplifier (Fig. 1) is of conventional form. A single-ended high-gain pentode (EF86) feeds a cathode-coupled phase-splitter using the high-mu double triode ECC83. The balanced output voltages derived from the ECC83 are used to drive the grids of two EL84 pentodes in push-pull. Negative voltage feedback is applied from the secondary of the output transformer to the cathode of the input valve.



A finished amplifier built to this design.

Frequency Response

Relative to 1,000 c/s the response is not down by more than ½ db at the two extremes of 10 c/s and 20,000 c/s. Overall feedback of 26 db is taken from the secondary of the output transformer.

Power Response

From 40-10,000 c/s, maximum output is 1 db relative to 10 watts.

From 20-16,000 c/s, maximum output is 0 db (10 watts).

From 16-30,000 c/s, maximum output is —2 db relative to 10 watts.

Distortion

Less than 0.4 per cent. at 10 watts. Total harmonic distortion has been measured at 40 c/s, 400 c/s and 2,000 c/s. For the rated output of 10 watts the total distortion is :—

Less than 0.4 per cent. at 40 c/s.
,, ,, 0.2 ,, ,, ,, 400 c/s.
,, ,, 0.3 ,, ,, ,, 2,000 c/s.

Hum and Noise

73 db below 10 watts. With the ear close to the loudspeaker no hum can be detected and residual

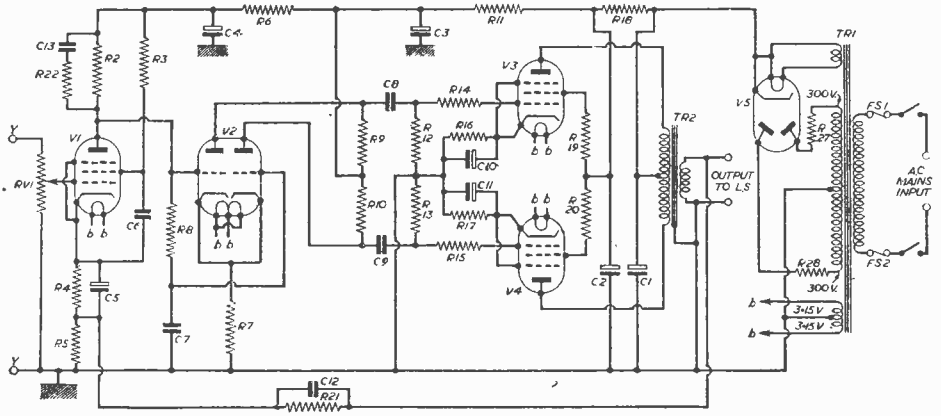


Fig. 1.—Theoretical circuit design.

noise is only a slight rustle. Under normal listening conditions hum and noise are completely inaudible. Hum and noise are 73 db below 10 watts, or 74 db below the maximum rated output of 12.5 watts.

Output Resistance

0.9Ω on 15Ω output. The output resistance of 0.9Ω on a 15Ω output is sufficiently small in practice to ensure adequate electrical damping of the speaker coil.

Tone Control

10 db boost in treble and bass ; 10 db attenuation in treble and 5 db attenuation in bass. The tone-control unit provides boost and attenuation at both treble and bass frequencies.

Details of a well-known type of tone control using a wide range, passive circuit are included on page 588 (Fig. 2). The treble control is RV23 and the bass control RV24.

This circuit produces an attenuation of about 12 times. Because of the high sensitivity of the amplifier —50 mV at Y-Y with feedback—the tone control unit is suitable for use with a crystal pick-up having a relatively large output, without the need arising for a separate valve pre-amplifier. The input voltage at X-X (Fig. 2) must be approximately 600 mV to load the amplifier fully.

Pick-ups and Equalising Networks

The Collaro "O" and "P" "Studio" pick-up heads and the Acos Hi-g microgroove and standard pick-ups are particularly suitable for use with the amplifier. Details of some equalising networks which have been found very satisfactory are given in Fig. 3. They are designed to match into the input impedance of the tone control circuit, and were derived using the Decca K1804A (78 r.p.m.) and Decca LXT2695 (33⅓ r.p.m.) recordings.

Detailed Circuit Description

The first stage of amplification is provided by the EF86 in a circuit having a gain of approximately 150 times. The negative feedback voltage from the

LIST OF COMPONENTS

RESISTORS

RV1—Variable, carbon, 1 MΩ (log. law).
R2—Fixed, carbon (high stability), 180 kΩ (10%—1 W.).
R3—Fixed, carbon, 1 MΩ (10%—¼ W.).
R4—Fixed, carbon, 1.8 kΩ (10%—¼ W.).
R5—Fixed, carbon, 100Ω (5%—½ W.).
R6—Fixed, carbon, 100 kΩ (10%—¼ W.).
R7—Fixed, carbon, 68 kΩ (10%—1 W.).
R8—Fixed, carbon, 1 MΩ (10%—½ W.).
R9—Fixed, carbon, 100 kΩ (10%—½ W.).
R10—Fixed, carbon, 100 kΩ (10%—½ W.).
R11—Fixed, carbon, 33 kΩ (10%—½ W.).
R12—Fixed, carbon, 820 kΩ (10%—½ W.).
R13—Fixed, carbon, 820 kΩ (10%—½ W.).
R14—Fixed, carbon, 4.7 kΩ (20%—½ W.).
R15—Fixed, carbon, 4.7 kΩ (20%—¼ W.).
R16, R17—Fixed, carbon :
Normal loading, 270Ω (5%—3 W.).
Low loading, 390—47Ω (5%—3 W.).
R18—Fixed, carbon, 1.2 kΩ (10%—1 W.).
R19—Fixed, carbon, 47Ω (20%—½ W.).
R20—Fixed, carbon, 47Ω (20%—½ W.).
R21—Fixed, carbon (see below) (5%—½ W.).
R22—Fixed, carbon, 18 kΩ (10%—½ W.).
RV23—Variable, carbon, 2 MΩ (log. law).
RV24—Variable, carbon, 2 MΩ (log. law).
R25—Fixed, carbon, 1.5 MΩ (10%—½ W.).
R26—Fixed, carbon, 150 kΩ (10%—½ W.).
R27—Fixed, carbon (see below) (20%—1 W.).
R28—Fixed, carbon (see below) (20%—1 W.).

The resistors for R9 and R10 should be matched to within 5%, and the larger used for R10.

The values of R27 and R28 depend on the winding resistances of the mains transformer and on the choice of rectifier. They must be chosen to make the total effective limiting resistance of each anode of the rectifier up to the required value.

The total limiting resistance, R_{lim}, in series with each anode of the rectifier must be at least 47Ω for the GZ30 or at least 215Ω for the EZ80. The amount of series resistance, Rt, contributed by the transformer is :—

$$Rt = \frac{1}{2} Rs + n^2 Rp$$

where Rs = resistance of secondary.
Rp = resistance of primary.
n = ratio of number of turns on half the secondary to number of turns on the primary.

Thus if Rt is less than R_{lim}, then R27 and R28 must both be chosen equal to the difference between them.

CAPACITORS

C1, C2—Double Electrolytic, 50+50 μF 350 v.w.
C3—Electrolytic, 10 μF 350 v.w.
C4—Electrolytic, 10 μF 350 v.w.
C5—Electrolytic, 100 μF 12 v.w.
C6—Paper, 0.02 μF 350 v.w.
C7—Paper, 0.1 μF 350 v.w.
C8—Paper, 0.1 μF 350 v.w.
C9—Paper, 0.1 μF 350 v.w.
C10—Electrolytic, 100 μF 25 v.w.
C11—Electrolytic, 100 μF 25 v.w.
C12—Ceramic or Mica. See below.
C13—Ceramic, 100pF (20%).
C14—Ceramic, 33pF (10%).
C15—Ceramic or Mica, 680pF (10%).
C16—Ceramic or Mica, 270pF (10%).
C17—Ceramic or Mica, 3,300pF (10%).

The values of the resistor R21 and its shunt capacitor C12 in the main feedback loop depend upon the impedance of the loudspeaker. A selection of values is given below :—

Speaker Impedance Ohms	C12 (pF)	R21 (kΩ)	Tolerance ±%
3.75	180	15	5
7	120	22	5
15	82	33	5

VALVES (Mullard)

V1—EF86.
V2—ECC83.
V3, V4—2 x EL84.
V5—GZ30 or EZ80. See note below.

The EZ80 must not supply a current of more than 90 mA.

MAINS TRANSFORMER (TR1)

Primary—10-0-200-220-240.
Secondaries—Normal loading : 300-0-300 100 mA ; 3.15-0-3.15 2 A ; 0-5 2 A. Low loading : 300-0-300 60 mA ; 3.15-0-3.15 2 A ; 0-6.3 1 A.

FUSES

FS1, FS2—1 amp.

secondary of the output transformer is introduced across the 100Ω resistor, R5, in the cathode circuit. In a feedback amplifier with a wide frequency response stability can be achieved only if the required difference in phase is maintained between the input signal and the feedback voltage.

The EF86 has accordingly been coupled directly to the following stage in order to reduce the phase shift at low frequencies. The C-R network (C13, R22) shunting the anode load produces an advance in phase which increases the stability of the amplifier at high frequencies.

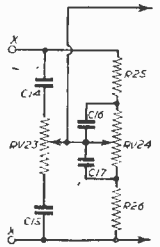


Fig. 2.—The tone controlling input circuit. The pick-up or equalising circuit is connected across X-X.

Phase Splitter

The output stage is fed by an ECC83 double triode operated as a cathode coupled phase splitter. The two grids are coupled together by R8, the second being capacitively earthed by C7. The correct value of 1.5 volt grid-to-cathode bias is produced when the anode voltage of the EF86 is 70 volts. Anode resistors R9 and R10 (=100 kΩ) should be matched within 5 per cent., R10 being given the larger value.

The use of the cathode coupled circuit provides for low distortion and facilitates direct coupling to the first stage. The gain obtained with the cathode-coupled circuit is about half that obtained from each valve section operated as a normal voltage amplifier. Nevertheless, it is sufficient as the ECC83 has an amplification factor of 100.

Output Stage

The output stage is equipped with two EL84 output pentodes operated in a self-biased push-pull circuit. The anodes are fed from the reservoir capacitor C1, the screen grids and the rest of the amplifier being supplied via R18 and C2. Separate bias resistors R16, R17 are used. Stopper resistors (R14, R15, R19, R20) are included in the control- and screen-grid leads.

A resistor with a value of about 1 kΩ may be placed across the output terminals to prevent instability from occurring with a disconnected loudspeaker.

Operating Conditions

Alternative modes of operating two EL84s in a push-pull output stage are available, and may be referred to as the "normal loading" conditions, the anode-to-anode impedance being 8,000Ω and the quiescent anode current 2 x 36 mA.

An alternative set of operating conditions will result in lower distortion when the amplifier is used for the reproduction of speech and music. Under these alternative conditions the anode-to-anode load is reduced to 6,000Ω and the quiescent anode current to 2 x 24 mA. This may be termed "low loading" operation.

For low loading operation the appropriate value of both cathode resistors R16 and R17 is 437Ω (=390Ω+47Ω), as compared with the value of 270Ω each for normal loading (that is, for the Class AB conditions given in the data).

The H.T. consumption is considerably smaller when the output stage is adjusted for low loading.

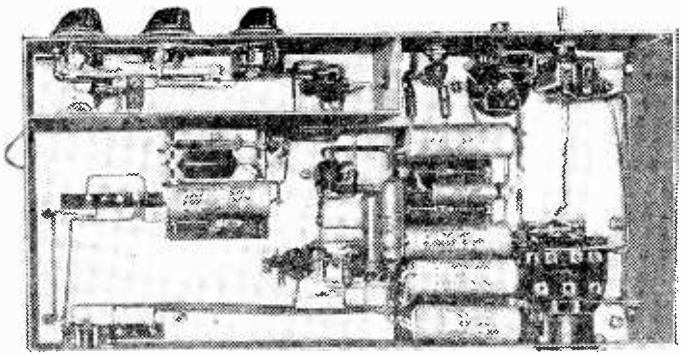
CIRCUIT VOLTAGES

Testing Point	Voltage (v.) D.C.	Voltage (v.) A.C.	Meter Range
C1	320	The ripple across C1 is 4v normal loading, and 2.5v low loading, measured with a valve voltmeter.	1,000 v. D.C.
	3		
C2	10		1,000 v.
Cathodes V3, V4	12		100 v.
Anodes V3, V4 ...	310		1,000 v.
Screen grids V3, V4	310		1,000 v.
C3	255		1,000 v.
Anodes V2 ...	210		1,000 v.
Cathodes V2 ...	71.5		1,000 v.
C4	182		1,000 v.
Anode V1 ...	70		1,000 v.
Screen-grid V1 ...	65		1,000 v.
Cathode V1 ...	1.5		25 v.

These voltages were measured with Model 8 Avometer (20,000Ω/v.) with zero input signal.

In consequence the standing dissipation in the output stage is reduced from 11 watt at each anode to 7.5 watt at each anode, the output valves then being run well below their maximum permissible anode dissipation of 12 watts. There will also be less ripple on the H.T. line. As a measure of economy the mains transformer can be given a lower rating provided the amplifier is to remain permanently adjusted to low loading.

Effective distortion for the low-loading adjustment cannot be measured easily because standard measurements of harmonic distortion and intermodulation distortion are not practicable when the maximum output is approached. A low level sine wave, however, may be used to measure frequency response on condition that the output power does not exceed 1-1.5 watts, otherwise excessive distortion will occur. Normal square-wave testing can be undertaken, but



Underside of an amplifier built to this design.

the input should not exceed a level similar to that used for the low-level sine wave.

Peak Handling Capacity

Larger peak currents are produced in the output stage under low loading conditions than with normal Class AB operation. These peak currents are of short duration with a speech and music input. They are supplied by the reservoir capacitor C1, which is of large value (50 μF). When the amplifier is at the point of overload on peak signal the momentary fall in line voltage should not be more than 2 volts on the nominal line voltage of 320 volts.

As the current in the output stage increases there follows an increase in the bias voltage across the cathode resistors at a rate determined by the time constant of the bias networks. Measurements have shown that in practice this increase in bias is not likely to exceed 1 volt. The working conditions of the output stage are such that the output valves are then driven back into a region where lower distortion is obtained.

As a result, however, of any change in the bias of the output stage a variation in gain will occur: but the distortion which is introduced in this way is held to a low level by the large amount of negative feedback.

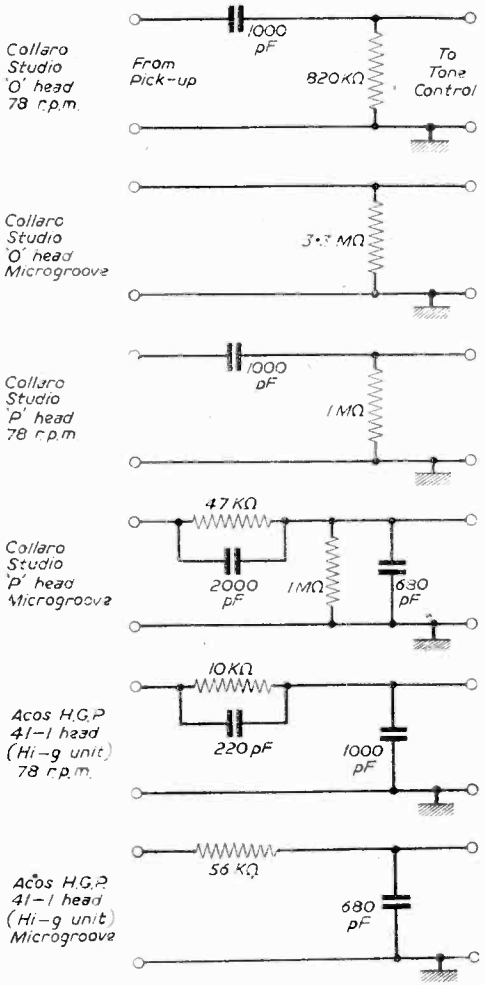


Fig. 3.—Equalising networks suitable for use with the tone control input unit.

Output Transformer

The output transformer is the most important component in a feedback amplifier, and it is essential that it shall give adequate performance. It is therefore advisable to obtain the output transformer from a manufacturer who has undertaken to build this component specially for the amplifier. It is essential that a component meeting the minimum specification be used, otherwise there will be instability and deterioration in performance.

Of the output transformers currently available the Partridge PPO may be recommended.

Rectifier

The GZ30 full-wave rectifier can supply a current drain of 125 mA and is completely suitable for all applications of the amplifier. With the GZ30 sine wave testing can be pursued up to full output power. Under practical conditions, with speech and music inputs, the GZ30 will have sufficient current reserve to supply an F.M. unit in conjunction with the amplifier.

The GZ30 has a five-volt heater and is mounted on the octal base.

Most readers will not have the necessary equipment to undertake sine wave testing at high output powers. Rectifier type EZ30 can then be recommended, the restriction being that the EZ80 must not supply a current in excess of 90 mA. Thus the EZ80 can be fitted when the amplifier is to be permanently adjusted to "low loading" condition, since sine wave inputs can then be used to produce an output power of up to 1-1.5 w. Under "normal loading" conditions the power output can be increased up to 6 w. before overloading of the EZ80 will occur. Square wave testing can be used with the EZ80 for both the normal loading and low loading adjustments, provided the input is of a similar level to that used for the corresponding sine wave testing.

The EZ80 should not be expected to supply the additional current required for radio feeder units and the like.

The EZ80 has a 6.3 volt heater and is mounted on the B9A (noval) base.

It can be seen that before making up the amplifier some consideration must be given to the way it is to be used and how this will affect the choice of rectifier.

An Experimental 5-Valver

CONSTRUCTIONAL DETAILS OF A LONG-RANGE GENERAL-PURPOSE RECEIVER

By N. T. Cook

THE Built-in Pre-amplifier (PRACTICAL WIRELESS, June, 1953) aroused more interest than the writer had anticipated when preparing it. Though it made good allowance for individual knowledge and techniques it seems the preference is for pieces complete as they appear. This article should cover all the points criticised in the original "pre-amplifier" and also those beginners who seek a lay-out that they can build up exactly to the book.

The circuit (p. 592) shows a 5-valve superhet, and a glance at V2 and V3 show they constitute the pre-amp. scheme first advanced by the writer (an audio boost arrangement that would cover another (H.F.) function). The "pre-amp." here, though, is not identical to the original. Considering the other parts working from left to right of the diagram will ensure no details are skipped or missed.

One waveband only is shown for simplicity as the diagram is already well noted with small figures, letters, etc. This one waveband aspect should not need extraordinary cost or thought to convert to other ranges as desired. Selectivity being such an important point to-day the circuit includes three features intended to assist listening on radio.

Feature one is bound up with the value of L1 in microhenrys. Some aerial loading (or reaction) coils are designed to be virtually self-tuned above or below a given band. We are not so much concerned though with theory of coil self-resonances as we are with the actual value of L1. A glance is often sufficient to guide one to an inductance estimate especially where wire gauges are the same for both L1 and L2. From the usual value of L2 for the medium band (170 μH) it should not be too hard to estimate L1, and, in any case, a precise figure is not necessary. The idea is to note the wavelength(s) that are most troublesome to reception at your point and CO, the aerial series capacitor shown dotted in the circuit, can be chosen to act, with L1, as an acceptor wavetrap to the interfering frequency. Note the possibility of including the receiver I.F. of 465 kc/s in this scheme. For a similar reason, using an opposite effect note the aerial switch that brings in VC1 or VC2, these two capacitors are pre-set so that they tune L1 to give greater reactive coupling at a given frequency. The whole idea depends on individual requirements and, of course, on particular values of L1. As is well known, interference varies with locality ; thus any attempt to set values at this point would be rather futile. A full list of the main components is given on page 592.

Tracking

When indulging in such "boosts and cuts," however, bear in mind that superheterodyne high-frequency stages are designed for accurate tracking (never perfectly achieved) and users of coilpacks and other pre-calculated devices should allow for the effects experiment here may cause (gaps and other manifestations of tracking "slip"). Relative to the foregoing we may consider the technique used on receivers with H.F. stages preceding the frequency-changer (and sometimes with straight receivers). The technique is the insertion of capacitors parallel to each H.F. transformer primary so that such windings are intended to favour a particular wavelength (and sometimes to overcome a dead spot).

The remainder of the first stage is conventional, though some readers may think the triode-hexode grid (triode oscillator section) should be tuned. However, arguments exist elsewhere on this point, and will not be exampled here. Where coilpacks are used oscillator coils should always be connected as the coilpack designers recommend, as, in design, inter-electrode capacities are allowed for normally.

Next in the circuit is the "Pre-amplifier" in modified form. Note that the 6J7 has been replaced by a double-diode pentode of 6B8/G type. The 6J7 is the more sensitive valve for audio work, and where A.V.C. control of this stage is not envisaged note that the 6J7 can be retained as detailed in a previous issue mentioned in this article. Do not think, though, that the valve shown will give poor advantage. Far from it, for its gain under these conditions should be in the region of 50-58 times. Though one can read of triodes that give a gain of 40 times such gain is rarely realised in practice, and usually requires unusual anode voltages. The main drawback to the 6J7 is its sharp cut-off characteristic, and could have made trouble at H.F. unless critically adjusted. In many instances (a modern trend this) readers adopting the idea would possess multi-valve apparatus for reception, and could afford to dispense with one stage of A.V.C. control and still retain an efficient A.V.C. control (A.V.C. systems improve as the number of tubes affected increases ; this is still true for simple A.V.C. techniques). Such possibilities were all (perhaps wrongly) left to individual circumstances and tastes. The valve used here cannot be doubted, for its characteristic makes it admirable for its double function. It is neither a sharp cut-off type, nor a remote cut-off, but a compromise which need hardly be named.

Circuit Details

Triode gain is still optional (switching it as cathode follower loses a very slight fraction of input value signal). If its gain is desired as a normal triode A.F. amplifier the following switch sections should be omitted with associated components : poles g-h-e (f, as a glance will show, should be retained to accept either radio "detected" signals or gram. from V2). For the benefit of constructors a clear diagram of each valve base is given. Also for those not wishing to "mess" with cathode-following (!) omit R19, R27, C17, C28 and remove "cold" end of R20 to chassis.

The A.V.C. system here is of the delayed type as this gives a notable advantage when listening for weak transmissions in that the receiver remains at maximum sensitivity. The former statement is just to mention one advantage of delayed A.V.C., of course. When preparing text one has continually to watch

lest straying into lengthy and valueless (from a practical aspect) paths is indulged in; readers of "ideas" are not concerned with patches of theoretical wrangling. And nothing short of several volumes can do justice to some theoretical pros and cons. Before discussing the A.V.C. here note that the diodes of V2, the 6B8G are not used. Possibly they can be used for some other function, but such is left to individual thought. The delay action is achieved as follows: With R26 in circuit the cathode potential should (on radio) be around the region of 10-12 volts to chassis. This must be overcome at the A.V.C. diode before any appreciable A.V.C. rectified voltage appears. At the same time neither the grid nor the signal diode (D2) of the valve are affected by the cathode potential, because R14 couples the signal diode directly to the cathode and in the case of the grid only R18 is effective for bias purposes as the volume control VR2 is connected to the junction of R18 and R26. The value of R18 sets the grid bias at −2 with anode current calculated at the expected anode voltage. Because of the connection of the volume-control C27 must be included as without it no proper low-volume setting would exist as normally found (i.e., the lowest setting might still be too loud.

Quality

Variable control VR1 is not by any means a critical value. No tone compensation or correction is shown with it because of the diversity of pick-up types available to those interested in this circuit. The value assigned to VR1 is thus purely nominal, and must be in view of the varying tastes and requirements in this type of entertainment. Also, there exist many circuits for tone modifications, "cuts" "boosts" and so on. Some of the latter are quite complex, others only amount to one condenser or resistor. Experiment with the pick-up used, the VR1 value bought or to hand, and components as desired is the best practice at this point.

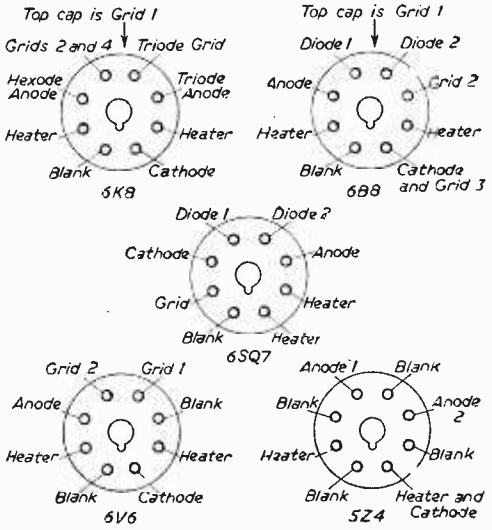
Full decoupling is shown throughout the whole receiver, and is a salient feature of good, modern constructions. Also the rectifier has a reserve of current available (about 60 mA.), provided an appropriate mains transformer is selected. The mains capacitors shown as "z" can be either a double (high-voltage) unit, preferably mica, or made up with two. Such simple schemes cannot pretend to suppress mains, of course, but often keep out many minor mains disturbances.

Fuses are of vital importance to this unit or any other for that matter. They represent an immediate protection against expensive breakdowns (failure of H.T. smoothing would mean possible loss of mains transformer and rectifier valve if F3 were not included).

Protection

Domestic fuse ratings will not protect receiver transformers from overload (shorting) damage whereas F1 and F2 will give such protection. If either fail, leaving F3 intact, the cause lies between the receiver side of the fuseholder and transformer output extremities. Various types of surge can blow fuses that are rated near to their normal load (for maximum safety). Thus otherwise inexplicable blow-outs can be explained by this if thorough testing reveals no faults in circuit. Such troubles vary with locality (again) and before raising fuse ratings check all factors.

Finally, when noting how delayed A.V.C. is arrived at note any attempt to raise the "inoperative" voltage by raising R26 is not to be recommended as



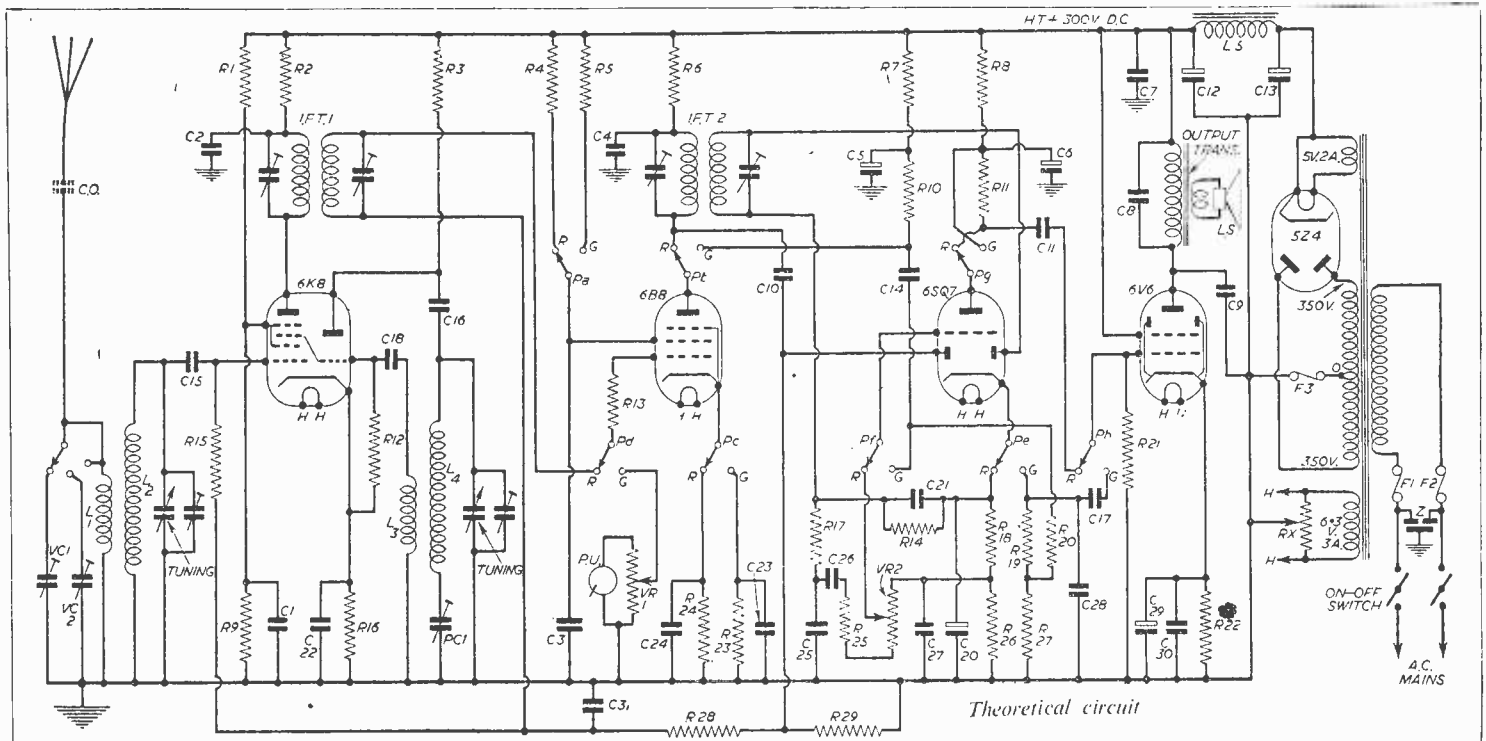
Details of valve base connections.

a point to consider is the heater cathode stress on this valve. It is advisable to screen all anode and grid leads in audio stages and coupling capacitors (A.F.) are best of the screened or mica type, to counteract hum tendencies.

Construction

It should be pointed out that no layout or blueprint is available for this particular design. A receiver built to it has, in fact, been in use for some time with very satisfactory results, but the layout is not unduly critical and the circuit is considered to be of such a nature that its construction should not be undertaken by those who are not sufficiently experienced to convert the theoretical diagram into a practical design. In any case the lining up of the circuit to obtain maximum efficiency calls for a certain amount of skill, and simpler designs are, of course, available for the inexperienced constructor. Another detail which should be mentioned at this point is that correspondence cannot be entertained regarding changes, such as a battery version or a D.C. version of this circuit. It is usual on publication of a circuit in these pages to receive a large amount of correspondence asking for individual modifications, and whilst we are always willing to try to assist readers who experience difficulties, it is obvious that a complete design always calls for a bench test, and it is impracticable to carry out such tests for each reader who wishes to make some changes in the circuit to suit his particular need.

Where permanent magnet loudspeakers are used, L5 will not, of course, be the speaker field, but should be a reliable choke of 20 to 30 henrys. Its D.C. resistance can be up to 1,000 ohms with efficiency. The H.T. smoothed should not be 10 volts over the figure shown without resistor adjustments. The mains switch is best of the two-pole type as same give clean isolation and make for safety.



Theoretical circuit

LIST OF PARTS

RESISTORS. (All ½ watt unless otherwise stated.)

R1—25 K Ω (2 w.).
R2—10 K Ω.
R3—50 K Ω (1 w.).
R4—100 K Ω (½ w.).
R5—1.15 M Ω (1 w.).
R6—10 K Ω.
R7—25 K Ω.
R8—5 K Ω.
R9—100 K Ω (½ w.).
R10—200 K Ω (½ w.).
R11—250 K Ω.
R12—50 K Ω.
R13—100 Ω.
R14—250 K Ω.
R15—100 K Ω.
R16—220 Ω.
R17—500 K Ω.
R18—10K Ω.
R19—10 K Ω.
R20—500 K Ω.
R21—250 K Ω.
R22—330 Ω.
R23—3,700 Ω.
R24—800 Ω.
R25—500 K Ω.
R26—50 K Ω.
R27—250 K Ω.
R28—1 M Ω.
R29—1 M Ω.
VR1—50 K Ω (var.).
VR2—500 K Ω (var.).
Rx—25-30 Ω, w. w. (2 w.). (Not needed where heater winding is centre-tapped.)

COILS

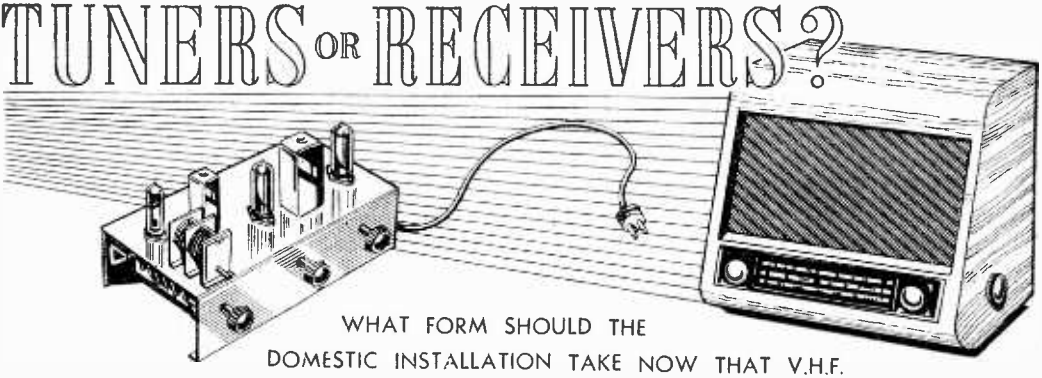
L1—See text.
L2—170 μhenrys.
L3—Osc. reac.
Osmor type recommended.
L4—80 μhenrys.
L5 — 1,000 Ω (speaker field), or choke. See text.
Full receiver H.T. load 60 mA.
I.F.—465 kc/s. (2).
Trans.—(645 m.)

Output Trans. Ratio.—50 : 1 (3 Ω imp. speech coil, 25 : 1 (15 Ω speech coil).
Switch—8-pole, 2-way.

CAPACITORS. (All 500 volts working unless stated otherwise.)

C1—.05 μF.
C2—.05 μF (m.).
C3—.5 μF.
C4—.05 μF (m.).
C5—16 μF (elec.).
C6—16 μF (elec.).
C7—.1 μF.
C8—.002 μF.
C9—300 pF (m.).
C10—80 pF (m.).
C11— 025 μF (s.).
C12—16 μF (elec.).
C13—8 μF (elec.).
C14—.01 μF (s. or m.).
C15—100 pF (m.).
C16—80 pF (m.).
C17—.025 μF (s.).
C18—100 pF (m.).
C20—25 μF 25 v.w. (elec.).
C21—100 pF (m.).
C22—.05 μF.
C23—2 μF 10 v.w.
C24—.05 μF.
C25—100 pF (m.).
C26—.02 μF (s.).
C27—.1 μF (s.).
C28—500 pF.
C29—25 μF 25 v.w.
C30—.001 μF.
C31—.05 μF.
VC1—50-500 pF.
VC2—100 - 1,000 pF.
PC1—50-500 pF.
Z—.001 μF, +.001 μF (m.).
Double unit or made up ditto.

TUNERS OR RECEIVERS?



WHAT FORM SHOULD THE DOMESTIC INSTALLATION TAKE NOW THAT V.H.F. IS TO BE ADDED TO THE RANGE OF TRANSMITTERS?

By W. J. Delaney

THE news that the BBC are authorised to inaugurate a chain of V.H.F. stations utilising frequency modulation will no doubt please many listeners, but although districts hitherto badly covered will now be able to receive relays of the Home, Light and Third programmes there are some added complications. An amateur living in one of the new areas will require a normal broadcast receiver if he is interested in long-distance reception; if he has a television receiver this will be a separate set, and the proposed new commercial transmissions (and latter alternative BBC transmissions) on Band III will call for another receiver, and if he is a gramophone fan he will have a gramophone pre-amplifier combined with tone controls. All of this means that he needs five separate pieces of equipment which in the modern home will require some housing. Obviously, if full advantage is to be taken of the different classes of transmission some new type of layout will be called for, and some suggested ideas will now be outlined.

Tuners

Fig. 1 shows in block formation the simplest arrangement to enable a listener to take advantage of all of the items mentioned above. One main amplifier is suggested, with the receiving sections made up as separate units, connected as required to the main amplifier. On the face of it, this should be the simplest solution, but there are a number of snags. First, the principal feature of FM and modern TV transmissions is the very high quality which is available, and this means that the amplifier must be designed with this end in view. Ordinary broadcasting does not call for such high quality owing to the 9 Kc/s bandwidth which has to be adhered to, and this means that heterodyne whistles and other troubles may arise using a normal broadcast tuner. This may be made a "local station" unit, but then it would probably be found that the FM tuner would receive those stations so that there would be no point in using such a local tuner. Long-distance broadcasts on the medium- and long-waves do not offer a very high standard of musical entertainment so perhaps this tuner could be dispensed with, and a small three- or four-valve midget receiver could be employed for the odd occasions when long-distance reception is required, and this would simplify the main installation. All the gramophone tone-correction and pre-amplification may be included in one unit and this would enable the "standard" amplifier to be used, and then the main radio tuners could all include a single stage of audio amplification so that the outputs from all of the units would match into the amplifier. Again, this introduces some problems. A local FM station (for instance, Wrotham, Norwich, Sutton Coldfield or Holme Moss) will use an effective radiated power of 120 kW, whilst the Band III TV transmitter may be at such a distance that it provides a signal only half of that of the FM transmitter. Therefore, additional audio stages will have to be provided in this case.

Cathode Follower

The final stage in the various units would preferably be a cathode follower and this would enable ordinary types of selector switch to be employed, or plugs and socket terminations, without loss of quality or hum pick-up. Unfortunately, however, this is only one side of the picture. The television transmissions radiated by the BBC are both vertically and horizontally polarised, and no details are yet available as to the polarisation of the proposed Band III transmissions. For the V.H.F. FM transmissions quite a small aerial will be needed and in

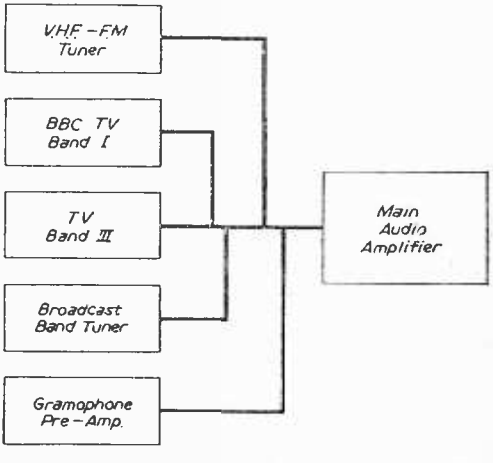


Fig. 1.—Block diagram of the various tuners which will probably be needed for future use.

many cases this could be an indoor arrangement. But the broadcast band will call for a larger aerial than the others, and this means that a minimum of four aerials as shown in Fig. 2 would normally be called for. These would have to be spaced from each other fairly well to avoid interaction or unusual tuning effects. The broadcast aerial could be of the indoor type, but this would probably defeat the aims, in the same way as would a small self-contained mains receiver, and it is possible that the V.H.F. aerial might serve also for the Band III TV transmission. However, some form of aerial switching will certainly be needed and at the moment it cannot be foreseen how such aerial selection could be carried out by means of a selector switch. At the frequencies used, a low-loss ceramic type of switch would certainly be needed and the bunching of the aerial leads and the "free" aerials in space, unless earthed or otherwise prevented from interfering with the aerial in use would introduce many difficulties. Would it be possible to erect some form of telescopic aerial

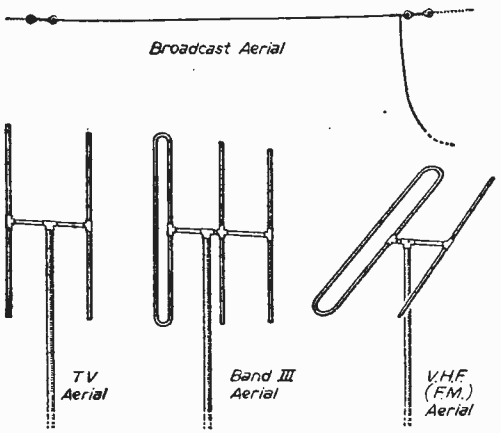


Fig.—Some aerial arrays which will probably all be seen together on some house-tops.

which could be controlled from inside the house, and opened out to the required length? Alternatively, will some new type of aerial come into use which will be effective on all bands? One recalls the original H.M.V. all-wave aerial, with its suspended matching transformers, but at V.H.F. these would certainly prove inefficient. The cage type of "slot" aerial has come into use on normal television bands, and perhaps some modification of this could be employed. Much of the advantage of the FM transmissions on V.H.F. is due to the removal of man-made static, and obviously a properly designed aerial plays quite a part in assisting in this direction. A large, badly-made aerial will probably nullify the advantages of quiet reception, so this must be borne in mind in arranging the final design. No doubt some experimenters have already foreseen some of these problems and have commenced experiments, but in most cases it will be necessary to wait for actual transmissions in order to carry out reliable tests as to the efficiency of different schemes.

BBC FM

For those who are interested in the new FM transmissions the following details are given: The stations will be in the band 88 to 95 Mc/s and will relay the three existing programmes (Home, Light and Third). The location of the stations and the power are as follows:—

	Effective radiated power kW
Wrotham (Kent)...	120
Pontop Pike (near Newcastle)	60
Divis (Northern Ireland)	60
Meldrum (near Aberdeen)	60
Norwich	120
South Devon	60
Sutton Coldfield	120
West Wales	60
Holme Moss	120

The areas to be covered by these transmitters are as follows:—

Wrotham.—South-east England, including the London area and extending as far west as Basingstoke and Bognor Regis. Towards the north the coverage will link up with that of Sutton Coldfield and Norwich To the south and east it will extend along the coast of Sussex and Kent except for a small area embracing Deal, Dover and Folkestone.

Pontop Pike.—The whole of the county of Durham and the North Riding of Yorkshire, most of Northumberland and part of Cumberland.

Divis.—An area including the city of Belfast, and extending to the borders of Eire in the south, as far as Cookstown in the west and Coleraine in the north, and as far as the coast on the east.

Meldrum.—All those parts of Morayshire, Banffshire, Aberdeenshire, Kincardineshire and Angus north-east of a line running roughly from Elgin to Montrose.

Norwich.—The whole of East Anglia, joining the service areas of London and Sutton Coldfield in the south and west and extending northwards to Boston and Skegness.

South Devon.—The whole of Devon and Cornwall, except possibly for small areas in North-east Devon and the extreme west of Cornwall.

Sutton Coldfield.—An area extending as far as Chester and Gainsborough in the north, Oxford in the south and Welshpool in the west, and linking up with the service area of Norwich in the east. This area includes the Nottingham district, where reception of the Midland Home Service on the medium wavelength is unsatisfactory.

West Wales.—The site of this station has not yet been finally settled, but it is expected to serve an area including the whole of the coast of Cardigan Bay and extending for a few miles inland.

Holme Moss.—The area bounded on the north by a line running roughly from Barrow to Bridlington and on the south by a line from Rhyl to Cleethorpes.

Propagation of Very Short Waves

THE increasing use of the frequency bands above 30 Mc/s and their importance for the development of television and other uses has made the study of the propagation of very short waves an important one. An investigation of ground wave propagation over irregular terrain at frequencies of 100 and 600 Mc/s has been made and propagation curves for general use have been constructed for the band 50 and 800 Mc/s. At larger distances a study has also been made of the effect of weather conditions on field strength levels. The statistical information gained, together with data supplied by the G.P.O. and the BBC, has been used in the preparation of propagation curves which have been adopted by the International Radio Consultative Committee for general use in the appropriate geographical regions.

Commercial Radio ?

I KNOW that the Beveridge Report advised in favour of commercial TV but against commercial radio, but I wonder how long it will be before we have commercial radio in this country? If commercial TV is successful, I see no reason ethical or otherwise why we should not also have commercial radio programmes. I do not suggest the sort of programme where a Beethoven Symphony is interjected with enjoinders to buy somebody's pills, but programmes of a quality similar to that which has been laid down for commercial TV. I know that there are many in this country against this sort of publicity, particularly the Church, and the Lord's Day Observance Society, that antiquated body of busybodies which interferes with the liberty of the subject and should have been proscribed by the State years ago. If people wish to spend their Sundays in a particular way, even if they are minorities, there is no one to say them nay. But because they have decided that their method of spending the Sabbath is the best, I see no reason why they should impose their method on me or anyone else. They may be wrong!

We are a squeamish race. We are resistant to change. In many instances we are hypocrites about it. The BBC, for example, does not permit publicity over the air, but does not hesitate to use programme time to plug its publications. It is, therefore, opposed to publicity, not on ethical grounds but on monopolistic grounds. Commercial radio could put over far better programmes than we receive from the BBC, excellent though those programmes are. We are all agreed that in the past five years the BBC programmes have improved in diversity and quality. Commercial interests could provide that spirit of competition which is necessary to act as a stimulant. At present the BBC has no competitor and it, therefore, can do what it likes, and certainly does what it likes. However, we are to have I.T.A. programmes within a year and it is my view that there will be pressure from commercial interests to carry the idea into radio. It would provide additional revenue and a greater variety of programmes.

The "Fury Four"

THE announcement that there is to be a new edition of the "Fury Four," that famous receiver which first saw the light of print in our issue dated January 28th, 1933, whetted my appetite, for I was one of the first to build that receiver. Incidentally, for the first time in the history of radio journalism, the whole of the front page of a daily paper, to wit the *Daily Mail*, was used to announce the free gift blueprint of the "Fury Four." Looking back, a comparison between the original set and the present gives one an indication of the great changes which have taken place in the last 20 years. The present receiver is less than half the size of the original. This is due to the almost universal adoption of the chassis system of construction, the gradual reduction in size of components and the elimination of certain components which hitherto were necessary to stabilise the set. Components are more reliable nowadays. Transmissions are more stable and valves much more reliable; tuning coils are now midgets; the old swinging reaction coil and plug-in coils have vanished with spaghetti resistances, and the clumsy valve holders are now unknown. Although many of the original "Fury Fours" are still being operated I should be surprised if they are not now scrapped in favour of this brilliant modern version.

Evening Courses

IT is a sign of the times that most of the technical institutes now run courses in radio, television and electrical engineering. The prospectus of the Polytechnic, Regent Street, for 1954/5 outlines National Certificate courses in electrical engineering, a five-year course in radio and television engineering and a four-year course in radio and television servicing.

The second-year course of the latter prepares the student for the City and Guilds of London Institute Intermediate Examination in radio service work, and the third year for the written and practical examinations culminating in the award of the Radio Servicing Certificate awarded jointly by the City and Guilds of London Institute and the Radio Trades Examination Board. The fourth and final year prepares the student for the Television Servicing Certificate Examinations. The session commences on September 27th and enrolment day is September 22nd.

The Radio Show

AT the time of writing these notes the Radio Show has not opened its portals to the vast multitudes who undoubtedly will visit Earls Court this year, and I prophesy that attendance records will be broken and that sales will achieve a new high. The relaxation of the hire purchase regulations means that many who had put off buying a new radio or television receiver will now take the plunge. Constructors will undoubtedly gravitate to our stand to see the new edition of the "Fury Four."

AMPLIFIER DESIGN

7.—UNTUNED AMPLIFIERS—CONTINUED

By R. Hindle

(*Continued from page 536 September issue*)

A Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, and Containing at a Later Stage Constructional Details of Various Types of Amplifier.

NEGATIVE feed-back will take place progressively more and more as frequency decreases and this reduces the gain. Inadequate by-passing, therefore, causes a reduction in low-frequency gain just as an inadequate coupling capacitor does.

Decoupling

The discussion up till now has made an assumption that must be brought to light. It has been assumed that each valve circuit is separate and quite distinct from the others except so far as coupling components have been deliberately included in the circuit. In actual fact this would be so only if each valve were completely isolated and screened, and did not have power equipment in common with the other valves. It is uneconomic, of course, to have separate power packs for each stage, and so we look for the next best. Ideally, the common power pack should have zero impedance, in which case there is no common impedance to cause coupling between the stages, and this is just as good as separate power packs, but like most ideals this is unattainable. There are methods of reducing the power supply impedance to a very small figure, but for ordinary amplifier work it is generally necessary only to provide good smoothing, and to put as large a capacitance as possible at the final smoothing position. The effectiveness of these measures is then enhanced to the necessary degree by introducing decoupling. This consists of a resistance in series with the power supply which forms a potentiometer with a capacitance put in parallel with the valve being fed. The aim is to have as little fed-back signal as possible across the capacitance, where it will affect the valve, and as great a proportion as possible across the series resistance where it will do no harm. Obviously, therefore, the aim is to use as large a resistance as possible and as large a capacitance as possible. The size of resistance permissible is limited, however, by the H.T. voltage that the designer can afford to drop, and rarely can more than 10/20,000 ohms be used unless the power pack is made to give a much higher voltage than the valve requires. The limitation in capacitance is chiefly a question of physical size and cost; it will need to be larger the lower the frequencies to be handled. The effectiveness of the components chosen for decoupling is measured by the product of capacitance and resistance (just as was found to be the case with intervalve coupling components) and this product should at least equal the period of the lowest frequency to be handled. The period is the time in seconds for one complete cycle of the frequency and the components should be measured in MΩ and μF. The frequency to be taken is not merely the lowest frequency that is likely to come out of the speaker, but is the lowest frequency that the amplifier is likely to be fed with and to amplify, independent of whether it will be heard. Taking 25 c/s as the lowest frequency likely to be experienced the period is one-twenty-fifth of a second or .04 second, so MΩ multiplied by μF must equal .04. Supposing a resistor of 22 KΩ is used (R1). This is $\frac{22}{1000}$ of 1 MΩ and so the capacitance must be $\frac{.04 \times 1000}{22} = 2\mu$F. This is the bare minimum, so in order to provide a satisfactory safety margin 8μF will be specified.

Volume Control

It is often necessary, of course, to vary the gain of an amplifier. This can be done by varying the

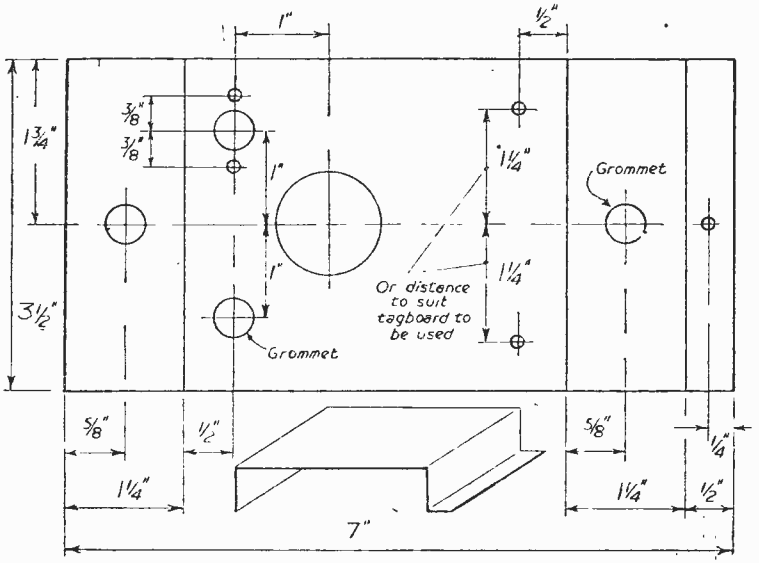


Fig. 27 and 28.—Details of the chassis as cut and bent to shape.

amplification of the valves themselves, using variable-mu valves, for instance, and varying the grid or cathode bias. This has the great advantage that the volume control carries only D.C. and not the signal voltages, so that it can be placed at a distance from the amplifier and the volume controlled remotely. Using these valves it is possible also to arrange for automatic control of gain by the signal itself, so that a steady level of volume is maintained just as A.V.C. maintains a steady R.F. signal. Where possible, however, the use of variable-mu valves is avoided in the type of amplifier now being discussed, because of the inherent curvature of their characteristics with resulting distortion. If special circumstances require their use, they are placed at the input end of the amplifier so that as little signal as possible has to be handled at the gain-controlling stage.

The more usual method is to allow the valves of the amplifier to amplify fully, and to control volume by tapping off only part of the signal by means of a potentiometer, variable if manual control is required. Often it is more convenient to put the volume control on the equipment feeding the amplifier rather than on the amplifier itself, and if this were so in the case of the design now being developed nothing more need be said. The purpose in mind was something in the nature of a utility model, however, and so it will be as well to incorporate a volume control. It can always be left untouched when not required.

There are many alternative positions for the control in the amplifier, at least in theory; any resistance carrying the signal can be made a potentiometer for this purpose, i.e., R2, R4 or R6, or alternatively a potentiometer can be added at the input to the amplifier to feed the grid of the first half of the valve. There are practical objections to R2 and R4, however. These resistors carry the anode current as well as the signal current and it can be taken as a general rule that, so far as possible, all controls are kept away from D.C. carrying positions because they tend to be very noisy in operation.

The choice between the two positions now left would largely be determined by the size of the signal to be fed to the amplifier; if this is to be very small it will be preferable to present the whole of it to the grid of the first stage so as to ensure the best possible signal/noise ratio, making R6 a potentiometer for volume control purposes. In this case, however, it must be quite certain that the input signal will never exceed the permissible fraction of a volt input. In the present design such a state of affairs cannot be assured, and so the alternative course of inserting a volume control in the input circuit is followed. The value of the potentiometer is chosen just as was the grid resistor, i.e., it will be made as large as the valve will allow so as not to load the circuit preceding the amplifier, and in the present case 1 MΩ will be specified. This is incorporated in Fig. 26.

Building the Triode Amplifier

Before giving constructional details of the amplifier that has been designed above a few words will be said about the plan of campaign. The triode amplifier is built as a separate unit without power supply, but the next theoretical step will be to consider power amplifiers and this will be followed by the process of designing pentode and triode output stages. These will incorporate power supplies which will be capable of feeding the present amplifier and the two will stand side by side with link connections, making them complete and versatile amplifiers. Another point is that both A.C. and Universal techniques will be represented. The present amplifier will, in actual fact, serve with power amplifier designs using both methods of applying power and the only variation is in the connection of the heaters. The valves and components are identical and the reader can, if he wishes, use the one unit to try out both schemes. The text below describes the heater connections for both power supply circuits. It is hoped later also to explain how the amplifiers can be incorporated in complete receivers.

Fig. 26 gave the circuit that is to be used. The chassis is made up of a strip of aluminium measuring 7in. by 3½in. overall and the drilling is given in Fig. 27, which shows the chassis in the flat. The illustration (Fig. 28) also shows the shape of the chassis when folded, the markings being as at the underside of the finished chassis. The ½in. flange is at the rear of the chassis and is used to fix the chassis to a baseboard or to the cabinet work in which it is to be used. It is necessary, of course, to ensure that the holes as indicated do actually match the com-

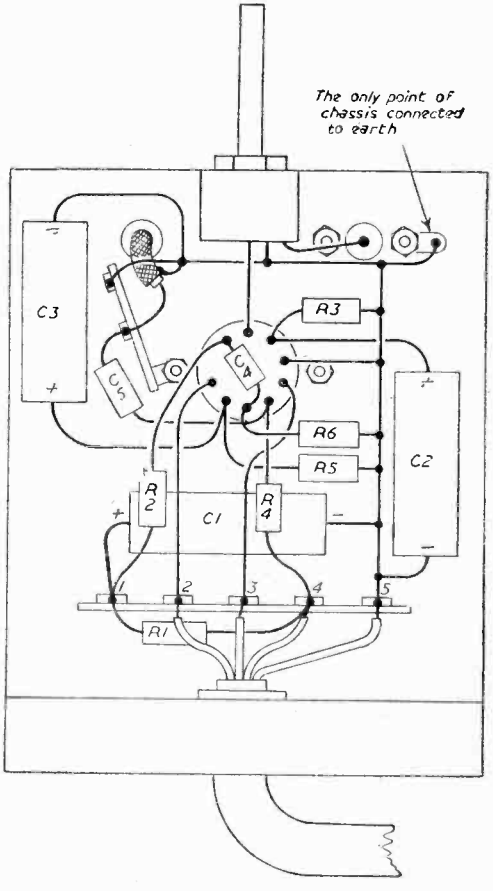


Fig. 29.—Wiring diagram.

ponents to be used, and these should be obtained and checked before commencing to drill. No holes for fixing screws for the valveholder are shown. The best way is to punch the $\frac{3}{4}$in. hole in the position indicated. Then drop the valveholder into it and position the holder so that the pins take up the relative positions shown in the wiring diagram, Fig. 29 (though remembering that Fig. 29 gives the view as seen underneath the chassis). The position of the fixing holes can then be marked through the valveholder and drilled. The hole at the rear of the chassis is fitted with a large grommet of a size suitable to accommodate the four-way cable; the grommet on the top and towards the front of the chassis is smaller and passes the $\frac{1}{4}$in. coaxial cable conveying the signal to the following unit.

It will be noticed that the modern miniaturised components are specified. These match the valve and allow the very compact design, but the reader who has followed the earlier parts of this series will know that there is the additional benefit of reduced stray capacitances. The first step, having shaped and drilled the chassis, is to mount the valveholder, the volume control, the coaxial input socket and the two tag strips. The wiring can then be proceeded with, and a wire-by-wire description is given below. Stress must be placed on the fact that the chassis is not used for the earth return leads. Instead, a busbar earth of stout wire is used and this contacts the chassis at only one point, i.e., at the outside mounting screw of the coaxial input socket. This is very important and should be followed by the constructor who should note that the busbar is anchored to the tag strips; *not* to the earthing tags in contact with the chassis but to floating tags.

If the wires are put on in the following order no difficulty will be experienced. The component mentioned in the left-hand column is wired between the points indicated or if no component is specified the points mentioned are connected together. Wiring is carried out using 24 gauge tinned copper wire in sleeving except for the earthing busbars, which should be in about 16 gauge tinned copper wire without sleeving. Shape the busbars carefully from lengths of wire that have been stretched to straighten them out before starting to solder them into place. They should be bent so that the wire runs at about 1in. from the under surface of the chassis.

The only change in the design developed theoretically is at C4. Theory prescribed a .02 μF component, but this was seen to be the minimum value and a larger capacitance would be better rather than worse from a low frequency point of view. From the point of view of upper frequency response as well as for convenience in construction the capacitor should be physically small and the Dubilier type 410 is ideal for the purpose, but a .02 μF component is not available in this range. There is one of .03 μF and this is specified. If a .05 μF component is available in this miniature range it could be used without noticeable difference.

1. Earth busbar, 16 gauge wire from tag 1 of two-way tagboard to solder tag under holding-down bolt of coaxial input socket. Wire should be shaped to pass $\frac{3}{4}$in. away from the volume control.
2. Earth busbar, 16 gauge wire from tag 5 of large tagboard to join first busbar.
3. Pass a length of coaxial cable (about 2ft. was used by the author for first tests) through the hole in the top of the chassis with a grommet, remove 1in. of the PVC covering and strip the braid back, leaving a pigtail of the braid which solders to the earth busbar. Bare the end of the inner and solder to tag 2 of the small tagboard.
4. R1. 22 KΩ. From tag 1 to tag 4 of the large tagboard.
5. C1. 8 μF positive to tag 1 of large tagboard; negative to earth busbar.
6. R5. 2,200Ω } From tag 8 of valveholder
   C3. 100 μF } (positive of C) to earth busbar.
7. R2. 100 KΩ. From pin 1 of valveholder to tag 1 of large tagboard.
8. Lead 1 (coded red) of volume control to pin 2 of valveholder.
9. Lead 2 of volume control to earth busbar.
10. Lead 3 of volume control to input coaxial socket.
11. R3. 2,200Ω } From pin 3 of valveholder to
    C2. 100 μF } earth busbar.
12. Pin 4 of valveholder to earth busbar.
13. Pin 5 of valveholder to tag 3 of large tagboard.
14. Pin 9 of valveholder to tag 2 of large tagboard.
15. C4. .03 μF. From pin 7 of valveholder to pin 1 of valveholder. (Bridge the component over valveholder with $\frac{1}{2}$in. leads supporting each end.)
16. R6. 1 MΩ. From pin 7 of valveholder to earth busbar.
17. R4. 100 KΩ. From pin 6 of valveholder to tag 4 of large tagboard.
18. C5. .1 μF. From pin 6 valveholder to tag 2 of small tagboard.
19. Pass the end of a length of 4-way cable through the grommet at the back of the chassis and connect to the large tagboard, indicating the coding colours as follows:
    Tag 2—Heater.
    Tag 3—Heater.
    Tag 4—H.T. positive.
    Tag 5—H.T. negative (and amplifier earth).

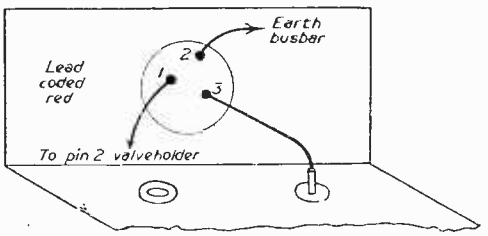


Fig. 30.—Fix volume control with connections in positions indicated.

Note that the heater connections are arranged to allow for either A.C. or universal working. If the unit is put into use with a power pack other than those to be shortly described care must be taken with the heater connections. Working from an A.C. supply, the lead from tag 3 must go to earth and the lead from tag 2 must go to one side of the 6.3 winding. The other end of the winding must also go to earth. For universal mains circuits with series connected filaments the lead from tag 2 is not connected and the lead from tag 3 goes to the remainder of the heater chain so that the present amplifier valve is at the earthy end of the chain.

(To be continued)

The Beginner's Guide to Radio

The Eighteenth Article of a Series Explaining the Fundamentals of Radio Transmission and Reception. This Month Further Notes on Testing Instruments and Measurements are Given By F. J. CAMM

RESISTANCE values for any other voltage ranges can be worked out in the same way. It will be obvious that when the voltage to be measured is above 50 the resistance of the meter can be ignored without affecting the accuracy of the measurement to any great extent.

Resistance Measurement

The milliammeter may be used to measure resistances by connecting it in series with a resistance, (Fig. 75 last month). When measuring the values of small resistances (less than 100 ohms) this method is not very suitable for extreme accuracy. In this case use should be made of a resistance bridge, the circuit arrangement of which is shown in Fig. 76. The resistances R1, R2 and R3 are of known value, whilst R is the unknown and R1 and R2 are adjusted until current ceases to flow through the galvanometer marked G. The value of R can be found from the equation R1/R2=R/R3. Simplified this becomes:

$$\frac{R1 \times R3}{R2} = R.$$

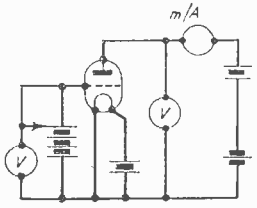


Fig. 78.—Circuit of a valve tester, by means of which characteristic curves can be plotted.

A simple resistance bridge is shown in practical form in Fig. 77, where it can be seen that the resistances R1 and R2 are replaced by a length of resistance wire a yard long attached to a baseboard to which is attached a 3ft. rule. R3 is of known value whilst the galvanometer should be of the centre zero type. The battery (an ordinary flashlamp type will do, or an accumulator) is connected up and the crocodile clip is connected to one galvanometer terminal and pressed against the length of resistance wire and moved along it until a zero reading is shown on the galvo. Then the above calculation can be made, taking R1 and R2 as being proportional to the distances of the clips from the two ends of the resistance wire. This is, of course, a very simple arrangement intended for demonstration purposes.

A simpler formula for calculating shunts is $Rs = \frac{Rm}{(N-1)}$, where Rs = the value of the shunt. Rm = the value of the meter resistance and N the multiplication factor.

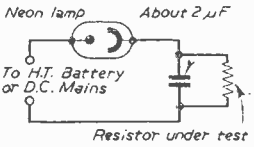


Fig. 80.—The circuit for testing resistances, using a neon lamp.

A more finished resistance bridge can be made by providing a slider to make contact with the resistance wire and fitting suitable terminals to a base-board so that the necessary components can be quickly wired up. The resistance wire can be 20 gauge Eureka, and it should be soldered at each end to tags fitted under the terminal. Resistances of about 10, 20 and 50 ohms will be required for R3.

A Valve Tester

A valve tester which will enable the experimenter to plot characteristic curves of valves can be quite simply made from the circuit shown in Fig. 78. This tester is, of course, intended for battery valves but a similar one could be made for A.C. valves, or a combination instrument for both could simply be devised on similar lines.

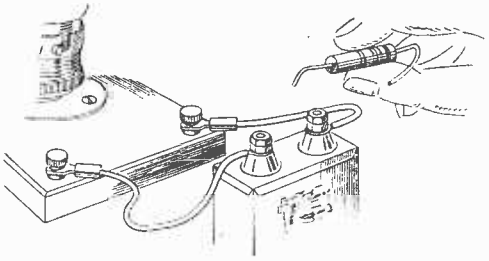


Fig. 79.—Measuring resistances by the flash method.

Testing Coils

It is sometimes interesting to compare the efficiencies of various types of tuning coil and in this case a valve voltmeter should be used. This consists of a circuit comprising a single valve,

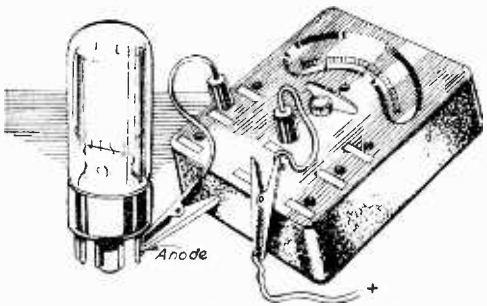


Fig. 81.—When testing the total H.T. current of a pentode, or a screened-grid valve, it is not sufficient to insert the milliammeter in the anode lead as shown here, as this does not include the screening grid current. Take care to insert the plugs in the correct (— and +) sockets of the meter.

arranged for anode bend rectification and having a milliammeter connected in its anode circuit. A simple arrangement of such a device is shown in Fig. 78. In this case, the milliammeter should have a maximum deflection of 1 milliamp, as this low reading enables very accurate results to be obtained.

Using Valve Voltmeter

In using a valve voltmeter the first thing to do is to adjust the grid-bias voltage by altering the position of the negative tapping and by varying the potentiometer setting until the milliammeter shows a reading of about .5 milliamps. When that is done, any tuned circuit which is connected to aerial and earth lead can be connected to the two terminals marked "Input." The circuit is then tuned to the local station or to the frequency of a local oscillator, and the increased reading of the instrument noted. The coils which are to be compared can then be connected in circuit, one at a time, and the readings carefully noted in each case. In each instance, the efficiency of the coil is represented by the change in anode current when it is connected in circuit. It is possible to calibrate the valve voltmeter so that actual voltage readings can be taken of H.F. currents, but that would only be necessary in the case of special laboratory work.

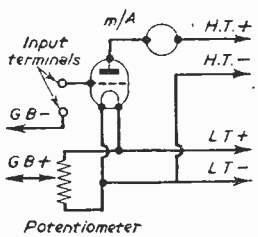


Fig. 82. — The circuit arrangement of a valve voltmeter which is suitable for comparing the efficiency of various coils.

Useful Adjuncts

A number of small components and accessories are desirable for use in conjunction with measuring instruments. These include a pair of test prods, which can be connected to the instrument and the two metallic ends of the prods used to make contact with various parts of the circuit when taking measurements. Another useful accessory is a split-anode valve adaptor. This consists of a combined valve holder, plug and socket which can be placed in a valve holder between the valve pins and the sockets. The grid and filament pins are connected directly to the corresponding sockets but in the case of the anode pin this is brought out to the terminal on the side of the adaptor, the anode socket being connected to another terminal on the adaptor. Thus, the anode current of any valve under exact working conditions can be measured by fitting the adaptor and connecting a milliammeter to its two side terminals.

The Characteristic Curve

Valve manufacturers issue useful books on their valves, giving what are known as the characteristics of the valve. In addition to tabulated details there is a graph. It will be found that the bottom line of this graph bears a number of figures marked "Grid Volts." The right- or left-hand edge of the graph bears a number of figures marked "Anode Current" and the thick lines running across the squares are labelled "Anode Volts." Sometimes these three sets of figures are referred to by their technical abbreviations, Vg for Grid Volts, Va for Anode Volts and Ia for Anode Current. The grid volts line is usually divided into two parts, a zero line being placed near the right-hand edge, and the volts to the left of this being marked "negative" and those to the right "positive." This set of curves provides all the details which are known as the characteristics of the valve.

Plotting a Characteristic Curve

You may plot your own characteristic curve in the following way. Connect up a valve holder, a grid-bias battery, an H.T. battery and a L.T. battery in the usual way. A milliammeter should be inserted in the anode lead, between plate and H.T. positive. Now prepare a piece of squared paper with a grid potential line and mark the right-hand line with a series of numbers from 0 to 30. Insert the valve in its holder. With no grid-bias and 60 volts H.T. note the current indicated by the milliammeter. On the squared paper make a dot on the zero line where the line corresponding to the anode current intersects. Next plug the grid-bias plug into the 1.5 volt socket, and note the anode current, making a dot on the chart above the 1.5 volt line at the point of intersection with the new anode current figure. *(To be continued)*

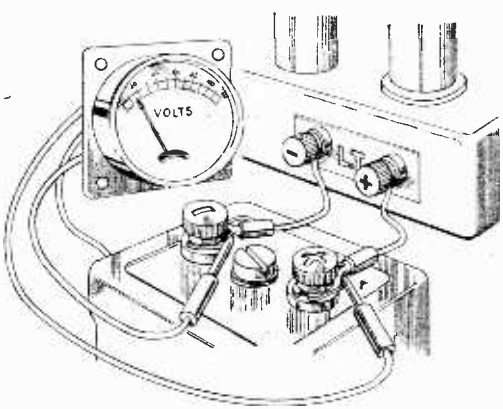


Fig. 83.—The correct way to test the voltage of an accumulator is while it is under load, that is, while it is connected to the set and switched on.

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

"Diplomacy"

AS a very young man I can remember a most exciting and dramatic play at Wyndham's Theatre called "Diplomacy," by Victorien Sardou. Among the stars in the cast were Gladys Cooper and the late Sir Gerald du Maurier. The potential enemy in those days was Germany and, although the nationalistic plotting and counter-plotting, spying and counter-spying of this most well-constructed piece were strictly Ruritanian in their imaginativeness, one was made to feel that the sinister Baron Stein and his associates were plotting for Germany against England. Further, was not the author a Frenchman?

Although my judgments in those days were less experienced and mature than I trust they are now, everyone, during a run of hundreds of performances, was tremendously thrilled and fascinated. There must have been something in both the play and the acting. But recently in the Monday night theatre series, there seemed absolutely nothing. The plot seemed jejune and naïve to the point of being Dick Bartonish or P.C.49-ish. Forty years of international immorality and knavery had done its work, presumably, and left me too sinister or blasé to care two straws as to what happened or "whodunnit." And as for the acting, my only memory of it is a most hideous conglomeration of catarrhal sickish foreigners talking pigeon English and trying to speak a language about which they knew nothing. Up they came one after the other: it was as though all the day trippers on a Bank holiday had been rounded up on Folkestone and Boulogne harbours and hurled into the cast. The Countess Zicka—Freda Jackson—was the worst offender. But listen to the names of the others: Madame la Marquise de Rio Zares, Baron Stein, Count Orloff, Mion, Antoine, etc. That all these were at it hammer and tongs throughout almost the entire length of the piece in broken English, to everyone's boredom and ennui, was the producer's fault. I won't mention any names other than Miss Jackson's and Gerard Heinz's as Stein in what was to me a dreadful show.

Other Plays

Another silly piece, this time the bored audiences foregathered on a Saturday evening, was "Who Killed Rikhjovic?" by Rex Reinitz. The story concerned the killing of the potential Wimbledon champion, whilst in course of play on the centre court, by means of refresher tablets which he sucked between games. This is a procedure very rare, I believe, if not entirely unknown in the tennis hierarchy —the sucking, not the killing. These pieces of fantastic adventure, which the BBC is so fond of these days, tell us nothing of real life or of real people whatsoever. For the devotee of the "Penguin Green-Back" they may have their excitements. The best member of the cast was the actual BBC's Wimbledon commentator, Max Robertson, who purported to be commentating this bizarre match. The crowd of centre court fans was too small and too obviously under a conductor's baton to convey much realism.

A much more interesting piece that concerned itself with realities which, if long since past and not very apposite to everyday life, are none the less an important, shattering and decisive episode in English history, was "My Lord Cardinal," written for radio by Donald Ford. Readers who didn't listen will guess that it dealt with the Henry the Eighth—Katherine—Anne Boleyn triangle. Maxine Audley, Baliol Holloway, James McKechnie, Catherine Salkeld, etc., gave it interest and realism.

But the *chef d'œuvre* of the theatrical month was an excellent production of a masterpiece, Sheridan's "The Rivals." "Give us the tools and we'll get on with the job," said the Prime Minister in darker days. Actors and producers must often quote the sentiment in words to suit a changed context. The deed usually works the trick. Barbara Couper pointed all the Mrs. Malapropisms effectively. Lydia Languish, in the person of Isabel Dean, won all our hearts, whilst Ivan Sampson as Sir Anthony Absolute, Richard Bebb as Capt. Anthony, Simon Lack as Bob Acres, T. St. John Barry as Sir Lucius o'Trigger, as well as all the others, passed across the stage in true eighteenth century fashion.

Programme Clash

I welcome back "The Name's the Same," probably the best of the current series of parlour games. It is a pity, though, that it is now timed for nine o'clock on the Light. It bites into the first quarter of an hour of the Monday night theatre on the Home Service, which starts at 9.15. This could surely be avoided.

Brian Johnston is a most excellent and highly-informed cricket commentator, but I do wish he wouldn't talk so fast. Cricket is such a slow-moving game that there is really no need to emulate Raymond Glendenning at football or Max Robertson at tennis.

The "Frankly Speaking" series of interviews was successfully continued when Colin McInnes, C. R. Hewett and Roger Bannister questioned Viscountess Astor. There are few more interesting items in current programmes than these questionings of famous public figures. One could sometimes wish the questioners were less diffident and shy seeming, and assume a bolder front as if to say "We don't care a rap whether you are the notorious Sir this or Dame that . . . All we want is the low-down, and the lower the better." Lady Astor is a forceful personality and has touched life at many points.

She was at her most amusing when talking on her American home and upbringing.

Farewell Broadcast

Ever ready to encourage youth and promising talent, Adelina de Lara, eighty-two years young, was allowed to give her farewell broadcast. She has already given more than one publicly. Her piece was Schumann's Kreisleriana, a task for any virtuoso male pianist of sixty. The same composer's "Scenes from Childhood" would have better suited her.

News from the Clubs

WEST LANCS RADIO SOCIETY

Hon. Sec.: Mr. S. Turner, 5, Balfe Street, Seaforth, Liverpool, 21.

THE club now has a 1154 transmitter and 1155 receiver, generously donated by Mr. F. Carter, who is a keen and enthusiastic member of the club. The club call sign is G3JQA, but operations are restricted at the moment owing to the lack of a good aerial. Future events include a talk on Superhets by H. Hipple (G3BNO), a radio film strip and a talk and discussion on the National Field Day (June 12th to 13th). The club meets every Tuesday at 8 p.m. over Gordon's sweet-shop, corner of St. Johns Road, Waterloo.

THE ACTON, BRENTFORD AND CHISWICK RADIO CLUB (G3HU)

Hon. Sec.: R. G. Hindes (G3IGM).

THANKS to notices published in "P.W.," the club membership continues to rise weekly. Meetings are held each Tuesday night from 7 p.m. to 10 p.m. at the A.E.U. Rooms, 66, Chiswick High Road, W.4. Many contacts have been made with the club's low power transmitter on the 80 and 160 metre bands. G3INE gave an interesting lecture recently on "Parasitics," and Pat Hawkes (G3VA) lectured on "The History of Amateur Radio." The club will operate with the call G5LQ/P on NFD from the L.P.T.B. Sports Ground at Acton Town.

SOUTH MANCHESTER RADIO CLUB

Hon. Sec.: M. Barnsley (G3HZM), 17, Cross Street, Bradford, Manchester, 11.

THE following programme of lectures has been arranged:
Sept. 10. Design of Mains Transformers and Chokes: N. Ashton (G3DQU).
Sept. 24. Power Pack Design: M. Barnsley (G3HZM).
Oct. 8th: Annual General Meeting.
New members are continually coming along in order to hear the simple lectures which have been instituted into the meetings, and which take place before the main lecture. Any readers who wish to come along will be very welcome.

THE CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Road, London, S.E.6.

ONCE again the Clifton A.R.S. has enjoyed a full month of events. On July 2nd a Junk Sale took place, on July 16th a session of "Any Questions," whilst on July 30th club member B. Herbert (G2WI) gave a very interesting talk on the Tesla Oscillator. Constructional evenings were held on July 9th and 23rd.

The second D.F. contest took place on Sunday, July 25th. The weather was unkind, but six teams took the field in the hunt for the club transmitter, G3GHN/P, operating in the 80 metre band. The winner was C. Hatfull (G3HZI), assisted by R. Poppi. Second was E. Strong assisted by D. Reed and D. Wenham.

The proposed programme for September is:
September 10th: 8th Annual General Meeting.
September 17th: Constructional Evenings.
September 24th: "Radio Receiving Valves and their Manufacture": Mr. G. P. Thwaites (Standard Telephones & Cables, Ltd.).
Meeting are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE meeting on October 9th will be devoted to the showing of Messrs. Mullard's films "The Manufacture of Radio Valves" and "The Industrial Application of Ultrasonics." On October 30th Mr. Edwards, of the A.E.I. Research Laboratory, Aldermaston, will be giving one of his lectures on Electronics.

WARRINGTON AND DISTRICT RADIO SOCIETY (G3CKR)

Hon. Sec.: G. H. Flood, 32, Capesthorne Road, Orford, Warrington.

THE annual Inter-Club Top Band Telephony Contest, organised by this Society, takes place on Sunday, September 26th, and is open to all TX and RX members of neighbouring societies. Further details from Hon. Sec.

A visit to the Port Radar Station, Gladstone Dock, Liverpool, is being arranged.

Meetings will be held on September 7th and 21st at the King's Head Hotel, Winwick Street, 7.30 p.m.

LEICESTER RADIO SOCIETY

Hon. Sec.: W. N. Wibberley, 21, Pauline Avenue, Belgrave, Leicester.

DURING the month of August the Leicester Radio Society held another of its popular D.F. Field Days. Members arranged themselves in parties of three or four, and in spite of the weather had a very enjoyable day.

Many books have been added to the Society's new library and the librarian is compiling an up-to-date list which will be issued to members.

The Experimental Transistor Group has been devoting its activities to the design of new equipment, and group members have taken part in all the transistor transmission trials with great success.

G2BVW gave a talk in July on V.H.F. circuits, and several members have built equipment as a result of his lecture.

The arrangements for the forthcoming Autumn and Winter sessions are now in hand, and a list of lectures will be published very soon.

BRADFORD AMATEUR RADIO SOCIETY

Hon. Sec.: F. J. Davies, 39, Pullan Avenue, Bradford.

THE 1954/55 syllabus is now practically complete and the first meeting of the winter season is on Tuesday, September 14th, 1954.

The syllabus caters for a variety of interests and includes a visit to one of the TV. link stations, and lectures on oscilloscopes, transistors and amateur test equipment. A copy of the syllabus will gladly be sent on application to the secretary.

ROMFORD RADIO SOCIETY

THE address of the secretary of the above society, Mr. N. O. Miller, has been changed from 10, Rom Crescent, Romford, to 18, Mascalls Gardens, Brentwood, Essex.

BOOK RECEIVED

"RADIO VALVE DATA: Characteristics of 2,000 Valves and C.R. Tubes." Compiled by the Staff of "Wireless World." Fourth Edition, Published on August 23rd, 1954, at 3s. 6d. net (postage 4d.), for "Wireless World" by Iliffe & Sons, Ltd. Size 11in. by 8½in. 100 pages.

THE latest edition of this widely-used reference book contains full operating data on over 2,000 types of British and American radio valves and some 200 cathode-ray tubes. Seventeen British valve manufacturers are represented, all of whom have co-operated with "Wireless World" in ensuring that the information given is accurate, comprehensive and up-to-date.

The main tables give the electrical characteristics of each valve, and separate tables show their base connections. The main tables further classify the valves into current, replacement or obsolete types, as recommended by the makers. An index enables any valve to be found in the tables immediately, while a valuable new feature is the full list of equivalents.

"Radio Valve Data" is an essential tool for every radio designer, service engineer, dealer and experimenter.

Principal Exhibits Reviewed

Aerialite, Ltd.

IN addition to many popular and well-known aerials there will be some new lines, especially in the Band III range. Two new aerials (Models 88 and 89) will also be seen, together with radio aerials, car aerials and interesting small accessories. These include coaxial plugs, attenuators, aerial distributor boxes, lightning arresters, mounting devices, etc. A wide range of cables will also be on view here.

[Stand No. 64]

Antiference, Ltd.

THE full range of aerial equipment exhibited here will include television aerials, indoor aerials, F.M. and Band III aerials, car aerials, etc. Special export models will also be on view, and amongst the other products will be the "Exstat" aerial, vertical rod aerial, plugs, sockets and other incidental items.

[Stand No. 34]

Associated Technical Manufacturers, Ltd.

THE full range of "Arrell" television aerials are shown, incorporating the unique polythene insulator. Several new types are among those on view, including an "X" type at a very low price. Band III aerials appear for the first time in readiness for the opening of commercial transmissions. The "Arrell" co-axial plug and socket, together with outlet boxes, are also included in the exhibit. Several examples of thermo-plastic moulding and a full range of television co-axial and balanced twin feeder make up the total of television components shown.

[Stand No. 25]

SPECIAL NOTE

This review has been compiled from information supplied by exhibitors, as we go to Press with this issue before the show opens. The omission of certain exhibits is, therefore, explained by the fact that the manufacturers concerned have not, at the time of going to Press, supplied us with the information. Further reports will appear next month.

Automatic Coil Winder & Electrical Equipment Co. Ltd.

A WIDE range of electrical and electronic instruments will be found. In addition to the well-known range of "AVO" equipment, two new multi-range instruments will be of interest. These are the "AVO" electronic multimeter, a 96 range valve voltmeter, and the "AVO" valve tester type 160. Both instruments incorporate novel features, are suitable for use in any climate, and meet the conditions of various British inter-service specifications.

It is hoped to show a model of an entirely new signal generator specially designed to cover the requirements of receivers catering for present and future television stations, and stations transmitting frequency modulated programmes. [Stand No. 51]

Balcombe, Ltd., A. J.

RADIO and television receivers are to be shown here, amongst which is what is claimed to be the smallest all-wave superhet—the C.114. This is the sixth successive year in which this model has been shown. Other radio models include portables, amongst which is a small portable radiogram operating from batteries or mains. Three console radiograms, big-screen television receivers, and a combined 17in. TV plus three-speed radiogram will also be shown.

[Stand No. 35]

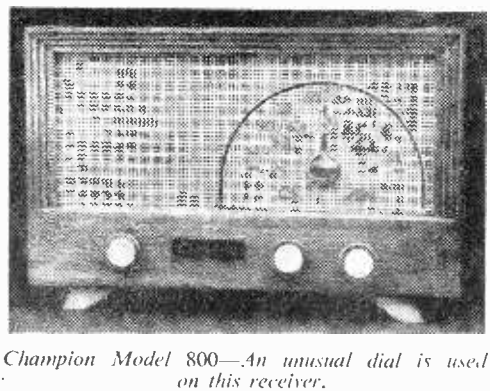
Belling & Lee, Ltd.

A VERY wide range of the smaller accessories will be seen here, including television aerials, radio aerials, amplifiers, aerial terminations, interference

suppressors, terminals, fuseholders, connectors, etc. Aerials for the new television Band III will be seen, and the amplifiers will include a model designed for installation in blocks of flats, etc., for the distribution of television or radio signals to a number of widely separated points. [Stand No. 67]

Bulgin & Co., Ltd.

ONCE again the enormous range of small items will be shown, including switches of all types, connectors, cut-outs, fuses, connectors, plugs and

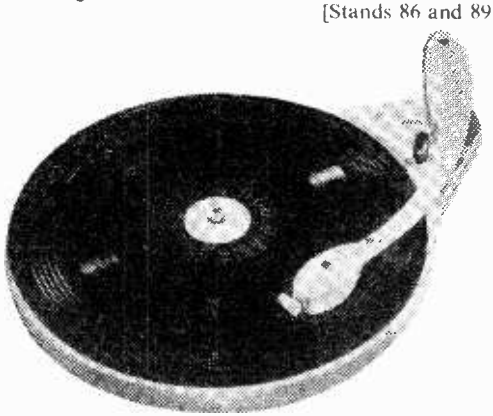


Champion Model 800—An unusual dial is used on this receiver.

sockets, lampholders and signal lamps, test prods, terminals, knobs and dials. Many of these are already familiar to most constructors, but there are dozens of new lines which should be inspected. [Stand No. 99]

Bush Radio, Ltd.

HERE will be seen "as usual" the Peter Pan model DAC.90A, which is now in its ninth year of continuous production, a mains-battery model first introduced last year and for which a special mains unit is available, and other table and console radios. One V.H.F. sound receiver will be seen, but no type of adaptor for radio sets produced in past seasons. A wide range of television models will also be shown. [Stands 86 and 89]



One of the Collaro gramophone units.

Chald Products, Ltd.

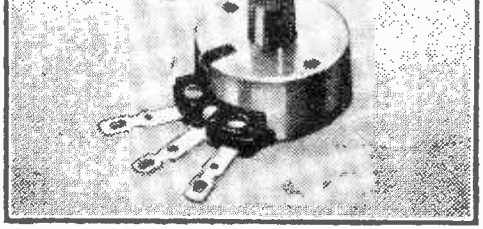
HERE will be seen the "Squarial" and the "Javelin"—two new television aerials of unusual design. [Stand No. 26]

Champion Elec. Corporation

A MIDGET broadcast-band only receiver, a three-speed record player and amplifier, a four-valve battery portable, a transportable three-speed radiogram and a bureau radiogram with record storage space are amongst the models to be seen on this stand. Model 800 sets a new idea in cabinet design, being very contemporary in appearance. (See illustration on this page.) [Stand No. 33]

Collaro, Ltd.

A VERY wide range of record players, turntable units and similar items will be shown here, including some new models such as the "54"—a high-fidelity record changer which mixes 7in., 10in. and 12in. records and has a constant change time at all record speeds. Also on show will be the new AC3/554 three-speed gramophone unit incorporating the new one-piece lightweight pick-up arm and new turntable with a further reduction in selling price. [Stand No. 11]



A miniature pre-set volume control from the Dubilier range.

Co-operative Wholesale Society, Ltd.

THE range of "Defiant" radio and television receivers will be shown here. The television receivers are dealt with separately in our companion paper. Amongst the radio models are a mains-battery four-valver and an A.C. super-radiogram with three-speed record changer and record-storage space. [Stand No. 106]

Cosmocord, Ltd.

HERE will be seen the well-known Acos products—pick-ups, microphones and other electro-acoustic devices employing crystals. The pick-ups cover a very wide range, being available as replacement heads or complete with carrier-arm. The microphones include a non-directional lapel type, as well as a vibration unit suitable for use in the reproduction of musical instruments of the stringed type. [Stand No. 44]

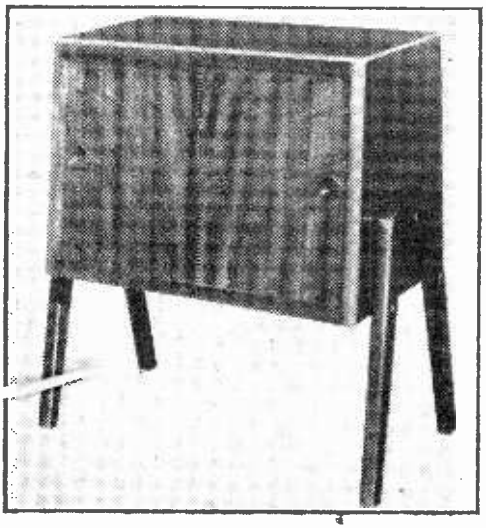
Cossor, Ltd., A. C.

AMONGST the radio models to be seen here will be provision, for the first time, for receiving F.M. transmissions which should commence in the

near future. The "Melody Master," covering three wavebands and incorporating 7 valves will also receive existing A.M. transmissions. A new radiogram, Model 522, has seven valves and a magic-eye and is also adaptable to receive the F.M. signals. A wide range of TV receivers will also be seen.
[Stand No. 57]

Decca Record Co. Ltd.

ON this stand the exhibits will range from a comprehensive tele-radiogram to a single-valve record reproducer. Fitted with a 6in. elliptical loudspeaker, this has a 3-speed motor and turn-over crystal pick-up and costs 19 gns. Among the television models will, of course, be the already familiar projection models. These will be covered in our companion paper. [Stand No. 39]



A modern style record storage cabinet by H. E. Gibbs.

Dubilier Condenser Co. (1925) Ltd.

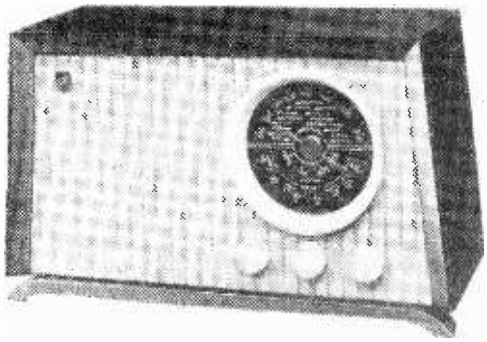
HERE will be seen a vast range of mica, ceramic, electrolytic and paper condensers, together with fixed and variable resistors and suppressors for radio and television purposes. The resistors include the smallest ½ watt unit (the BTS) and include special high-stability types as well as those which are wire-wound. The condensers are supplied in an extremely wide range suitable for radar, and other electronic purposes. [Stand No. 83]

Edison Swan Electric Co. Ltd.

THE main feature on this stand will be aluminised cathode-ray tubes. Apart from these, however, will be seen a wide range of radio valves and many interesting Ediswan-Clix radio components. Amongst these will be valveholders and plugs and sockets. The exhibit will be completed by Ediswan stabilised power units, a low-frequency oscillator and the Ediswan portable electrical recording equipment for medical and industrial use. [Stand No. 37]

E.M.I. Sales & Service Ltd.

ON the four stands occupied by this firm will be seen H.M.V. and Marconiphone radio and television receivers, H.M.V., Columbia, Parlophone and M.G.M. records, and an interesting array of electronics equipment including an analoge computer. The radio receivers of the H.M.V. and Marconiphone Companies will be seen on Stands Nos. 10 and 13, whilst the records will be on Stand No. 9 and E.M.I. Sales and Service on No. 73.
[Stands 9 and 73]



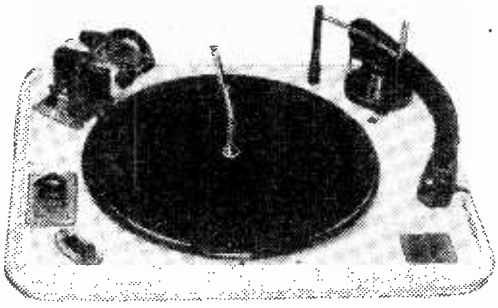
This is one of the Alba receivers—Model 3112.

Ever Ready Co. (Gt. Britain) Ltd.

DRY batteries of all types will be seen here, together with some radio receivers in which they are employed. Of these the All-dry type will be predominant and incorporate portables as well as table models. The famous "Saucepan Special" will be on show together with other export-only models. Among the home models the "Skyscraper"—an all-dry model designed for strong reception in difficult areas, and having four wavebands—should prove an attraction. [Stand No. 66]

Fitton Ltd., F.N. (Ambassador Radio)

HERE will be seen the well-known Ambassador receivers, which will include a "Viscount" de-luxe auto-radiogram at £79 10s. which has nine wavebands and a Garrard record changer, and sundry television models. [Stand No. 41]



A complete record player from the range of Garrard units.

Garrard Eng. & Mfg. Co. Ltd.

INCLUDED in the wide range of gramophone units on this stand will be some new models, such as the Model 301 Transcription motor and the GCE3 ceramic turnover pick-up. A noticeable feature of the exhibits here, is that a new finish has now been adopted and all record changers and record players are now cream and brown. Three-speed players and mixed changers may be seen, and many are now standard equipment in complete commercial radiograms. [Stand No. 71]

Gibbs Ltd., H. E.

HERE may be seen a range of cabinets of all types. On page 609 is an illustration of a record storage cabinet, finished in blonde Australian walnut veneers, with sliding doors and a special metal fitment to take 170 records. Measuring 24in. by 15in. by 28in. high, this costs £8 8s.
[Stand No. 20]

General Electric Co. Ltd.

THE G.E.C. will be showing many new radio and television receivers. On the radio side there is a new table radiogram, a new compact mains portable and a new transportable mains table model. The television display features new G.E.C. all-programme receivers, also adaptors which will equip the older type of single-programme receiver for alternative programme reception. A new 17in. television receiver developed especially for export markets is also being shown. [Stand No. 68]

Hartley Baird, Ltd.

HERE will be shown a range of television receivers designed for "double band viewing." A turret selector covers Band I and Band III, and our companion paper *Practical Television* deals more fully with these. [Stand No. 88]

Hunt (Capacitors), Ltd., A. H.

AGAIN miniature and standard fixed capacitors for all radio, electronic and electrical use will be exhibited, and the range will include electrolytics, metallised paper, foil and paper and silvered mica components. In addition many well-known standard types in stacked mica will be seen, in company with some samples of Bondac printed circuits, and a capacitor analyser and resistance bridge.
[Stand No. 90]

Invicta Radio, Ltd.

THE main exhibit on this stand will be the Invicta 57 radiogram. This is a five-valve (including rectifier) A.C. radiogram, covering long, medium, trawler and short wavebands, and is fitted with a B.S.R. Monarch changer. With record storage space and a 10in. speaker, this costs 53 gns., including P.T. [Stand No. 95]

J. Beam Aerials, Ltd.

THE main portion of this exhibit will consist of television aerials, for both the Band I and Band III transmissions—horizontally and vertically polarised. [Stand No. 31]

Kolster Brandes, Ltd.

HERE will be seen a comprehensive range of radio, radiograms and television receivers, including multi-channel TV and F.M. radio. Some of the radio receivers have had an F.M. band added, whilst certain of last year's models are retained. Lower-priced radiograms will be featured and will include the LG.40AM/FM, a model with A.M. and F.M. bands, push-pull output and bass tone control.
[Stand No. 70]

Marconiphone Co., Ltd.

AS part of the E.M.I. group many of the chassis in the receivers seen on this stand will be found also in the H.M.V. models on Stand 10. Three new radio models will be seen, a five-valve portable of the mains-battery type, an A.C./D.C. "Companion" receiver, and a five-valve three-waveband table receiver with inbuilt aerial. Three new radiograms will also be seen. A number of television receivers will also be displayed and are covered elsewhere.
[Stand No. 13]

Masteradio, Ltd.

TWO new models are being introduced at this year's show, a Model GP200—a portable record player retailing at 16 gns., and the RG356, a three-speed auto-change table radiogram retailing at 36 gns., and known as the "Mastergram."
[Stand No. 62]

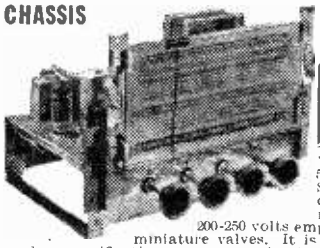
Mullard, Ltd.

IN addition to the range of popular Mullard valves and tubes to be seen here, the main display will be on electronics and the part they play in modern life. The new amplifier design which they have produced will also be shown, whilst a large working model will show how the modern valve functions. Radio and television receivers of various types will also be seen. [Stand No. 59]

(*Continued on page* 613)

This is the Masteradio record player—Model GP200

A COMPLETELY ASSEMBLED "ALL-WAVE" SUPERHET CHASSIS



MODEL B.3—A 5-valve 3 waveband Superhet Receiver for operation on A.C. mains 100-120 volts and 200-250 volts employing the very latest miniature valves. It is designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both Gram and Radio, making it the ideal replacement Chassis for that "Old Radiogram," etc.

Brief specifications :—Model B.3—Valve line up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Waveband Coverage : Short 16-50 ; Medium 187-550 ; Long 900-2,000 metres. Controls (1) Volume with on/off ; (2) Tuning (flywheel type) ; (3) Wave change and Gram ; (4) Tone (3 position switch operative on Gram and Radio).

Negative Feedback is employed over the entire audio stages. Chassis size. 11in. x 7¼in. x 8¼in. high. Dial size. 9¼in. x 4¼in. Price, complete and READY FOR USE excluding speaker. £12/12/- (Carr. and Pkg. 7/6 extra). Or H.P. Terms £3/4/- Dep. 12 Months at 17/6. **MODEL B.3 P.P.**—This model is the B.3. Receiver but incorporates two 6BW6 VALVES in PUSH-PULL resulting in really excellent quality reproduction up to approximately 6 watts. Price £15/15/- (Plus 7/6 carr. and ins.) or H.P. Terms £3/19/- Dep. 12 months at £1/2/2.

MODERNISE YOUR OLD RADIOGRAM FOR £23

We offer this Auto-changer complete with Model B.3 3-waveband as advertised together with 10in. p.m. Speaker for £23/6/- plus 10/- carr. and ins., or H.P. Terms £5/16/- Dep. and 12 months of £1/12/10, or with B3PP Model for £26/9/-, plus 10/- carr. and ins. or H.P. Terms £6/11/- Dep. and 12 months of £1/17/4.

A GENUINE SPECIAL OFFER!

The **COLLARO** 3RC/521

3-SPEED AUTO-CHANGE UNIT

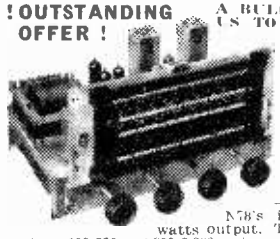
£9/19/6 H.P. Terms £2/10/- Dep. and 11 months at 15/9 (plus 7/6 carr. and ins.)

Normal price £18/10/-.

- These units will auto-change on all three speeds.
- Incorporating Hi-fi Crystal "Turnover" Head
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a simple switch.
- Minimum base-board size required 13¼in. x 12¼in. with height above 5¼in. and height below baseboard 2¼in. A bulk purchase enables us to offer these BRAND-NEW UNITS, including mounting instructions, at this exceptional price.

7in., 10in. and 12in.

! OUTSTANDING OFFER !



A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER

For only **£12/19/6**

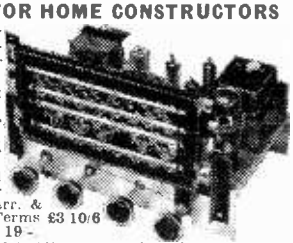
(Carr. and Ins. 7/6 extra). H.P. Terms £3/4/6 Dep. 12 months at 18/4.

These receivers Model AW3-7 are made by a well-known set manufacturer and incorporate the lastest Osram Valve Line-up of X79—W77—DH77—H77—U78 and two N78's in Push-Pull for approx. 7 watts Output. They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts. They make an excellent replacement Radiogram Chassis having a P.U. connection on the chassis. Extension speaker connection is also provided.

Overall size of chassis : 12in. long x 7¼in. x 6¼in. high, dial aperture 8¼in. x 4¼in. (Dial Escutcheon available for 4/9).

THESE RECEIVERS ARE BRAND NEW, FULLY GUARANTEED.

The "SUPER-SIX" FOR HOME CONSTRUCTORS



A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.

YOU CAN BUILD IT FOR £10/7/6 Including the OCTAL VALVE LINE-UP. (£12/7/6 with the miniature valves.)

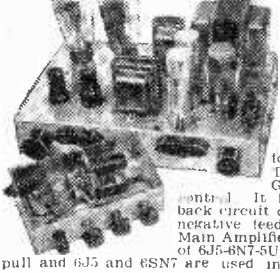
We will supply it assembled and READY FOR USE for **£13/13/0** (Plus 7/6 Carr. & Ins.) H.P. Terms £3/10/6 deposit and 12 months at 19/-

Incorporating the new B.V.A. Miniature Valve Line-up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained.

A few brief details :

- Covers 3 wavebands 18-50 metres, 190-550, and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operates on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. x 8in. x 6in. Dial aperture 8¼in. x 4¼in.
- For operation on A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION and ASSEMBLY MANUAL is available for 2/-, it contains very detailed practical drawings and circuit diagrams and a complete Component Price List.



A 12 WATT "HIGH FIDELITY" Push-Pull AMPLIFIER

Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier-Tone Control Unit. The remote control unit measures only 7in. x 4in. x 2in and contains four controls, being : Bass-Treble-Volume and a Radio. Gram. Microphone Switch control. It incorporates its own feedback circuit on the Bass Channel. Loop negative feedback is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25's in push-pull and 6J5 and 6SN7 are used in the remote control unit.

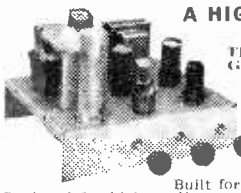
THE COMPLETE KIT IS AVAILABLE FOR **£14** (Carr. & Ins. 3/- extra.)

THE COMPLETE UNIT ASSEMBLED AND READY FOR USE **£17/0/0** (Carr. & Ins. 5/- extra.)

H.P. Terms £4/5/- Deposit, 12 Months at £1/3/11.

The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps. and 30 mA. H.T. is provided for tuning unit, etc. **This Amplifier compares well with the Williamson and similar designs at a fraction of their cost. The complete set of assembly instructions are available for 2/-.**

A HIGH QUALITY 8-10 WATT AMPLIFIER



THE IDEAL AMPLIFIER FOR GENERAL HOME USE AND FOR SMALL HALLS, ETC.

Price of COMPLETE KIT including Valves and Drilled Chassis, etc. **£7/10/0**

(Plus 2/6 Carr. & Ins.)

We will supply it Completely Built for **£9/0/0** (Plus 3/- Carr. & Ins.)

Designed for high quality reproduction up to an output of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. It is suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 3 and 15 ohm speakers. **BRIEF FEATURES**

- Valve line up 6J5, 6SN7, 5Z4, with V6's in push-pull.
- The undistorted output level of up to 10 watts is produced from an input of 25 volts.
- First-class reproduction of Radio (where a Tuning Unit is used) and Record Playing.
- Separate Bass Boost and Treble Controls provide an excellent range of frequency control.
- Very satisfactory results are obtained with an average type of high impedance Moving Coil or Crystal Microphone, a clear speech level of approx. 5 watts output being obtained.
- Power supplies (HT and GT) are available for a Tuning Unit.
- For operation on A.C. Mains 200-250 volts 50 cycles.

THE ASSEMBLY MANUAL is available for 1/- and includes detailed layouts and component Price List.

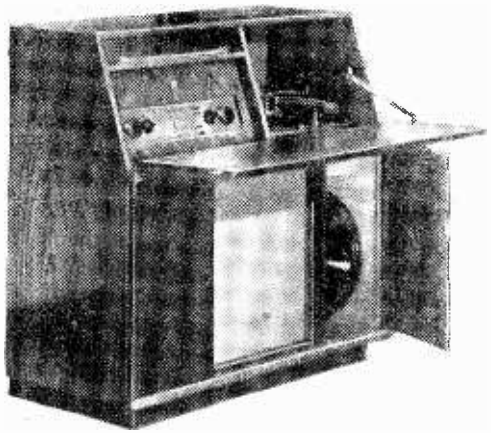
STERN RADIO Ltd.

109 & 115, FLEET STREET, E.C.4

TELEPHONE : CENtral 5812/3/4

Multicore Solders, Ltd.

ON this stand will be seen for the first time the new five-core solder wire. In conjunction with Thorn Electrical Industries they will also be showing the actual assembling, wiring and soldering of Ferguson TV tuners. At the close of each day these tuners will be sent to the Ferguson works for incorporation in receivers. It is estimated that more than 25,000 soldered joints will be made during the run of the show, using the standard factory size 7lb. reels of solder. [Stand No. 100]



A typical modern radiogram—Pam Model 966/RG.

Murphy Radio, Ltd.

IN addition to television receivers, Model U198 and 212 radio receivers will also be seen. The latter is built into what the makers term a "semi-baffle"—a cabinet which cuts out boxy reproduction. It has an 8in. speaker. Model U198 is intended for those who find their main interest is in television—it is a small transportable designed for high quality reproduction and wide range of reception, with a special bass compensating circuit. It has a maroon plastic cabinet. [Stand No. 40]

Nera of England, Ltd.

TELEVISION equipment mainly of the projection type will be the main exhibit on this stand. Picture sizes from the domestic 30in. model to the 84in. "Panoramavision" screen will be shown. [Stand No. 208]

Pam (Radio & Television), Ltd.

TWO stands are to be occupied by Pam Radio, Stand No. 4 being devoted to an exhibition and demonstration of a television converter unit. This is to enable users of five-channel receivers to receive stations on Band III. High-fidelity radio receivers and an all-dry battery portable will also be seen on their other stand. [Stands 4 and 84]

Peto-Scott Electrical Instruments, Ltd.

THREE television receivers will be seen in addition to a new table receiver, the R.54. This is a five-valve three waveband superhet selling at £14 6s. 2d. plus P.T. A Bureaugram automatic radiogram and a record reproducer will also be on show. The latter has a three-speed changer and a one-valve amplifier and costs £22. [Stand No. 60]

Philips Electrical, Ltd.

ON Stands 96/97 will be a full range of radio and television receivers and record players. Increased prominence is being given this year to Philips records. Two new radio receivers to be seen are an A.M./F.M. table model and a clock radio receiver. The latter is a five-valve set with four pre-set stations and is for A.C. mains operation only. It acts as an ordinary alarm clock, will switch the set on at a pre-arranged time and switch off and on again at pre-set times. In addition it incorporates a socket for a five-amp three-pin plug for the attachment of any other electrical apparatus up to 750 watts. [Stands 96 and 97]

Pilot Radio, Ltd.

A 13-channel TV tuner is the main exhibit, but in addition the Little Maestro is still going well and seems as popular as ever. A battery-mains portable is also to be seen and high-fidelity is an important feature of some of the remaining radio models. Model X.754 is a new table model which makes a feature of the trawler waveband, side controls, magic eye tuning and an extra large baffle area for the 8in. speaker. [Stand No. 59]

Pye, Ltd.

ALTHOUGH again television is to be the main feature of this stand, some interesting radio receivers and high-fidelity record reproducers will also be seen. [Stand No. 94]

Radio Society of Gt. Britain

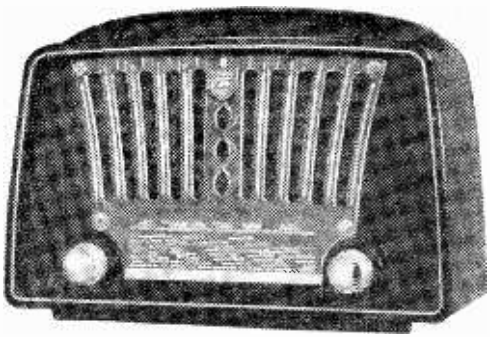
ON this society's stand will be many items of an amateur nature, built by members and including single-sideband transmitters and receivers. Many interesting historic pieces of equipment will also be on show. [Stand No. 209]

Regentone Radio & Television, Ltd.

RADIO and television receivers will be seen on this stand, and the TV receivers will incorporate 13-channel tuners. [Stand No. 38]

Rola Celestion, Ltd.

THE interesting display of sound reproducers to be seen on this stand includes many of the Rola and Celestion loudspeakers which have been in use for many years by both amateurs and commercial manufacturers. The Truvox P.A. equipment will also be shown here. [Stand No. 3]

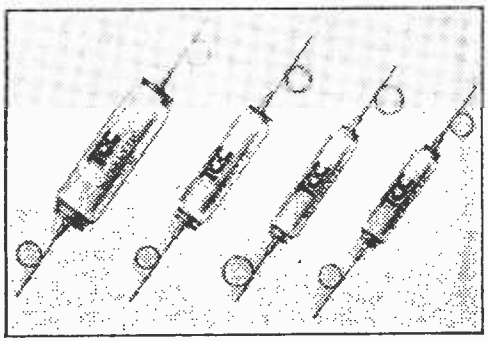


Philips Model 141U—A modern plastic-fronted design.

Rudman, Dalington (Electronics), Ltd.

THE main exhibit on this stand is the Reflectograph magnetic tape recorder, which has simplified slot loading and continuously variable speed, from 3.75 to 8.5ins. per second. The model is available as a transportable or in a console cabinet.

[Stand No. 207]



T.C.C. condensers of the "Superlytic" type. See these on Stand No. 101.

Sobell Industries, Ltd.

A NEW model, the 515RG, makes its appearance this year, and the main feature of the whole range of equipment is the use made of colour in both moulded plastics and the specially woven flexible plastics in conjunction with wood veneers. The radio receivers now embody switched gramophone pick-up input, and provision for external loudspeakers, with internal muting. With the exception of Model 515STG, which has a single-player, three-speed gramophone mechanism, all gramophones incorporate three-speed mixer type changers with crystal pick-up. [Stand No. 12]

Standard Televisions & Cables, Ltd.

HERE will be seen an extensive range of SenTerCel selenium rectifiers, battery chargers, germanium photo-electric cells and power rectifiers. These will be shown on Stand No. 82, whilst on Stand No. 6 will be an exhaustive range of Brimar valves and picture tubes for television. [Stands 6 and 82]

Stella Radio and Television Co., Ltd.

THE Stella exhibit will include two table radio receivers, a console radiogram, a record player and four table television receivers. A display of illuminated colour transparencies will illustrate how easily the Model ST.105U may be carried about the house. A special feature of Model 102A is the bass compensation for low positions on the volume control.

[Stand No. 55]

Taylor Electrical Instruments, Ltd.

THE usual comprehensive range of "Windsor" instruments will be seen here and include moving coil and moving iron and electrostatic panel mounting meters; a range of multi-range meters; a mains-operated resistance-capacity bridge; a mains-operated valve tester; a circuit analyser; a volume indicator and sundry similar types of service or laboratory equipment. [Stand No. 54]

Telegraph Condenser Co., Ltd.

AMONG the exhaustive range of condensers featured on this stand, six newly developed ceramics for modern TV receivers will be seen. Amongst the electrolytics, the new "Superlytic" tubulars set a new standard in the performance of this class of condenser, in that for the first time it is possible to think in terms of insulation resistance for an electrolytic. They are primarily intended for grid coupling in L.F. amplifiers, but may be used elsewhere in a circuit. This year the mechanical feature of the stand will be centred round the unit which simulates the daily conditions that might be experienced at any factory, and by switching in suitable power factor correction condensers immediately shows the reduction in current consumption and kVA demand on the appropriate indicator, thus emphasising the financial advantages that can result from the installation of T.C.C. power factor correction condensers. [Stand No. 101]

Ultra Electric, Ltd.

AN extended range of television and radio receivers is to be seen here, and will include a luxury radiogramophone. Amongst old friends will be the Ultra Twin and the Troubadour, the latter in a new presentation. The new radiogram incorporates a record changer of the 3-speed type with turn-over pick-up, and has separate tone controls for bass and treble. A similar model is also designed to pick up the proposed new F.M. transmissions.

[Stand No. 69]

Valradio, Ltd.

IN addition to projection television equipment this firm will also be showing some multi-channel tuners and some power units suitable for D.C. mains supplies. [Stand No. 29]

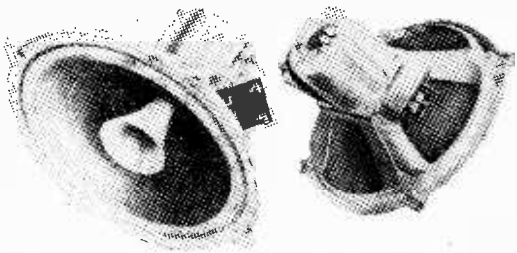
Vidor, Ltd.

SUPPORTING their claim that the Vidor range includes portables for every purpose, this exhibit will embrace six models for home and outdoor use. They will include a long-life battery attaché case receiver and some attractive mains-battery models. Special export models will also be seen, in company with some television receivers. [Stand No. 87]

Waveforms, Ltd.

WAVEFORMS will introduce this year a new portable TV signal generator and most of the exhibits on this stand will have the main application to television. [Stand No. 75]

(*Concluded on page* 634)



Two views of the Stentorian Duplex loudspeaker by Whiteley-Electrical.

EX-A.M. RECEIVER TYPE R.1155

5 Frequency ranges : 18.5-7.5 Mc/s ; 7.5-3.0 Mc/s ; 1,500-600 kc/s ; 500-200 kc/s ; 200-75 kc/s. Supplied in maker's original wood transit case.

LASKY'S PRICE
Secondhand. Grade 1. **£9.19.6**
Secondhand. Grade 2. **£7.19.6**
Carriage 17/6 extra, including 10/- returnable on packing case.

ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER
For use on 200-250 v. A.C. mains. Complete with 2 valves. In metal case size : 12 x 7 x 5½ins. **LASKY'S PRICE 79.6.** Carr. 5/- extra.
Power Pack as above. Fitted with 6½in. p.m. speaker. **LASKY'S PRICE £5.5.-.** Carriage 5/- extra.

R.1132A RECEIVERS. Tested, soiled condition.
Grade 1. Specially selected. 79/6
Grade 2. Secondhand..... 59/6
Carriage 10/- per unit extra.

EX-GOVERNMENT MAINS POWER UNITS. For R.1132A. Working order, for 200-250v. A.C. mains.
LASKY'S PRICE 59/6
Carriage 7/6 extra.

BAKER'S SELHURST SPEAKERS

"Stalwart." 12in. 15 ohms impedance. Frequency response 30-13,500 c.p.s. Power handling capacity 15 watts, peak A/C. **PRICE £5/10/-.**
"Standard." 12in., 15 ohms impedance. Frequency response 30-14,500 c.p.s. Power handling capacity 20 watts, peak A/C. **PRICE £6/10/-.**
"De-Luxe." 12in., 15 ohms impedance. Re-entry cone. Frequency response 18-17,000 c.p.s. Power handling capacity 15 watts, peak A/C. **PRICE £8/10/-.** Carriage 3/6 per speaker extra.

RESIN CORED SOLDER. 7/6 per 1-lb. reel.

L. & M. WAVE T.R.F. COILS. With Circuit, 4/6 pair.

L. & M. DUAL WAVE Superhet Coils. Aerial and oscillator 5/11 pair.

100K. CARBON POTENTIOMETERS. Less switch. SPECIAL OFFER. 1/6 each.

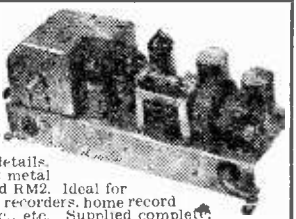
I.F. TRANSFORMERS
MINIATURE TYPE 465 Kc/s. ¾ x ¾ x 2¼ins. PRICE 9/6 pair.
MIDGET TYPE 465 Kc/s. 1 x 1¼ x 2½ins. PRICE 8/6 pair.
WEARITE TYPE 550. 445-520 Kc/s. 8/6 per pair.
WEARITE TYPE 500. 450-170 Kc/s. 8/6 per pair.

PLASTIC ESCUTCHEON MASKS
With dark screen filter.
12in. 12/6
16in. 25/-

BRIMISTORS
Type CZ.1, 1/6 each. CZ.3, 10½d. each or 9/- doz.

CRYSTAL DIODES
Wire ends. Glass.....1/6
Type WX.6. Wire ends.....1/6

3-WATT MIDGET AC/DC AMPLIFIERS
PUSH PULL. VERY HIGH GAIN



4 valves : 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 A.C./D.C. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size : 9 x 4 x 4ins. Uses 2 metal rectifiers, 1 each RM1 and RM2. Ideal for ships record players, tape recorders, home record players, baby alarms, etc., etc. Supplied complete, fully assembled and wired, with 4 valves, **65 -.**

GANGED TUNING CONDENSERS .0005 MFD.
Standard 2-gang. Size : 2¾ x 1⅛ x 2¼in. ¼in. Spindle..... 5/-
Standard 3-gang. Size : 2¾ x 1⅛ x 3¼in. ¼in. Spindle..... 7/6
Midget 2-gang with trimmers. Size : 1½ x 1¼ x 2¼in. ¼in. Spindle..... 7/6
Midget 3-gang with trimmers and perspex cover. Size : 1¼ x 1¼ x 2¼in. ¼in. Spindle..... 12/6

CYLDON 5-CHANNEL SWITCHED TELETUNERS

Instant and positive selection of any one of the 5 B.B.C. television channels, by a single control knob. Uses EF.80 RF. pentode and ECC81 or 12AT7 Double Diode Triode as frequency changer. Tuning is obtained by switching incremental inductances. Size : 4¼ x 2¾ x 2¼ins. Spindle 2¼in. long, ¼in. diameter. I.F. Output 9.5-14 Mc/s., noise figure on all channels better than 10.5dB., I.F. rejection better than 45dB on all channels. Power gain 24dB.
LASKY'S PRICE. less valves, **12/6.** Post Free.
Valves for tuner available, at **12/6** each.

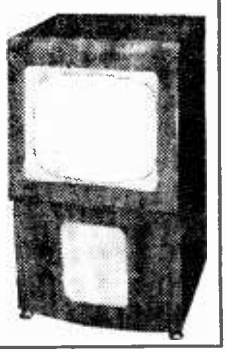
RADIO CABINETS

Size : 12in. wide, 6½in. deep, 8in. high. Finished in medium walnut veneer, with high polish. Complete with back, chassis, and dial, calibrated L. M. and S.

LASKY'S PRICE.....**16/11**
Carriage 2/6 extra.

THE TELE KING

5 Channel 16 or 17 inch SUPERHET RECEIVER



This famous and well tried home constructor set can now be built for **£29.10/-.** Tube and cabinet extra.

EVERY COMPONENT CAN BE SUPPLIED SEPARATELY.

Full constructional data, wiring diagrams and circuits

PRICE 6/- **POST FREE**

WRITE NOW FOR OUR NEW TELE KING PRICE LIST. WE CAN SAVE YOU MONEY.

LASKY'S RADIO,

LASKY'S (HARROW ROAD), LTD.,
370, HARROW ROAD, PADDINGTON, LONDON, W.9.
Telephones : CUNningham 1979-7214.

Hours : Mon. to Sat. 9.30 a.m. to 6 p.m. ; Thurs., half day, 1 p.m. Postage and packing charges (unless otherwise stated) : on orders value £1—1s. 0d. extra ; £5—2s. 0d. extra ; £10—3s. 6d. extra ; over £10 carriage free. All goods fully insured in transit.

LASKY'S RADIO

TELESCOPIC PORTABLE AERIAL MASTS
Made of lightweight but extremely strong alloy. Extends to 15ft. Guyed at top and centre. Supplied complete with all guy lines.
LASKY'S PRICE 32/6
Carriage free.

R.F. 25 UNITS. Complete with 3 valves. New **19/6.** Secondhand **15/-.** Carriage 2/6 each extra.

SUPERHET COIL PACKS
With Circuit.
No. 1. L.M.S.G. Size : 4¼ x 5 x 2¼in. With ¼in. spindle.....19/6
No. 2. M.S.S. Size : 4 x 4 x 3in. With ¼in. spindle.....16/-
Both for use with 465 Kc/s I.F.

LOUDSPEAKERS
First Quality. All 3 ohms speech coil. Less output trans.
5in.....14/6 8in. 19/11
6½in. .....15/- 10in.....19/6

ENERGISED SPEAKERS
8in. With O/Trans. 600Ω.....15/6
8in. Less O/Trans. 600Ω.....12/6
8in. Less O/Trans. 1,200Ω...12/6
6½in. With O/Trans. 600Ω...14 -

TELEVISION SELENIUM RECTIFIERS
The very latest "Sentercel" S.T.C. range.
K3/40, 3.2 kV..... 6/-
K3/45, 3.6 kV..... 8/2
K3/50, 4.0 kV..... 8/8
K3/100, 8.0 kV..... 14/8
K3/160, 12.8 kV..... 21/6
K3/200, 16 kV..... 26/-

METAL RECTIFIERS
6 and 12 volt F.W.

2 a. ...	9/-	R.M.1 ...	3 10
3 a. ...	9/11	R.M.2 ...	4 3
4 a. ...	12/-	R.M.3 ...	5 -
6 a. ...	19/6	R.M.4 ...	16/-
6 Volt		12 Volt	
½ amp.	2/6	½ amp.	3 11
1 amp.	4 6	1 amp.	6 6

COLLARO 3-SPEED AUTO CHANGERS, Model 3RC 521. New and Unused.

Cream or fawn finish. Complete with hi-fidelity "studio" turnover crystal pick-up.
LASKY'S PRICE.....**£9.19.6**
Carriage free.

MAGNETIC RECORDING TAPE. SPECIAL OFFER. Plastic. 600 feet reels. 6/11. **Paper Base.** 1,200 feet reels. 17/3. Postage 1/6 per reel extra.

AERIAL ROD SECTIONS. Steel, heavily copper plated. 12in. long, ¼in. diameter. Any number may be fitted together. **PRICE 2/6** per doz. Post free.

300 PF. FEED THROUGH CONDENSERS. Ceramic. **6d.** each. 4/6 per dozen.

20 PF. AIR SPACED TRIMMERS. 9d. each. 7/6 per dozen.

TRANSMITTING TOPICS

PI NETWORK TANKS

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

THE Pi network tank circuit is at present enjoying a boom in popularity with amateur transmitters. This high popularity is due to its good reputation as a cure for TVI troubles. Pi output tank circuits, however, are not necessarily a complete cure for TVI. The use of other measures such as effective screening of the transmitter, efficient by-passing of power leads, cannot be overlooked. Only with due attention to all the TVI aspects of a transmitter can one be reasonably sure of preventing TVI. It can be said, however, that Pi network tanks do provide a high degree of TVI harmonic discrimination and are a very valuable device in this respect. Many cases of TVI have in fact been cured by a changeover to Pi tank circuits. However, it is not claimed that they are an infallible remedy in themselves against TVI. Furthermore, by one or two measures it is possible still further to increase their effectiveness as TVI suppressing devices.

Orthodox tank circuits—with elaborate precautions—can provide about as much TVI reduction as a Pi network tank. The merit of the Pi network, however, is that it inherently provides a high degree of rejection without elaborate precautions. It should be stressed, however, that this is not automatically so. The high degree of harmonic rejection is provided in a Pi network feeding from the PA anode into a low impedance load—usually an 80 ohm coaxial line. Where a Pi network is used to feed energy into "any old length of wire" directly from the output harmonic rejection may be quite small. Further—unless the constants of the Pi network are reasonably correct—even the use of 80 ohm coaxial line into a further tuned aerial coupler (Fig. 1) may not give effective harmonic rejection. Correctly speaking, the 80 ohm coaxial cable should be terminated in a reasonably matched load in order to ensure high harmonic rejection. One way of setting up for this condition is to use an actual 80 ohm resistive load (Fig. 2) for setting up the tuning of the Pi tank. When this has been done, the coaxial cable can be transferred to the aerial coupling circuit, and power drawn by adjusting the aerial network without disturbing the Pi tank settings. Final loading can then be effective by minor adjustments only of the Pi tank circuit. This enables operation to be conducted with the tank circuit operating in the correct condition for harmonic suppression. A Pi tank may in fact be operated so as to load power into an aerial and yet not suppress harmonics fully.

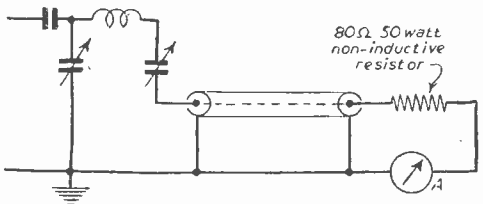


Fig. 2.—Pi tank load adjustment can be checked by use of a dummy 80 ohm load and R.F. ammeter (A).

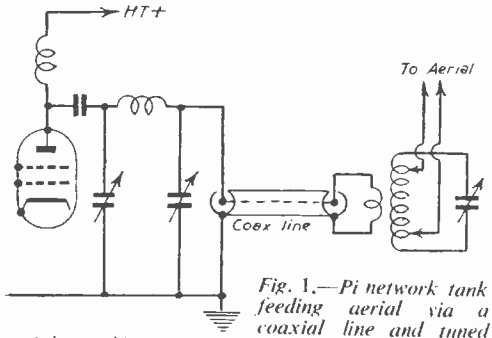
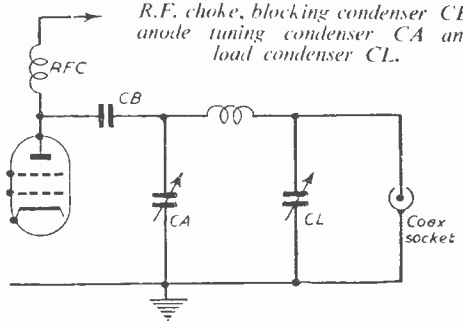


Fig. 1.—Pi network tank feeding aerial via a coaxial line and tuned aerial matching unit, enabling good TVI rejection to be obtained.

Fig. 3.—Essential components in the Pi network: R.F. choke, blocking condenser CB, anode tuning condenser CA and load condenser CL.



Inductance Values

One failing is to use a tank coil of too great an inductance. While this may enable power to be drawn into an aerial, it will not provide optimum harmonic rejection. The general calculation of Pi networks to deliver power into arbitrary values of load is somewhat involved. However, in the usual amateur case where power is to be delivered into a coaxial line it enables these difficulties to be short-circuited. To design the tank circuit, calculate the correct operating value of tank capacity as for a single ended tuned circuit. With the aid of the graphical chart previously published in these pages, this is simple. For operating with the Pi tank, however, use some 20 per cent. to 40 per cent. more capacity than this for the setting of the anode tuning condenser CA as shown in Fig. 3. The actual value of the "loading" or output capacity CL will vary from some three times to some nine times the value of CA. Selecting these values therefore will give ample range of adjustment in loading up on a specific frequency. It will also be noted that H.T. is blocked off from the Pi tank by the use of a blocking condenser CB. This should be a high-grade high-voltage mica or ceramic condenser of at least .001 μF capacity. It should be rated for a voltage of at least the D.C. anode voltage rating for CW operation, and at least twice the D.C. anode voltage for telephony operation. A safety margin is obtained, therefore, by using a condenser rated to withstand, say, three times the D.C. anode H.T. voltage. An alternative position for the blocking condenser would be at the low voltage output end, but unfortunately this would require a very large capacity condenser. This would be expensive, and might introduce other troubles, so that isolation of the whole of the Pi tank in the manner of Fig. 3 is the practical solution. Notice also that although the tuning condenser CA has no D.C. voltage to withstand, it still has to withstand the full R.F. voltage. Accordingly, for CW operation it must be rated to withstand a peak voltage equal to the D.C. H.T. supply voltage, and twice this value for anode modulated telephony operation. However, the output condenser CL has only moderate voltages to withstand—if the network is operated correctly—and an ordinary receiving variable is the choice for this position. However, this applies only if the network is used correctly to step-down into an 80 ohm or similar low-impedance cable. With the use of the Pi tank to load directly into "any odd length of wire" high voltages may appear at the output end. The TVI fearing operator, therefore, should not consider any other operation than to feed into a low-impedance line. Also cost mounts steeply if a high voltage variable condenser has to be used at the output end as well!

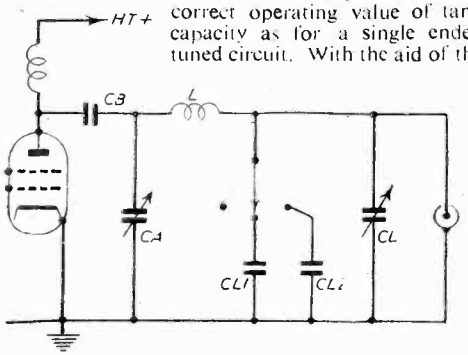


Fig. 4.—Switched fixed capacitors enable smoother and wider load control to be effected without an excessively large value of variable loading condenser (CL).

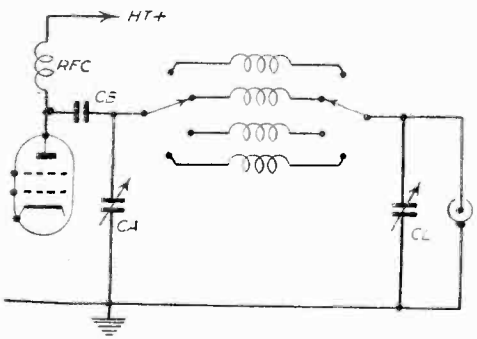


Fig. 5.—Switching independent tank coils is the simplest method of band-changing.

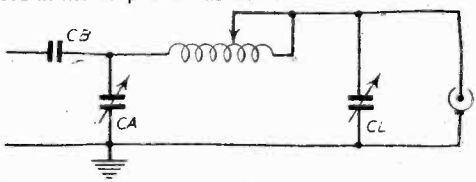


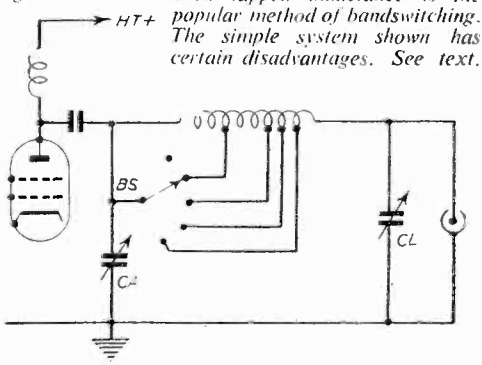
Fig. 6.—The variable inductor is often employed where suitable surplus "roller coaster" inductances are available.

Practical Aspects

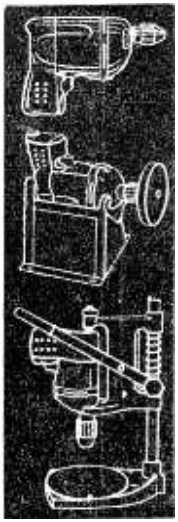
We may now consider some practical arrangements of a Pi network tank circuit for use on a number of bands. The lowest frequency band fixes the maximum size of plate variable condenser CA that will be required. 80 metres represents the usual band, as 160 metres can be covered by a small topband rig. The problem then is to obtain optimum conditions for operation upon the bands 80 metres to 10 metres. A reference to the chart previously supplied will enable the maximum tuning capacity required for 80 metre operation to be determined. This chart figure should be increased by some 30 per cent., and

(*Continued on page* 621)

Fig. 7.—The switched tapped inductance is the popular method of bandswitching. The simple system shown has certain disadvantages. See text.



14 DAYS' FREE TRIAL



Send only £1 deposit—refunded if tool not approved.

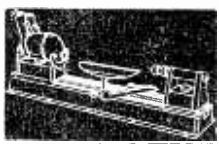
¼in. DRILL

Robust tool with trigger switch and self-centring chuck. Drills, sands, polishes, grinds, sharpens. Also, with attachments, drives: lathe, saw bench, rise and fall, grinder, buffer, etc.

Price **£5. 19. 6** cash, or 20/- deposit. Carriage and Packing 2/6.

Horizontal Stand 17/6, post 1/6

Vertical Bench Stand £3.7.6, post 2/6.



Lathe Stand £5. 5. 0. or 20/- deposit. Carriage and Packing 5/-.

The four items £15. 9. 6, or £3 deposit.

HANDY BATTERY THREE

Constructional data showing how to make useful portable loudspeaker set (total cost 70/-, including cabinet) is available. Price 1/6.

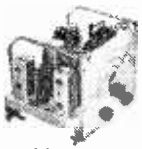
MULTI-METER KIT

The Multi-meter illustrated measures D.C. volts, D.C. m amps and ohms. It has a sensitivity of 500 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick on range indicator and full instructions for making are available as a kit, price 15/- plus 9d. post and packing.

MAKE A RADIO

Using our parts in one evening you can make an all mains 4 valve radio with bakelite case, then you will be giving a £12 present which costs you only £5.15.0. or £2 deposit. (Carr. and insurance 5/-.) Data book 1/6.

BEETHOVEN 5-VALVE SUPERHET



Complete with valves and Rola loudspeaker, ready to work off A.C. mains—three wa es (L. M. and S.) large dial, slow motion drive, dust cored coils, etc. **£8. 17. 6.** or £2 deposit (balance over 12 months), carr. 7/6.

Fine walnut veneered and polished cabinet to take the Beethoven 5-valve Superhet with 6½in. loudspeaker, thus making a really excellent table model—worth £18 £20. Price 49/6, carr. and packing 5/- extra. If bought with the Beethoven chassis, the hire purchase deposit is £3, carr. 10/-.

THE SUPERIOR 15in.

up to the minute big picture TV for only £37. 10. 0. A 20-valve televisor for the amateur constructor, all components, valves and 15in. Cossor Cathode Ray Tube costs **£37.10.0.** plus £1 carriage and insurance or **£12. 10. 0** deposit and 12 monthly payments of **£2. 11. 6.** Constructor's envelope giving full details and blueprint, 7/6. Returnable within 14 days if you think you cannot make the set.

MAINS MIDGET RADIO

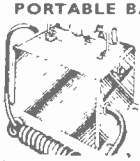
This is an excellent little radio in an attractive cabinet to which can be affixed transfers, thus making it extra suitable for nursery or child's bedroom. The circuit is a T.R.F. for A.C. mains operation. All the parts — bakelite cabinet, valves, knobs, back—in fact everything will cost you only **£3.15.0.** plus 2/6 postage. Construction data free with the parts or available separately at 1/6.

MAGNETRON MAGNETS

The immense power of these magnets makes them ideal for a magnetic chuck and, of course, many other purposes. Price 30/- each, carriage 7/6.

4ft. long made from heavy gauge sheet steel (galvanised), 1 kW, suitable A.C. or D.C. Price **£2**, or with thermostat **£3.15.0.** Note: The thermostat mounts separately and will control up to three heaters.

PORTABLE BATTERY CHARGER



Stands on running board or box—gives 1½ amp. charge. Price **29/6.** Ready to use complete with car size croc clips. State whether six or twelve volt battery.

ELECTRIC CLOTHES HORSE

Warms room as it dries clothes, towels, etc.—stove enamelled rails—A.C. or D.C. 650 watts. Size 5ft. x 3ft. x 5in. Made to sell at **12 gns.**, fully guaranteed only **£3. 19. 6.** carr. 7/6.

Complete kit comprises battery control unit, starter lamp, lamp holders, clips and wiring diagram. Price less tube **22/6**, plus 1/6 post, with tube 30/-, carriage and insurance 5/6. Tubes 7/6 each carr. free, minimum quantity 6.

CONSTRUCTOR'S PARCEL

3 colour, 3 waveband scale covering standard Long, Medium and Short wavebands, scale pan, chassis punched for standard 5 valve superhet, pulley, driving head, springs, etc., to suit. Scale size 14½in. x 5½in. Chassis size, 15in. x 5in. x 2in. deep. Price **15/-**, plus 1/6 post.

Note: We have a really excellent walnut veneered cabinet for this, price only **37/6.**

AUTO RADIOGRAM

From 25 gns.

Good assortment of cabinets, chassis, and auto changers, available at all branches—total cost from 25 gns.

ADJUSTABLE THERMOSTAT

250 v. heavy silver contacts can be adjusted to operate between 70 deg.-300 deg. F. These are suitable for aquarium heaters, electric blankets, etc., etc.
1 Amp. Model, **3/6.** 2 Amp. Model, **5/6.** 5 Amp Model, **8/6.** Post, etc., 6d. extra.

CONNECTING WIRE SNIP

P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Colours available: Black, Brown, Red, Orange, Pink, Yellow, White, Transparent. 4 coils for **10/-.**

RADIO KIT 19/6

Build this high-quality portable radio for less than 49/6. Exceptionally sensitive twin-triode circuit, using unique assembly system. Can be built by anyone in 45 mins. Size only 6½in. x 5in. x 3in. in handsome black-crackle steel case with beautiful black and gold dial (stations printed !). Covers all medium and long waves. Uses only one self-contained all-dry battery : **Many unsolicited testimonials.—Mr. Norton of Oxted, writes :** *" Yesterday evening on the medium waveband, I counted 32 separate stations ; I am very pleased with the set—which is well worth the money."* **Mr. Fraiser of Ipswich, writes :** *" I think it is a wonderful station getter, with lovely tone and ample volume on all. Its performance is almost unbelievable, and it gives me stations I've never been able to get on my large radio."* **SEND TODAY,** cheque/C.W.O./C.O.D. for 22/- (includes 2/6 packing/post), **for Case, Handle, Dial, Plans, Parts Lists, etc.** sent by return.

BRIGHTON RADIO CO. (Dept. P.W.5), 69, PRESTON ST., BRIGHTON, 1, SUSSEX.

thus roughly a third of the value should be added to the chart figure. The output capacity or " matching " capacity that feeds into the coaxial line will vary from about six times the anode or " tuning " capacity as, say, for a single 807 running at 600 volts at 100 mA to about four times the anode capacity in the case of a pair of 807s running at a total of 200 mA at 600 volts.

As only low voltages appear at the matching condenser end, and a high value of capacity is needed to load up on the 80 metre band, it is often recommended that the output condenser be a two-gang receiving variable of 500 pF per section with the two sections paralleled. This gives a total capacity of 1,000 pF. This may be a little cramping, however, when operating on the higher frequency bands, so that a single 500 pF condenser or even a 300 pF may be used with auxiliary fixed condensers switched in for matching on the L.F. bands. This spreads the matching adjustment comfortably (Fig. 4).

Bandswitching

Bandswitching the Pi tank may be performed in several ways. The simplest solution is to switch in a fresh coil for each band (Fig. 5). This is a solution free from trouble, but for the bands 3.5, 7, 14, 21 and 28 Mc/s five coils are needed. As it is advisable to screen the tank assembly in the interests of TVI suppression, much chassis space is occupied. However, one commercial Pi tank unit does employ separate tank coils quite successfully and compactly.

However, the more usual approach is to use some form of variable inductance. Two alternative methods are in use. In Fig. 6 is shown the roller type of variable inductance. Such roller type variable inductors are available on the surplus market, and one type was available as a " spare " for the celebrated 145 VFO. At least one well-known operator, G5US, is running a 150 watt rig with a variable inductor tank. With the usual variable inductors available, the only precaution is not to adjust the

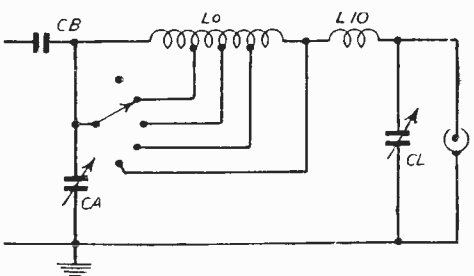


Fig. 8.—Switching losses due to short-circuited turns are reduced by using a separate 10 metre band coil L10.

inductor while the PA is running, as this may cause R.F. arcing and pit the roller and inductance wire so that poor contact eventually results. With this proviso the " roller coaster " type of variable inductor is very satisfactory. Moreover with the inductance itself variable the need for a fully variable " matching condenser " disappears, and a range of fixed matching condensers may be switched in for matching. Alternatively, only a small variable together with a range of fixed condensers can be employed.

Fig. 7 illustrates the more usual tapped inductance method with a bandswitch linked to the taps. This again is a generally satisfactory solution. The taps are selected, so that approximately the optimum value of tank capacity needed for any band (as calculated from the tank capacity chart previously given) is required for resonance. In practice by determining the maximum inductance required for 80 metres, it is a simple matter to find the correct tap points for the other bands by using temporary clips. Once determined, the final tap points can be soldered into position.

An Objection

There is one objection to the tapped type of tank in which the unwanted sections of coil are shorted

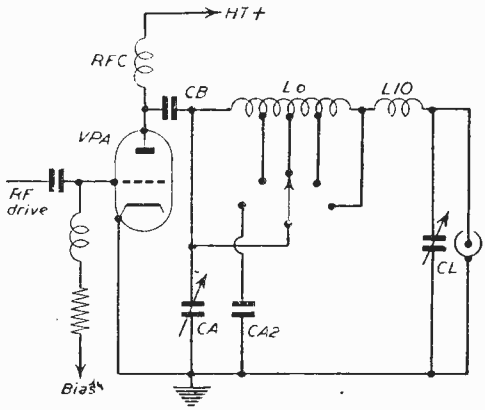


Fig. 9.—A large tank condenser may be avoided by using an auxiliary fixed condenser (CA2) for 80 metre operation connected to the 80 metre switch position.

out. The shorting out of turns is generally liable to deteriorate the efficiency of a coil, and many amateurs are not happy at the carefree shorting of turns necessitated by the tapped Pi tank method. In point of fact, the only serious trouble, as might be expected, occurs upon 10 metres, where almost all the coil is shorted out. The tiny piece of coil in use is closely coupled to the unwanted short-circuited sections, so that losses may become excessive. The solution is to provide a separate coil for 10 metre operation, as shown in Fig. 8. This coil is connected to the main coil, but physically separate from it. Thus, the coil is not coupled to the short-circuited turns magnetically, and operates at high efficiency. Also as the coil is in circuit on 21 Mc/s and 14 Mc/s it helps in reducing the losses on these bands as well. This is because the " shorted turns " are only a part of the total in circuit inductance, so that losses are reduced.

With the use of an auxiliary coil for 10 metre operation, the switched Pi tank is a very effective and satisfactory performer. There is yet another point to notice, however. In the case of paralleled 807s running at the full CW input of 120 to 150 watts, the tank tuning capacity required for 80 metre operation comes out at around 250 pF. An anode tank condenser of this capacity capable of transmitter use is rather large. One solution is to arrange that the bandswitch provides extra fixed tuning capacity on the 80 metre position. This enables a

smaller (100 pF) tank capacity to be used. Fig. 9 shows a way of doing this. Fortunately high-voltage ceramic condensers are now made at a low cost for TV purposes that are suitable for use in this position.

It should be noted that the most important feature of the Pi network tank transmitter has not yet been mentioned. This is the anode choke. The anode choke is connected directly to the PA anode, and as it is effectively in parallel with the Pi tank, it is essential that it be a choke of high impedance at all the frequencies covered by the Pi tank. Unfortunately this is a difficult design problem for the choke manufacturer. This especially as the 21 Mc/s band has to be covered. It is easy to find chokes that will operate satisfactorily on some of the bands and not on others. The usual symptom of choke defect is that the PA anode current does not dip with tuning, even when the PA is unloaded. Also a neon lamp run along the choke windings may reveal violent R.F. voltages in the middle of the choke. In one case investigated the neon when applied directly to the PA anode could hardly be persuaded to light, while midway down the anode choke it lit brilliantly. A partial cure in such cases is to connect a second choke between the anode and the main choke. This enabled good R.F. output to be obtained from the PA in the above case, although the auxiliary choke became extremely hot. The only real cure is a new choke meeting the requirements of high impedance over a wide frequency range. This question of choke efficiency is one of the most important aspects of successful Pi tank circuit operation, and it is believed that Eddystone may shortly market a choke specially designed for high efficiency in this type of circuit. Certainly no commercial choke is available that is really satisfactory in this circuit, and generally home-made chokes are used. If a commercial choke is made available it would be welcome, as home-constructed chokes often require much laborious "fiddling" to give good results on all bands. Much disappointment with Pi tanks can be traced to this choke question, and a good ready-made choke should be assured of a ready market. Certainly amateurs everywhere would welcome the commercial solution of this question. Those who have had difficulties with Pi tanks, therefore, are invited to investigate choke efficiency with some care.

A Simple Radio Control Device

I WAS interested in the letter from your correspondent, G. Paish (Devon) (February issue), who asks for information on remote control for models. The following idea should provide a simple method for controlling a model boat by means of radio impulses.

It consists of a disc of insulating material having 10 pairs of contact studs (more or less according to the number of operations) arranged at equal intervals round the circumference. These studs are connected to the appropriate parts of the boat's mechanism to be controlled, the actual connections will be self-explanatory from the diagram.

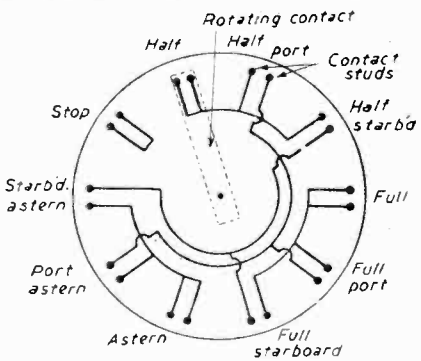
The circuit through the studs is completed by means of a rotating contact arm held on a spindle passing through the centre of the disc.

The spindle itself is connected to a wheel with 10 saw-teeth cut in it, and which works as follows: A pawl constructed of springy brass sheet and fixed to a soft-iron armature, suitably hinged in front of an electromagnet, engages behind a tooth.

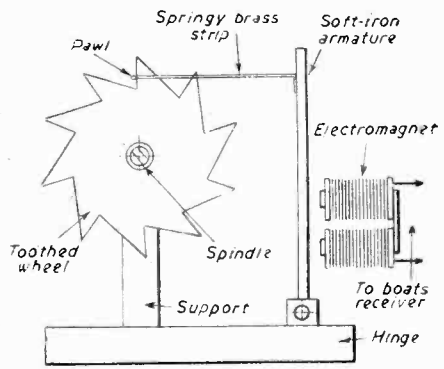
When the electromagnet is energised, the armature is attracted, and the pawl takes one tooth with it in moving forward. On de-energising the electromagnet, the armature is pulled by a spring, the pawl rides over the next tooth and comes in behind it ready for the next cycle of operations.

In this way it is possible (by sending the appropriate number of pulses) to select any one pair of contact studs and so control the movement of the boat.

The circuit controlling the electromagnet is closed by a relay in the boat's radio receiver. Impulses can be sent from the transmitter by means of a morse key, and a repeating mechanism could be provided to indicate the position of the control switch in the boat.



Wiring details for the control arm.



Practical arrangement of the control.

Rudder movement is effected by two electromagnets (one for port, one for starboard), the mechanism, which works against a spring, returning to a central position when the electromagnets are de-energised.

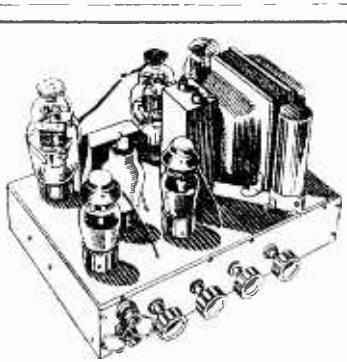
The mechanism must rotate in one direction only, and for this reason a back-stop should be provided to prevent the toothed wheel from reversing.—W. G. KEEL (Glasgow).

R.S.C. 25 WATT QUALITY AMPLIFIER 9 Gns.

We firmly believe our All " Push-Pull " Quality Amplifier to be by far the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full, glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands. The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

Outputs for 3 or 15 ohm speakers.

Twin volume controls with twin input sockets allow SIMULTANEOUS INPUTS for BOTH MICROPHONE and GRAM, or TAPE and RADIO. SEPARATE BASS and TREBLE CONTROLS, giving both LIFT and CUT. FOUR NEGATIVE FEEDBACK LOOPS with 15 db in the main loop from output transformer to voltage amplifier. Frequency response ± 3 db, 50-20,000 c.p.s. HUM and DISTORTION LESS THAN 0.5 per cent. measured at 10 watts, comparing favourably with most highest priced amplifiers. Six B.V.A. valves, Marconi/Osram KT series output valves. A.C. only, 200-230-250 v. 50 c/cs. input, 420 v. H.T. LINE. Paper reservoir condenser. Compact chassis. Matched components. Size 14-10-9in. Available in kit form at the amazingly low price of 9 gns. Plus carriage 7/6. Or ready for use 50/- extra.



R.S.C. 8-10 WATT "PUSH-PULL" HIGH-FIDELITY AMPLIFIER A3

Complete with integral Pre-amp. Tone control stage (as All amplifiers) using negative feedback, giving humproof individual bass and treble lift and cut tone control. **Six Negative Feedback Loops.** Completely negligible hum and distortion. Frequency response ± 3 db. 30-20,000 c.p.s. Two independently controlled inputs. Six B.V.A. valves. A.C. mains 200-230-250 v. input only. Outputs for 3 or 15 ohm speakers. Kit of parts complete in every detail. **£7.19.6.** plus 5 - carriage, or ready for use. **45/-** extra.

H.M.V. LONG PLAYING RECORD TURNTABLE WITH CRYSTAL PICK-UP (Sapphire Stylus). Speed 33½ r.p.m. For A.C. mains 200-250 v. Limited supply. Brand New Cartoned. Perfect. Only **£3.19.6.** Plus carr. 5/-. (Normal price £8 approx.).

BATTERY SET CONVERTER KIT. All parts for converting any type of Battery receiver to All Mains. A.C. 200-250 v. 50 c/cs. Kit will supply fully smoothed H.T. of 120 v., 90 v. or 60 v. at up to 40 mA, and fully smoothed L.T. of 2 v. at 0.4 to 1 a. Price, complete with circuit, wiring diagrams and instructions, only **43/9.** Or ready to use, **8 9** extra.

PERSONAL SET BATTERY SUPERSEDER KIT. A complete set of parts for construction of a Unit (housed in metal case) to replace Batteries where A.C. Mains supply is available. Input 200-250 v. 50 c/s. Outputs 90 v. 10 mA and 1.4 v. 250 mA, fully smoothed. For 4-valve receivers. Price complete with circuit. Only **35/9.** Or ready for use, **42/6.** Size of unit, 5½ x 4 x 11in.

BATTERY CHARGER KITS
For mains 200-250 v. 50 c/s.
To charge 6 v. acc. at 2 a, **25/6.**
To charge 6 or 12 v. acc. at 2 a, **31/6.**
To charge 6 or 12 v. acc. at 4 a, **49/9.**
Above consist of transformer, full wave rectifier, fuses, fuseholders and steel case. Any type assembled and tested, **6/9** extra.

THE SKY CHIEF T.R.F. RECEIVER A design of a 4-stage, 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point to point wiring diagrams, instructions, and parts list. **2/6.** This receiver can be built for a maximum of **£4.16/-** including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6½ x 5½in.

ELECTROLYTICS (Current production. Not ex-Govt.).

Tubular Types			
8µF 350 v.	1/9	8µF 500 v.	2/11
8µF 450 v.	1/11	16µF 450 v.	2/9
8µF 500 v.	2/11	24µF 350 v.	2/11
16µF 350 v.	2/3	32µF 350 v.	2/11
16µF 450 v.	2/9	32mfd 450 v.	4/9
24µF 350 v.	3/6	40µF 450 v.	4/11
32µF 350 v.	3/6	64µF 450 v.	4/9
25µF 25 v.	1/3	8-8µF 350 v.	3/9
50µF 12 v.	1/3	8-8µF 450 v.	3/9
50µF 50 v.	2/3	8-16mfd 450 v.	2/11
Can Types		8-16µF 450 v.	3/11
8mfd 350v.	1/3	16-16µF 450 v.	4/11
8µF 450 v.	2/3	16-32µF 350 v.	5/3
		32-32µF 450 v.	5/11

RECORDING TAPE. Best Quality, Plastic, 1,200 ft. Reels only **18/9.**

A PUSH-PULL, 3-4 watt HIGH-GAIN AMPLIFIER FOR £3/12 6. For mains input 200-250 v. 50 c/s. Complete kit of parts including circuit, point to point wiring diagram, and instructions. Amplifier can be used with any type of Feeder Unit or Pick-up. This is not A.C./D.C. with "live" chassis, but A.C. only with 400-0-400 v. trans. Output is for 2-3 ohm speaker. (We can supply a suitable 10in. unit by Rola at **27 9.**) The amplifier can be supplied ready for use for **25/-** extra. Carr 2 6. Full descriptive leaflet, **7d.**

BRAND NEW COLLARO 3 SPEED AUTOMATIC RECORD CHANGERS. Type RC3 521, with Orthodynamic Magnetic Pick-up and matching trans. Separate (switched) Alloy Stylii for standard or long-playing records. Mains input 200-250 v.. **£9/19/6.** Plus Carr. 5/-.

COLLARO 3-SPEED MIXER AUTO-CHANGERS. RC.3/522 with " Plug-in " Crystal Heads for Mains 200-250 v. 50 c cs. Brand New cartoned, **£10/10 -.** Carr. 5 -.

MICROPHONES. Crystal type, good quality. Recommended for use with our amplifiers. Hand type. **59 6 ;** Stand type. **£6 19.6.**

CONNOISSEUR HIGH FIDELITY LIGHTWEIGHT MAGNETIC PICK-UP COMPLETE WITH MATCHING TRANSFORMER. A fortunate purchase enables us to offer limited supplies. Brand New and Perfect at a fraction of normal price. Only **26/6.**

FOUR STAGE FEEDER UNIT. Design of a High Fidelity Tuner Unit. L. & M. Wave. Full decoupling. Self contained heater supply. Detailed wiring diagrams parts list, and illustration. **2 6.** Total building cost, **£3/15/-.**

COAXIAL CABLE. 75 ohms. ½ in., **7d.** yard. Twin Screened Feeder, **9d.** yard.

P.M. SPEAKERS. All 2-3 ohms. 6½in. Goodmans, **16/9,** 8in. Plessey, **15.9.** 10in. Plessey, **18/6.** 10in. R.A., **29/6.** 10in. Rola with trans., **29/6.** 12in. Truvox, **49/9,** 10in. W.B. "Stentorian" 3 or 15 ohm type HF1012 10 watts. Highly recommended for use with any of our amplifiers. **£3 13 6.**

M.E. SPEAKERS. All 2-3 ohms. 6½in. Rola, Field 600 ohms, **11/9,** 10in. R.A., Field 1,000 or 1,500 ohms, **23/9.**

VOLUME CONTROLS with long (1½in.) spindles, all values, less switch **2/9,** with S.P. switch **3/9.** D.P. sw., **4/9.**

R.S.C. MAINS TRANSFORMERS (FULLY GUARANTEED)

Interleaved and Impregnated. Primaries 200-230-250 v. 50 c/s Screened

TOP SHROUDED. DROP THROUGH

250-0-250 v. 70 mA, 6.3 v. 2.5 a ...	12/11
260-0-260 v. 70 mA, 6.3 v. 2 a 5 v. 2 a	14 11
350-0-350 v. 80 mA, 6.3 v. 2 a, 5 v. 2 a	17 9
275-0-275 v. 80 mA, 6.3 v. 2 a, 4 v. 2.5 a	14 11
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	21/11
300-0-300 v. 100 mA, 6.3 v. 4 v. 4 a, c.t. 0-4-5 v. 3 a	31/-
350-0-350 v. 160 mA, 6.3 v. 4 a, 5 v. 3 a	21 6
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a	27/9
350-0-350 v. 150 mA, 6.3 v. 2 a, 6.3 v. 2 a, 5 v. 3 a	29/11

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3in.	16/9
350-0-350 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a	18/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	22 9
250-0-250 v. 100 mA, 6.3 v. 6 a, 5 v. 3 a, for R1355 conversion	29/9
300-0-300 v. 100 mA 0-4-6.3 v. 4 a 0-4-5 v. 3 a	22 9
350-0-350 v. 100 mA, 0-4-6.3 v. 4 a, 0-4-5 v. 3 a	22 9
350-0-350 v. 150 mA, 6.3 v. 4 a, 0-4-5 v 3 a	31 6
350-0-350 v. 250 mA, 6.3 v. 6 a, 4 v. 1 a, 0-2-6 v. 2 a, 4 v. 3 a, for Electronic Eng. Televisor	69/6
425-0-425 v. 200 mA 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T., 5 v. 3 a. Suitable Williamson Amplifier, etc. ..	47 9
Economy Quality Amplifier type .	52 6
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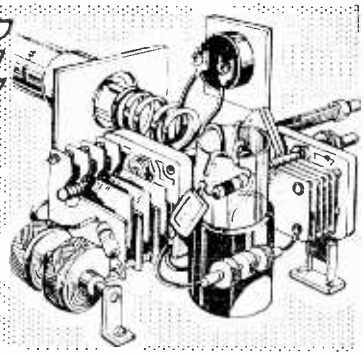

BUILDING COMMUNICATIONS RECEIVERS

1.—R.F. AND F.C. STAGES

THE possibility of building a communications type receiver is an attractive one, and in some ways this type of receiver lends itself very well to modification. It is a comparatively easy matter to add further wavebands, as required, to provide additional R.F. or I.F. stages, or to introduce special features such as a beat-frequency oscillator, tuning meter, etc. It is, therefore, quite feasible to begin with a straightforward four or five valve circuit, which tunes only one waveband, and to add other stages and coils until a very comprehensive receiver is arrived at. It is, therefore, proposed to deal with the design and construction of such receivers. R.F. and F.C. stages will be covered first. The circuit of a communications type receiver may conveniently be split up into a number of sections, and I.F., B.F.O., and A.F. stages can be dealt with later, together with S-meters, noise-suppressor circuits and similar features.

The term "communications receiver" is generally applied to a receiver having a higher standard of sensitivity and selectivity than that of the usual type of domestic receiver. Provision will usually be made for tuning wide bands of frequencies, and band-spreading and other feautres may be present. It is worth noting, however, that extreme complication and a large number of valves are not essential in a communications receiver. Some of the simpler models widely used employ only five or six valves, and may have no R.F. stage. On the other hand, it is possible to add R.F. and I.F. stages until a much greater number of valves will be employed.

When the construction of such a receiver is first considered a large, stout chassis should be chosen. Cramped construction is undesirable, and limits future additions. Rigidity is an essential feature for stable, easy tuning on the higher frequencies, and a really high-class tuning drive is very important. With suitable circuits an extremely high degree of selectivity can be chieved and a poor drive will become very troublesome. The possible limitations of the power pack should also be kept in mind. If a push-pull output stage is not required, however, a transformer and rectifier able to deliver 80 to 100 mA will be ample, while the total consumption of many excellent circuits can be kept within the 60 mA limit.

Band Selection

Some older receivers of good type employ plug-in coils, and these may still be obtained and used if simplicity is essential. Good efficiency is possible with such coils, and there is the added advantage that extra coils for further wavebands may be purchased and inserted at any time. Against their use is the relative awkwardness of band changing, especially

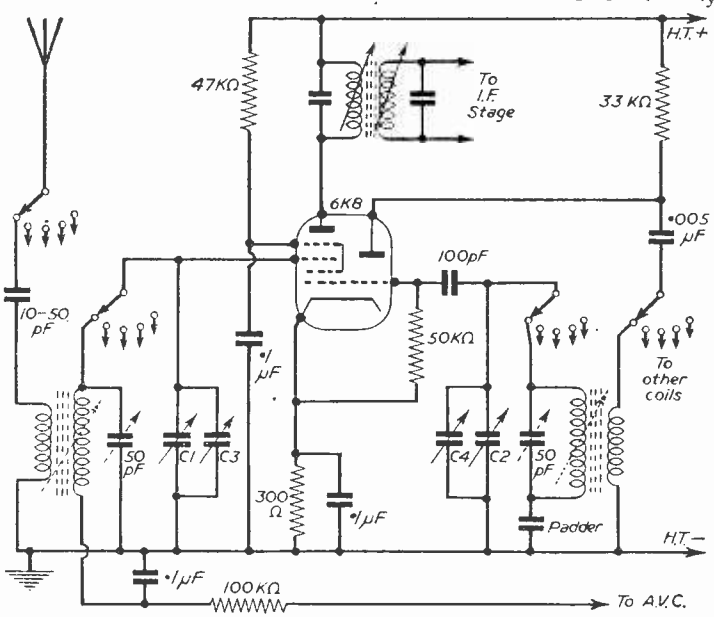

Fig. 1.—Multi-band switching and bandspread.

with three or more tuned circuits, and wavechange switching is preferable for home construction.

A circuit suitable for the F.C. stage is shown in Fig. 1, and several points require note. The wavechange switch should have a sufficient number of "ways" to permit of sufficient wavebands—usually five or six, though three or four would be sufficient in some cases. If unit type coils are used, as shown, extra coils can be wired in with extreme ease. The receiver may, therefore, be put into operation as soon as possible upon the most desired band, with a single pair of coils, appropriately wired. In the interests of stability and selectivity transformer type coupling is best throughout, so that a four-pole switch will be necessary, or a six-pole type if an R.F. stage is to be added later.

C1 and C2 are sections of the gang condenser. If all-wave working is intended this may be .0005μF. If short waves are primarily in view a capacity of .00015 to .0003 μF for each section would be more appropriate. A three-gang condenser is required if an R.F. stage is to be added. C3 and C4 are the band-spreading condenser sections (if this form of tuning is used), and would normally be of about .000015 μF (15 pF). If space exists this condenser may be added later, if not fitted originally. In addition, each tuning coil has a pre-set for initial alignment. This may be wired in parallel with the tuned winding or to chassis. For ease of alignment, small size and general efficiency small dust-cored coils are most suitable throughout.

The selectivity of the first tuned circuit can be increased to a useful extent by using a small pre-set or fixed capacitance in series with the aerial coupling winding, as shown. When a wide range of frequencies is tuned it is best to have an individual condenser for each band. The most suitable values for S.W. bands would result in a severe loss of signal strength on higher wavelengths, and particularly on the L.W. band.

Though the values given are suitable for a 6K8 other valve types can be used. The 6K8 is, however, readily obtainable and capable of efficient operation up to 60 Mc/s, with average circuits.

R.F. Stage

Such a stage is effective in reducing types of interference which arise through insufficient selectivity in the F.C. tuned circuit, and values for the readily obtainable 6K7 type are shown in Fig. 2. A manual R.F. gain control is provided in addition to A.V.C., and this is usual in this type of receiver, where individual R.F., I.F. and A.F. manual controls may permit of best possible results under all circumstances.

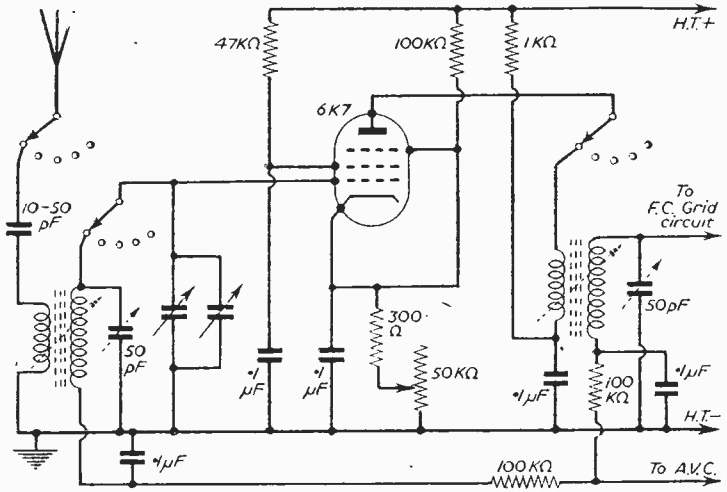

Fig. 2.—R.F. stage with R.F. gain control.

Each tuning coil will be of the type used in the F.C. first tuned circuit and aligned to gang with it. If bandspreading is used, then the condenser should have a third section, for the R.F. stage. Any provision for panel operated trimming of the R.F. stage is not usually required in modern designs, but is worth while with home-wound coils. Such a trimmer may be of 50 pF, wired in parallel with the main tuning condenser, and all the 50 pF trimmers otherwise used with the R.F. coils may then be omitted. If the panel trimmer is set to a mid-way position adjustment of it should prove necessary only when a "difficult" station is being received.

A somewhat similar stage may be made up, using the non-VM 6J7 type of valve, operated in a state of maximum gain. A circuit for this is shown in Fig. 3 and can give high sensitivity. If this circuit is used it should be remembered that the life of the 6J7 will be in the neighbourhood of about only 500 hours' operating time.

Usually it will be satisfactory to use one efficient R.F. stage, and many highly expensive communications receivers are limited to this. Though two or more R.F. stages are possible it is more convenient to employ extra I.F. stages, Ganging difficulties are thereby avoided, as is possible instability arising from wave-change switching. (*Continued on page* 629.)

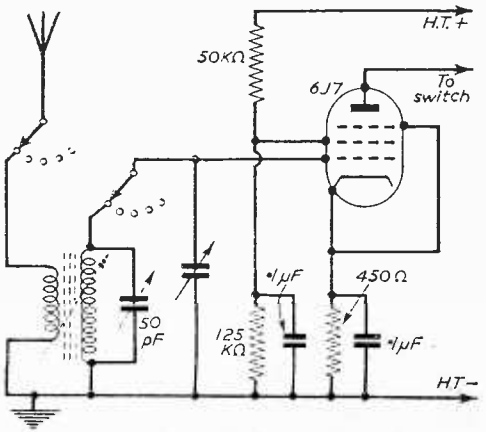

Fig. 3.—Stage giving high signal-to-noise ratio.

Input Circuits

Though world-wide reception of the more powerful transmitters is not difficult with indoor or other ordinary aerials, weak and difficult stations will be improved by more suitable aerial systems. Such systems may also prove helpful in reducing interference.

Fig. 4 (A) shows connections for a dipole, the primary being that which would otherwise be used for aerial coupling as in Fig. 3. A transposed or twisted twin lead passes from the aerial, and this

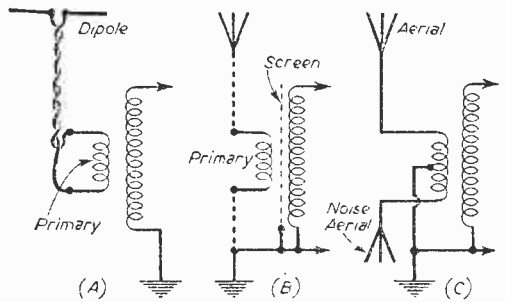

Fig. 4.—Dipole, Faraday screen and noise aerial inputs.

type of feeder may pass through an area of local interference without introducing this interference into the receiver to such an extent as does the single-wire down-lead of the usual type of aerial. It is, therefore, helpful in some localities. The dipole itself may be of such a length that maximum results are obtained upon a desired band, and may also be directed for maximum pick-up from a given direction.

A second method of reducing some forms of static interference is shown at (B) and uses a copper or similar screen between primary and secondary. Such a screen may consist of a close mesh of copper wires, insulated from one another and joined along one end only. Or a strip of foil may be used, interposed between secondary and primary when the latter is wound upon the secondary. The foil must be insulated from both windings. The beginning and end of the foil should overlap, but be insulated so that actual contact is impossible. Such screens are moderately effective against spurious static, but do not much reduce the transference of signals, where the coupling is of an inductive nature.

The method shown at (C) is justified only where bad local interference is being introduced into the first tuned circuit, and uses a "noise" aerial feeding into the receiver in opposite phase. The noise in noise aerial and aerial proper, therefore, largely cancels out, the signal in the aerial proper being transferred to the tuned circuit. The noise aerial should be as inefficient as possible from the viewpoint of ordinary reception, and may consist of a short wire bound with the mains leads of the receiver. It should be adjusted so that the noise pick-up by the wire as far as possible equals that of the aerial proper and its down-lead.

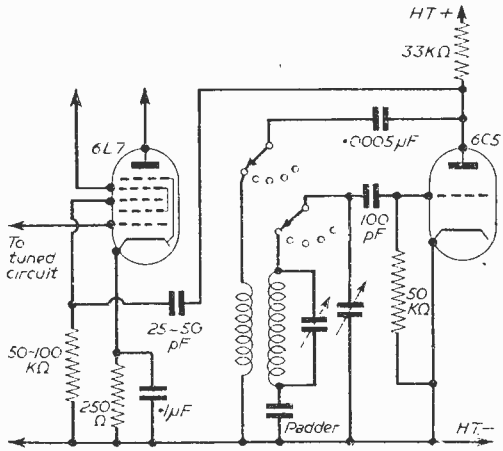

Fig. 6.—Anode-coupled mixing.

Separate F.C. Oscillator

A circuit for this type of frequency changer stage is shown in Fig. 5, and a somewhat similar arrangement is depicted in Fig. 6. The use of a separate oscillator valve can simplify and improve the practical layout of a receiver, while adequate oscillation can better be maintained, especially at very high frequencies.

In Fig. 5 cathode coupling is shown, and this can be arranged with home-wound coils by having the cathode tap about one-tenth from the earthed end of the tuning coil. If several bands are provided switching of this circuit is also necessary.

Fig. 6 is suitable for standard coils and can give excellent results. This circuit may also be used with an R.F. pentode as mixer, the screen grid being wired

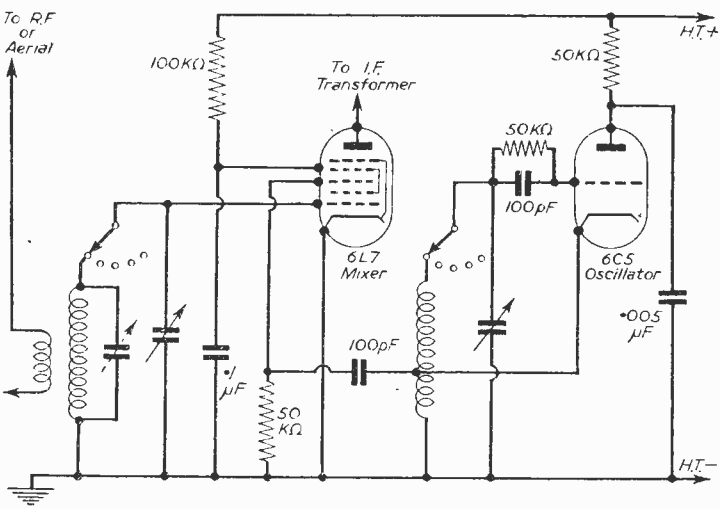

Fig. 5.—Separate oscillator stage.

directly to 6C5 anode. However, the special mixer valve is preferable if to hand. In either Fig. 5 or Fig. 6 A.V.C. bias may be applied to the 6L7 as shown for the 6K8 in Fig. 1. The 6C5 coils, with related padders, as listed by the coil manufacturer, would be the same as with the 6K8 stage. A 6K7 is equally suitable, with S.G. wired to anode for triode operation.

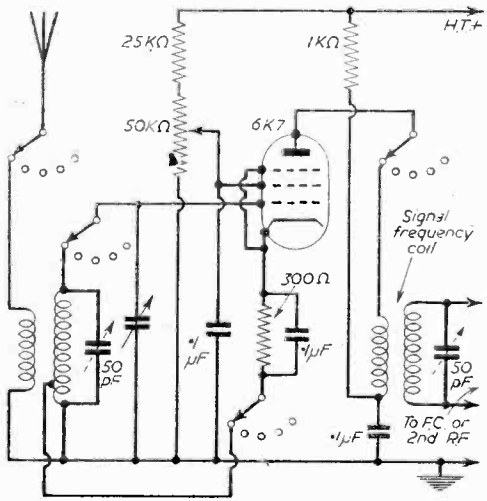

Fig. 7.—Regenerative preselector or R.F. stage.

For V.H.F. working a separate oscillator usually becomes essential, but is by no means necessary for all bands between about 15 and 2,000 metres. Such V.H.F. oscillators are not within the scope of the present circuits, and would use acorn or other V.H.F. valve types. There are numerous button-based and other mains type valves which will give excellent results in communications type receivers, but these are not shown in the present instance because the octal types are particularly cheap and easy to obtain, and extremely robust. In this direction it is worth noting that these valves are obtainable also in G and GT types, this suffix denoting large and small glass envelopes. If space permits such types may be used, but screening cans will in most cases be required for them.

Regenerative R.F. Stage

In some circuits sensitivity may be increased by introducing regeneration of a controllable nature into the R.F. stage, and cathode coupling, as shown in Fig. 7, has various advantages. Here the 50 K-ohm potentiometer acts as regeneration control, allowing the stage to be brought right up to the point of oscillation on any frequency. Such an arrangement is primarily of advantage when the maximum possible efficiency is required from a limited number of valves, or when a single-valve pre-selector, in separate cabinet, is to be made up for inclusion between aerial and receiver.

The degree of cathode coupling will require to be rather smaller than in Fig. 5, so that the stage can reach a condition of quite high gain before oscillation commences. It is particularly convenient with home-wound coils, where a tapping may readily be provided. In a single-band receiver without wavechange switching such regeneration can be added with great ease.

Hum and Power Supplies

As any final circuit is likely to have a high degree of gain every care should be taken to keep hum down to the lowest possible limit, or weak signals may be lost. In this direction adequate smoothing of the rectifier output is essential, with individual decoupling

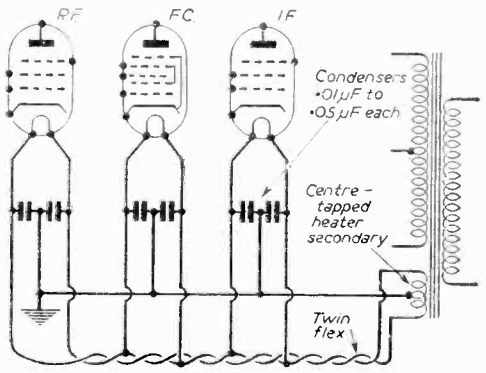

Fig. 8.—Heater connections for high-gain receiver.

of the earlier stages of the receiver. Full-wave rectification is best, with one or two smoothing chokes of adequate inductance and smoothing condensers of 16 to 32 mfd.

Leads carrying A.C. should be kept away from those in the grid and signal circuits, and no coil, by-pass condenser or other component should be connected to the same chassis earthing tag as is used for a heater or other A.C. circuit. Twin flex against the chassis is recommended for heater wiring, and by-pass condensers may be added, as shown in Fig. 8. If there is no centre-tap on the heater winding of the transformer two resistors of about 30Ω to 50Ω may be wired in series, their junction being used as a centre-tapping point.

With care in this direction hum may be kept to an insignificant level. If it *does* arise, and other components are above suspicion, a faulty valve should be suspected. In some circuits leakage of quite high value, arising between heater and cathode, can induce hum, which may be amplified by subsequent stages to a very troublesome level.

(To be continued.)

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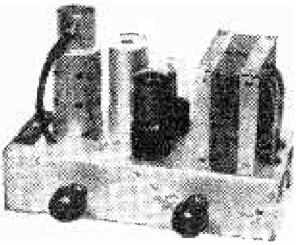

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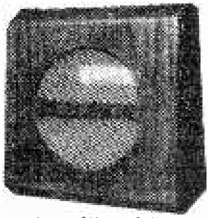
50 mfd. 12 v.	1/9
50 mfd. 50 v.	2/3

LOUDSPEAKER CABINETS



Available for 6½in. and 8in. Speaker units. Polished walnut finish. A very attractive cabinet at quarter of to-day's prices.
Price : 6½in. Type Cabinet, 15/6 each.
Price : 8in. Type Cabinet, 19/6 each.
See page 596 under loudspeakers for suitable speaker units.

"AEROVOX" Condenser Clips, 1d each.

HIGH VOLTAGE CONDENSER. .01 mfd. 5 kV, D.C. working.

JUNCTION BOXES. Type 5X 2234, 20-Way.

PUSH BACK WIRE. Size 7/012. Available in colours, blue, green, red. Price 2½d. yard.

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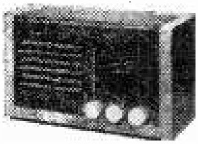

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NEW VALVES. 35Z4, 35L6, 25Z4, 25L6, U281, U50, 5Y3GT, 6K7GT, 6V6GT, 50L6, 42, 80, 11/6 ; 6K8GT, 117Z6, 12 6.

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REALLY MIDGET TUBULARS (500 v.), waxed, wire-ended, 0.001, 0.002, 0.05 (¼in. dia.) ; 0.01 (¼in.) ; 0.04 (⅜in.). All 1in. long, 3 6 doz.

STANDARD TYPE. 0.1 mfd., 0.01, 3 6 doz.

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E.H.T. CABLE.— Heavy PVC insulated, 1 - yd

NEW STRANDED COAX. 6d. yd. 80Ω approx. ½in.

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New Resistors, famous make, 30Ω, 5 K, ½ w., 6 -; 200Ω, 12 K, 15 K, 30 K, 75 K, 150 K, 1 w., 9 8 ; 330Ω, 15 K, 2 w., 10 - ; 5.6 K, 20 K, 5 w., 21/-.

New Condensers (wire ended) P.x.s.s., miscellaneous 5,000 pf., 9 -. British mica 75, 2,000 pf., 7 6.

Potentiometers, wire wound 5 K, ¼ spindle, 35 -. Preset, 25 -. 1 mm. **Sleeving,** 2yr. yds. 21/-

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	5 -	6BW6	6 6	(soiled)	5 -
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1T4	6/6	6J5	5 -	6SH7(soiled)	5 -
1U5	6 6	6K7	4 -		
3Q4	7 6	6V6	7 -	15D2	4 -
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6AM6	6 6	7S7	6/-	VR21	3 -
6AT6	7 6	7S7	6 -	W77	6 6
6B8	6 -	9D2	5 -	1B24	50 -
6BA6	6 6	9D6	6/6		

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VALVES. fully guaranteed, all post free. 954, 1/9 ; 9004, 2 - ; 6K7, 4 - ; 6V6GT, 6 6 ; VR91, 3/6 ; VR65, 1 6 ; VU111, 2 - ; EL32, 4 - ; 6J5, 2/- ; U14, 8 - ; KTZ41, 1 9 ; 9D2, 2 - ; 8D2, 1 9 ; 15D1, 4 - ; VR54, 1 3 ; VR92, 1/3 ; VR78, 1 - ; MH1, 3 6 ; 12SJ7, 3/6 ; 12SC7, 3 6 ; 12H6, 1 9 ; 1D8, 2 6 ; Type 46, 5 - ; 12AH7, 3 6. Any of the above valves in lots of six 10 per cent. extra reduction.

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6K8g	8 -	25Y5	8/6	EL91	6/6	VP23	6/6
6L7g	7/6	30	7/6	EM34	10/6	VP41	7/6
6N7g	7/6	35L6	8/-	EY91	7/6	VR55	5/-
6Q7g	8,6	42	8 -	F92	10/6	VR150	8/6
6R7g	8,-	42Mpt	15/-	FW13	9/-	X24	10/6
6SA7	8/-	43	8/6	H30	7/6	X66	7/6
6SH7	7 6	50L6	8 -	H63	7/6	Y63	7/6

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VALVES.—Brand New. Every one guaranteed. CV140, D77, 6AL5, 6D2, EB91, CV138, EF91, 6AM6, 8D3, Z77, 6K7G, VT52 (EL32), 5 - each, 54/- doz.

6P6C, 5 6, 6V6GT, 6X5GT, DH77, 6AT6, 12AX7, 1S5, 3S4, 6 9 each, 12AT7, 7 -, 1S4, 1R5, 1T4, 5 6 each. RK34, 2C34, 1 9, EA50, 1 9, 954, 1 6, EF50, 4/6, 12AU7, 7/9, 6X4, 6/-, SP51, 2/6, 6BW7 (EFF80) 7 9, ATP4, 2/6, 24 - doz. Post extra.

VOLUME CONTROLS, with S.P. Switch, 1½in. spindle, ¼ and 1 meg., 2 - each. Post 4d.

RESISTORS.—1 watt Assorted. Brand new, 1 6 box of 12, post 4d.

GERMANIUM XTAL DIODES.—Wire end. Brand new, 1/6, 12 - doz.

OUTPUT TRANSFORMER.—32-1. 55-1, 80-1, 60 m/a. Brand new, 3 9, post 10d.

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VALVES, C.R.T.s, TEST EQUIPMENT

11/- MIDGET COIL PACK KIT 11/-

Comprising chassis 3" x 2" x 1½", switch, LMS iron cored coils, padders, trimmers, nuts and bolts, wire, sleeving, circuit diagram, 456 Kc. Brand new Int. Oct., Valveholders, 2d., 2 - doz. All Can Electrolytics, 8 x 500, 1/3, 12/- doz. ; 2 x 350 8d., 6 - doz. ; 200 x 12 6d., 4 6 doz. ; 100 x 6 3d., 2 - doz. ; Coils, Coils, "P" Type 2 -, "Q" Type 2/3. TRF 4/- pr. ; MSS Superhet 6 coils with circuit, 4 - set ; HF Dual-wave 2 9. Crystal Coil L & M 2/- ; Tub Cond. .1 x 500 3 - doz. .1 x 350 2 9 doz. ; Asst. Grommets 6d. doz. ; 2, 4, & 6 BA Nuts 2 - gr. ; Brand new BA Nuts & bolts asst. 2 gr. 5 - ; Ex-equip. BA nuts, bolts, washers 2/6 lb./approx. 500 pieces) ; PK self tap screws 2 6 gr. ; 18 SWG Multicore 2/6 doz. yds. ; 1 m m sleeving 1 - doz. yds. ; ¼ meg. vol. con. with DP sw., 3 -.

2 WB SUPERHET & TRF RECEIVERS Superhet £6 10 -. TRF £5/5/- including all components, valves, cabinet, the lot. Book of instructions 1/6 post free.

Latest list 3d. Min. P. & P. 1/-

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Open to Discussion

Re T.V.I

SIR,—It would appear from your correspondents that nobody ever takes the trouble to read the conditions of the schedule on the back of a receiving licence.

Para 3 of the Sound Licence and Para 4 of the TV Licence state :

"The apparatus shall be so maintained that it does not cause interference with any other wireless telegraphy."

Surely this applies equally to interference from the time bases of a TV set as it does to the radiations of an oscillating receiver, and the last four words of the paragraph applies as much to amateur reception as to the reception of broadcasting.

If the terms of this paragraph are enforced, then the owner of an offending TV set can be made to switch off until the interference is suppressed.

If the Post Office fail in their duty to enforce their own terms for granting a licence, then I see no reason at this point why legal action cannot be taken and an injunction be obtained to restrict the use of the offending set until such times as the set is made interference free.

Perhaps some of your legal minded readers would like to take the matter up.—JOHN W. ROBINSON (G5UP via Carnforth).

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

Super-regen Experiments

SIR,—I thought that PRACTICAL WIRELESS readers might be interested to hear of my experiences with super-regenerative receivers. This type of receiver, now long past its prime, possesses extraordinary sensitivity. Selectivity is low but may be appreciably increased by the use of regenerative R.F. stage preceding the detector. These receivers are mistakenly supposed to be useful only at V.H.F. This is not so, as I have in my possession a receiver, working on this principle, comprising super-regenerative detector and L.F. stage which brings in numerous amateurs on the 160 metre band, as well as picking up ship-to-shore telephony and various commercial communications stations. The main snag in connection with these receivers is that only a very low value tuning capacitor is permissible —a high L/C ratio is essential for satisfactory performance. This could presumably be overcome by the use of a variable inductance as a bandset control ; the final tuning (bandspread) being done within the limits of the capacitor. Although both gain and signal/noise ratio are lower at the low frequency regions, I have had amazing results from my own receiver operating on a 3ft. aerial. I consider these little sets the answer to the poor man's problem in connection with expensive and complicated communications receivers.—H. RIDDLE (Maidstone).

The Coronet Battery 4

SIR,—I have taken your PRACTICAL WIRELESS and PRACTICAL TELEVISION magazines for the last three years and have built several of your battery sets, as we are on 110 D.C. on the ship. I built your Coronet Battery 4 when I was last at home. I have taken it with me up to the Persian Gulf and now down to here. It has been excellent in every way. I had the Home programme and the Light all through the Mediterranean and once at Abadan.—A. S. BASHFORD (Capetown, S. Africa).

Modern Reflex Receiver

SIR,—Since you published the above circuit of mine I have had complaints from some of your readers who have constructed this receiver. The trouble appears to be that they can receive the Home programme perfectly at good volume but instability is encountered when attempts are made to tune in the Light. This fault was not apparent in the original receiver but there are two simple modifications which can be made which should clear up any trouble experienced in this respect. It is suggested that the components be added in order till the trouble is removed.

(a) Connect 1,000 pF mica condenser directly between the triode anode and chassis.

(b) Connect ½ meg. ¼ watt resistor between pentode control grid (g1) and chassis.

(c) Adjust trimmers with volume control full up on the Light programme for greatest volume consistent with stability.

The addition of (b) will probably cause a slight drop in volume but this should not be serious as the receiver has plenty in hand.

A point to watch when wiring the set is that the triode grid leak resistor (390 kΩ) goes to the cathode of the valve and *not* to chassis as is usually done with this type of detector. This mistake usually shows itself by very poor volume and oscillations. It is also good practice with T.R.F. receivers of this type to mount the aerial coil vertically above the chassis and the R.F. coil horizontally below the chassis. This will make stray coupling between the coils negligible.

I may add that the original receiver is still working perfectly and experiments are proceeding with a superhet version.

Hoping these notes will be of some help to those of your readers having trouble with this receiver.—C. M. STEWART (Glasgow S4).

SIR,—I would like to thank your contributor C. M. Stewart for his "Modern Reflex Receiver," which solved my problem of a birthday present for our excellent German cook! I am a "superhet" man, but the results astonish me. May I offer a warning and a suggestion. This set is dangerous if no isolating series condenser is placed in the lead to the aerial: something around 500 pF makes it safe and selective. The suggestion is to use the energising winding of a mains energised speaker to save space on the chassis where the choke would go.—RICHARD PAGE (B.A.O.R.5.).

Modifying R1132A

SIR,—With regard to the query as to 144 Mc/s reception with R1132A, made by F. J. Walker, the following modification I carried out (based on an article by S. T. Smith (G3BS1) in a 1949 R.S.G.B.) may be of some help.

Remove the coils and rewind as follows: Aerial coil—2 turns, ¼in. inside diameter, ¼in. long. Frequency changer coil—the same as above. R.F. anode coil—1¼ turns, ¼in. inside diameter. Oscillator—2 turns ¼in. inside diameter, ¼in. long.

Solder on to original columns, keeping ends of oscillator and anode R.F. coils (which are small for the gap between the pillars) as short as possible.

(When tracking, open or close the R.F. and oscillator coils for maximum performance.) If the frequency changer grid coil will not respond to 144 Mc/s, then remove the 5$\mu\mu$F ceramic condenser (C16 on circuit) which is connected across this coil.

A spacing of 1/64in. in R.F. and F.C. coupling will give maximum gain with little loss of second channel rejection. By removing an outside rotor-vane from each section of the tuning condenser (the nearest to the front panel in the oscillator section) a simple bandspread is obtained.

(Note.—The vanes must *not* be unsoldered, but removed, using a pair of pliers.) Adjust oscillator to about 133 Mc/s for 50 deg. dial reading. If there is difficulty to get this high oscillation, then the following will rectify this:

Replace the 10,000 ohms resistor (R11) by a (2 watt) 3,000 ohm resistor and a second 7475 neon stabiliser is connected in series with the original. While the form of bandspread used is extremely simple and reasonably good, this matter is best left to the taste of the person carrying out any modifications. The tuned circuits are aligned by tuning for maximum noise.—M. J. SHEPHERD (Canvey Island).

The Ground Plane Antenna

SIR,—I am an ardent reader of PRACTICAL WIRELESS, and have met with great success with the "Ground Plane" antenna recently described.

I have been using a 132ft. long wire for a long time, and have only got a fair amount of DX (not good DX) until a friend of mine who has a ground plane told me to erect one. However, he gave me no dope on one, but I remembered seeing the article and studied it.

Coming to the conclusion that I had to use materials I had available, I used 1¼in. alloy tubing cut to 16ft. 5½in. mounted on top of a 20ft. wooden mast taking H radials N, S, E, W at an angle of 45 degrees from ground, cut to 17ft. 2in. each, using them, and guy rope, as guys.

This antenna with 60 watt TX was put on the air at 21.44 G.M.T. on August 5th, 1954, and has since produced the following:—

W2EWD	— 5 8 9!!	5A2FA	— 5 6 9
4X4DH	— 5 6 9	KH6IJ	— 5 6 9
LU2HH	— 5 5 9		

which is five new continents!

Surprising, isn't it? Seeing that I have been pounding DX for months without result. Maybe it is conditions, maybe the TX, and maybe the antenna!—DAVID BUTLER (G13JEX), Belfast.

RADIO SHOW

(*Continued from page* 614)

Westinghouse Brake & Signal Co., Ltd.

HERE will be seen again a selection from their extensive range of metal rectifiers. These extend from small instrument type units to those designed for industrial use and for extreme high voltages in television and other equipment. [Stand No. 2]

Whiteley Electrical Radio Co., Ltd.

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Wolsey Television, Ltd.

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3s. each.

Modern Two-valver (two band receiver) ... PW98*

Three-valve: 2s. each.

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

3s. each.

The All-dry Three ... PW97*

Four-valve: 2s. each.

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

Mains Operated

Two-valve: 2s. each.

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

Three-valve: 3s. 6d. each.

A.C. Band-Pass 3 ... PW99*

Four-valve: 2s. each.

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

SUPERHETS

Battery Sets: 2s. each.

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

Mains Operated: 3s. 6d. each.

"Coronet" A.C.4 ... PW100*
AC/DC "Coronet" Four PW101*

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve: 2s. each.

Simple S.W. One-valver PW88*

Two-valve: 2s. each.

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

Three-valve: 2s. each.

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

PORTABLES

1s. 6d.

The "Mini-Four" All-dry (4-valve superhet) *

MISCELLANEOUS

2s. each.

S.W. Convertor-Adapter (1 valve) PW48A*
(2 sheets), 7s. 6d.
The P.W. 3-speed Autogram ... ... *
The P.W. Electronic Organ (2 sheets), 7s. 6d. *

TELEVISION

The Practical Television Receiver, (3 sheets), 10/6
The "Argus" (6in. C.R. Tube), 2/6*
The "Super-Visor" (3 Sheets) 7/6*
The "Simplex" 3/-*

All the following blueprints, as well as the PRACTICAL WIRELESS numbers below 94, are pre-war designs, kept in circulation for those amateurs who wish to utilise old components which they may have in their spares box. The majority of the components for these receivers are no longer stocked by retailers.

AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated

One-valve: 2s.

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

Mains Operated

Two-valve: 2s. each.

Coyne-electric Two (D, Pen), A.C. AW403

SPECIAL NOTE

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

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

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

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve: 2s. each.

S.W. One-valver for American AW429*

Two-valve: 2s. each.

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

Four-valve: 3s. each.

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

Mains Operated

Four-valve: 3s.

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

MISCELLANEOUS

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

QUERY COUPON

This coupon is available until Oct. 6th, 1954, and must accompany all Queries, sent in accord with the notice on page 633.

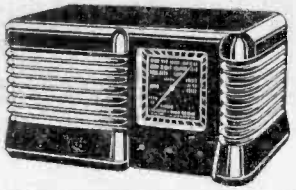
PRACTICAL WIRELESS, Oct., 1954.

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by W. SPEAIGHT & SONS, Exmoor Street, London, W.10. Sole Agents for Australasia and New Zealand: GORDON & GOTCH (Asia), LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rate including postage, for one year: Inland and Abroad 14s. 6d. (Canada 13s.) Registered at the General Post Office for the Canadian Magazine Post.

PLASTIC CABINET as illustrated, 11½ x 6½ x 5¾in., in walnut, cream, or green. ALSO IN POLISHED WALNUT. complete with T.R.F. chassis, 2 waveband scale, station names, new waveband, backplate, drum, pointer, spring, drive spindle, 3 knobs and back, **22/6**. P. & P., 3/6.

As above with Superhet Chassis, **23 6**. P. & P., 3/6.

As above complete with new 5in. speaker to fit and O.P. trans., **35 -**. P. & P. 3/6 with Superhet Chassis, **38 -**. P. & P. 3/6.



Used metal rectifier, 230 v. 50mA., 2/6 ; gang with trimmers, **6/6** ; M. & L. R.F. coils, **5 -** ; 3 Govt. valves, 3 v/h and circuit, **4/6** ; heater trans., **6/-** ; volume control with switch, **3/6** ; wave-change switch, **2 -** ; 32 x 32 mfd., **4 -** ; bias condenser, **1/-** ; resistor kit, **2 -** ; condenser kit, **4 -**.

M. & L. Superhet Coils with circuit, **6/6** ; iron cored 465 IFs, **7/6** ; min. gang, **5/6** ; volume control with switch, **4/-** ; wave-change switch, **2/6** ; heater trans., **7/6** ; 4 v/h, **1/6** ; 4 Ex Govt. valves, metal rectifier and Xtal diode with circuit, **14/6** ; 25 x 25 mfd., **1/-** ; 16 x 16 mfd., **3/3** ; condenser kit (17), **7/6** ; resistor kit (11), **3/6**.

All dry A.C. mains battery unit, 200/250 v. Metal case size 8 x 5 x 3in., by famous manufacturer incorporating Westinghouse metal rectifiers, 3 500 mfd., 16+24 mfd. mains trans., 3 smoothing chokes, output 90 v. 10 mA., 1.4 v., .25 amp. P. & P. 2/6. **39 6**.

Medium and Long Wave Crystal set, in attractive plastic cabinet incorporating Germanium diode. **16 -**.

Headphones to match above, per pair **7/6**.

COMPLETELY BUILT SIGNAL GENERATOR

Coverage 12" Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s-2.7 Mc/s., 2.75 Mc/s-8.5 Mc/s., 8.5 Mc/s-25 Mc/s., 17 Mc/s-50 Mc/s., 25.5 Mc/s-75 Mc/s. Metal case 10 x 6½ x 4½in., size of scale 6½ x 3¼in., 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel, **£4/19/6**, or 34/- deposit and 8 monthly payments of 25 -. Post and Packing 4/- extra.

High impedance plastic recording tape by famous manufacturer. 1,200 feet complete on spool, **17/6**. P. & P. 1/6. 600 feet 8/-. P. & P. 1/-.

Pr. 200/250 v., secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps. **13 -**.

Drop thro' 280-0-280, 200 mA., 6 v. 5 amps., 5 v. 3 amps., 27/6.

Heater Transformer. Pri. 230-250 v. 6 v. 1½ amp., **6/-** ; 2 v. 2½ amp., **5 -**.

R.I. MAINS TRANSFORMERS, chassis mounting, feet and voltage panel. Primaries 200/250.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., **13/6**.

350-0-350 70 mA. 4 v. 5 a. 4 v. 2.5 a., C.T., **18/6**. P. & P. on above transformers **2/-**.

500-0-500 120 mA. 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., **27/6**.

500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., **39/6**.

P. & P. on the above transformers **3/-**.

32 mfd., 350 wkg.	2/-
16 x 24 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 450 wkg.	3/6
16 x 8 mfd., 500 wkg.	4/6
16 x 16 mfd., 500 wkg.	5/9
8 x 16 mfd., 450 wkg.	3/9
32 x 23 mfd., 350 wkg.	4 -
32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	11d.
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg., wire ends	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
50 mfd., 25 v. wkg., wire ends	1/9
100 mfd., 350 wkg.	4 -
100+200 mfd., 350 wkg.	9/6
16+16 mfd., 350 wkg.	3/3
Ex Govt. 8 mfd. 500 v. wkg., size 3¼ x 1¼, 2 for	2/6
60+100 mfd., 230 v. wkg.	4/-
16+32 mfd., 350 wkg.	6 -
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60+100 mfd., 280 wkg.	8/6
50 mfd., 12 wkg.	11d.
32+32 mfd., min., 275 wkg.	4/-
50 mfd., 50 wkg. 3 mfd., wkg., wire ends	1/9
Miniature wire ends moulded 100 pf., 500 pf., and .001 ea.	7d.

CONSTRUCTOR'S PARCEL, comprising chassis 12½ x 8 x 2in., cad. plated 18 gauge, v/h., 1F and trans. cut-outs, backplate, 2 supporting brackets, 3 waveband scale, new wavelength station names. Size of scale 11½ x 4¾in., drive spindle, drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs, and pair of 465 IFs, **16/6**. P. & P. 1/6.

AS ABOVE, but complete with 16+16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 m.a., 6 v. 3 amp. Pri. 200-250, and twin-gang, **31/6**. P. & P. 3 -.

Trimmers, 5-40 pf., 6d. ; 10-100, 10-250, 5-450 pf., 10d.

Germanium crystal diode, 1/6, post paid.

PATTERN GENERATOR 40-70 Mc/s. direct calibration, checks frame and line time base, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits, and vision channel band width. Silver plated coils, black crackle finished case, 10 x 6½ x 4¼in. and white front panel. A.C. mains 200/250 volts. This instrument will align any TV. receiver. Cash price, **£3.19.6** or **£1.9.0** deposit and 3 monthly payments of £1. Post and packing 4/- extra.

TV. CONVERTER for the new commercial stations, complete with 2 valves. Frequency :—can be set to any channel within the 186-196 Mc/s. band. I.F. :—will work into any existing TV. receiver, designed to work between 42-68 Mc/s. Sensitivity 10 Mu/v. with any normal TV. set. Input :—arranged for 300 ohm feeder. 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator, ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. amplifier, 10 db. Requires power supply of 200 v. D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only, **£2.10.0** Post and packing 2/6.

PERSONAL PORTABLE CABINET—in cream-coloured plastic, size 7 x 4½ x 3in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7½ v. batteries, **10 -**. P. & P. 2/-.

3in. P.M. SPEAKER to fit above, **10/-**. Miniature output transformer, **5 -**. Miniature wave-change switch, **2 -**. Miniature 1-pole 4-way used as Volume and Off, **2/-**. 4 B7G valveholders, **2 4**. Midget twin gang .1in. dia., .1in. long and pair medium and long-wave T.R.F. coils .1in. long x .1in. wide ; complete with 4-valve all-dry mains and battery circuit, **9 6**. Condenser Kit, comprising 11 miniature condensers, **3/6**. Resistor Kit, comprising 15 miniature resistors, **4/6**. 2in. x 25 mfd., **1/6**. P. & P. 2/6. Valves to suit above **10 -** ea. Point to Point Wiring Diagram **1 -**.

View of chassis as it would look when assembled with valves inserted.

Extension speaker cabinet, in contrasting walnut veneers, size 15 x 10½in. Will take 6½ or 8in. speaker, **17 6**. P. & P. 2/-.

Volume Controls. Long spindle less switch, 50 K., 500 K., 1 meg. **2/6** each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4** each ; 10 K. and 50 K., **3/6** each. ¼ and 1 meg., long spindle, double pole switch, miniature, **5/-**.

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

Valveholders. Paxolin octal, **4d.** Moulded octal, **7d.** EF50, **7d.** Moulded B7G, **7d.** Loctal amphenol, **7d.** Loctal pax., 4d. Mazda Amph., **7d.** Mazda pax., **4d.**, B8A, B9A amphenol, **7d.** B7G with screening can, **1/6**. Duodecal paxolin, **9d.**

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

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

P.M. SPEAKERS

	with trans.	less trans.
3½in.	...	13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-
10in.	...	19/6

Post and packing on each of the above, 1/6 extra.

RADIOGRAM CHASSIS.—5 valve A.C./D.C. 3-way band superhet, 195/255 volts 19-49, 200/550 and 1,000-2,000 metres, flywheel tuning frequency, 470 K/cs iron-cored coils and IFs. Size of chassis, 13 x 6½ x 2½. Complete with valves and 8in. P.W. speaker, p. & p., 5/-, **£8/17/6**.

Terms of business : Cash with order. Dispatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.