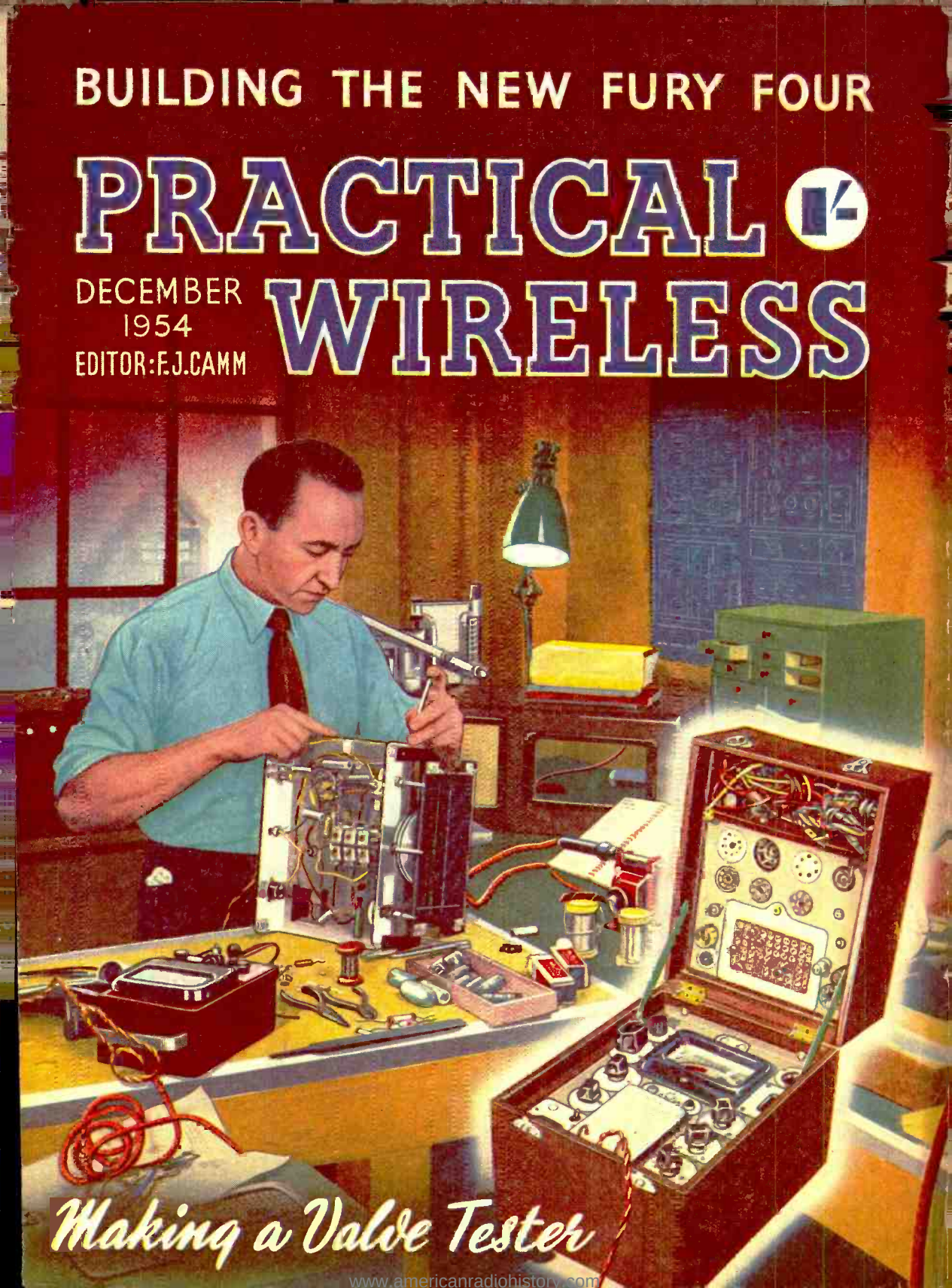
BUILDING THE NEW FURY FOUR

PRACTICAL WIRELESS

1/-

DECEMBER
1954
EDITOR: F.J.CAMM

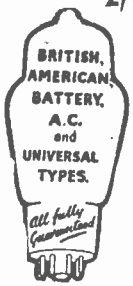


Making a Valve Tester

Great Britain's Valve Mail-Order House

One Year's Guarantee					
IR5	16/5	ECH25	20/2		
IS5	16/5	ECH42	20/2		
1T4	14/6	ECL80	23/4		
3S4	14/6	EF9	19/6		
3V4	14/6	EF37A	22/1		
01A	7/4	EF39	16/5		
1A4	13/3	EF40	22/1		
1B4	13/3	EF41	16/5		
1F4	10/2	EF50	22/1		
1E5G	12/-	EF80	22/1		
1F5G	11/4	EF91	22/1		
1J6G	12/-	12AT7	22/1		
5Y3GT	13/3	12AU7	22/1		
6A1	15/1	12AX7	22/1		
6AL5	11/4	12SAGT	20/2		
6AQ5	11/5	12SK7GT	16/5		
6AT6	15/1	12SQ7GT	15/1		
6AU6	22/1	25L6GT	16/5		
6BA6	16/5	35Z5GT	13/3		
6X4	13/3	50L6GT	16/5		
6J6	31/6	10	12/-		
GSA7GT	20/2	22	18 3		
6SK7GT	16/5	81	13 3		
6SQ7GT	15/1	71A	8/10		
6V6GT	16/5	112A	12/-		
	16 5	1A7GT	18/11		
7E7	14 6		11.4		
AZ1	13 3	1C3GT	14/6		
AZ31	13.3		15/1		
AZ50	16/5	1H5GT	14 6		
(DW4)	13/3	1N5GT	14 3		
CBL1	22/1		22 1		
CL4	20 2	3A4	18/11		
CY1	13 3		22 8		
EB41	11 4				
EB91	16/5				

SALE (2,000 101 TYPES) VALVES FROM 2/-



01A	2/-	13SPA	5/-		
1B4	3/-	71A	2/-		
1H6	3/-	220PT	4/-		
1LN5	7/-	ACHL-DDD	6/-		
2A6	2/-	DD207	4/-		
2A7	3/-	EF6	17/6		
2B7	2/-	HL1320	5/-		
4TPB	5/-	KTZ63	5/-		
6A7	11/-	MSP4	5/-		
6F7	6/-	MSP41	5/-		
6J7	5/-	MSPen	5/-		
6K25	9/-	MSPenB	7/-		
9D2	7/-				
12A	2/-		5/-		
12SF5	6/-	OM4	5/-		
P2	2/-		3/-		
P215	3/-		2/-		
PM24A	8/-		7/6		
35L6	8/-		4/-		
48	4/-		7/6		
50Y6	8/-	SP13	4/-		
954	2/-	SP42	5/-		
117Z6	7/-	T41	9/-		
4TSA	6/-	VP13C	7/-		
6F32	6/-	Post 9d.			

DEMOBBED Valves "Manual" 2/3

Giving equivalents of British and American Service and Cross Reference of Commercial Types with an Appendix of B.V.A. Equivalents and Comprehensive Price List. We have still some Valves left at very old Budget Rates (33⅓%) which are actually sold at the old price. (1951 rate).

PIFCO

All-in-one Radio - meter A.C./D.C. Tests everything in Radio. Complete with Test prods. **29/6.** Post 1/6.

TYANA TRIPLE THREE

Small Soldering Iron Latest development. Complete with detachable bench stand, **19/6.** Post 1/-.

Electric PAINT STRIPPER

Outdates blow-lamp. It's a unique fool-proof electric tool. Easier and Faster. Clean and safe. Old paint goes like magic. Cost ½d. per hour. A.C./D.C. Complete. Guaranteed.

Tax Free Post 1/3 **37/6** Usually 39/6

B.T.H. GERMANIUM CRYSTAL DIODE. Complete with and operating instructions. **2/-**

Q MAX

Chassis Cutters with Keys

The easiest and quickest way of cutting holes in sheet metal. The cutter consists of three parts: A die, a punch and an Allen screw. The operation is quite simple. Prices incl. key: ⅛in. **12/4**; ⅜in. **12/4**; ½in. **13/4**; ⅝in., ¾in., and 1in., **16/-** each; 1⅛in. and 1¼in., **18/-** each; 1½in., **19/9**; 2 3/32in., **31/9**; 2½in., **36/9**; 1in. square **24/3.** Post 1/-.

Deposit and Monthly 10/-

A.C. ELECTRIC

PAINT SPRAYER

Just plug in and spray. Easier than a brush and twice as fast. Post 2/-. Ceiling Adaptor Free. *Cash* 75/-

ROD Antennas. 1ft. sections interlocking and extending, copper plated steel. BARGAIN. dozen **2/6**

SERVICE SHEETS

The one you require enclosed if available in a dozen assorted of our best choice. **10/6.**

RADIO BULLS VALVES

246 HIGH ST HARLESDEN NW10

TUBES 20/-

VCR 97 NEW

EMISCOPE

Type 4/1

3" Electrostatic

20/-

12" Type 511

Electrostatic, same base as VCR 97

£4 - 10 - 0

TAYLOR METERS on EASY TERMS. Ask for Catalogue

12/6

"2000" AUTOMATIC BLOWLAMP

Burns methylated spirit. Completely Automatic. Absolutely safe. Suitable for all kinds of tinman's and silver soldering, glass bending, etc. 2,000 deg. Fahrenheit flame. Post 9d.

HENRY'S

(RADIO LTD.)

We have over 20,000 American and B.V.A. valves in stock

ALL VALVES NEW AND GUARANTEED

1A5GT	10/-	6AK5	9/-	35Z4GT	8/6	TDD2A	8/6
1A7GT	12 6	6J7G	6/6	35Z5GT	8/6	DK40	11/-
1N5GT	11/-	6K7G	6/6	25A6	8/6	UL41	11/-
1LD5	7/6	6K8G	9/-	35L6GT	8 6	UY41	11/-
1R5	7/6	6L6G	10/-	50L6GT	8 6	D41	5/-
1S4	7/6	6U5	7 6	42	8/6	KT2	5 -
1S5	7/6	6N7GT	7/6	43	8/6	U52	8 6
1T4	7/6	6Q7GT	8/6	75	8/6	U19	10 -
1C5	8/-	6SJ7GT	8/6	80	8/6	Y63	8/6
3A4	9/-	6X5G	8/6	866A	15 -	MU14	8/6
3V4	7/6	6SA7GT	8 6	TZ40	37/6	PL81	11 -
3S4	7/6	6SQ7GT	8/6	931A	50/-	PL82	10/-
5Z3G	8/6	6SG7	7/6	EA50	2/-	PX25	12/6
5U4G	8/6	6SK7GT	7/6	ECH35	12/-	PY81	10 -
5Z4G	8/6	6SL7GT	9/-	EF54	6/-	PY82	8/6
6A7G	8/6	6SN7GT	9/-	EB34	3/6	KT33C	10/-
6AC7	6/6	6SC7	10/-	EBC33	8/6	KT66	12 6
6A8G	8/6	6V6GT	7/6	EF36	6/6	GU50	12/6
6AM6	9/-	6AG7	12/6	EF39	6/6	XP2V	4/-
6B8	7/6	12K7GT	8/6	EY51	12/-	XH (1.5)	4/-
6C5GT	5/-	12K8GT	8/6	EK32	6/6	VU111	4/-
6C6	6/6	12Q7GT	8/6	EF91	9/-	VU133	4/-
6D6	6/6	12SA7GT	8/6	EL33	10/-	VU120A	4/-
6F6G	8/6	12SQ7GT	8/6	EL32	7/6	QP230	8/-
6G6G	6/6	12SJ7	8/6	EF50		VR105/30	8/6
6H6GT	5/-	12SK7	8/6	Red Syl.	10/-	VR150.30	8/6
6J5GT	5/-	12SR7	7/6	EF50	5/-	CK510AX	5/-
6J6	9/-	25Z6GT	8/6	SP2	8/6	DI	2/-
6L7	7.6	25Z5	8/6	VP2	8/6	AC6PEN	6/6

PCC84	12/6		
PCF82	12 6		
PEN25	6/6		
PEN46	7/6		
QP25	6/6		
SP61	4/-		
SP41	4/-		
HL23/DD	6/6		
VP23	6/6		
VP41	7/6		
U22	8/6		
ATP4	4/-		
TP22	8/6		
TH233	10/-		
41MP	7/6		
42SPT	6/-		
215SG	4/-		
MS/PEN	7/6		
MS/PENB	7/6		
VT501	7/6		
AC/PEN(7)	8/6		
	10/-		
PENDD4020	12/6		
FC13C	10/-		
VP4(7)	8/6		
ID5	8/6		
EF80	10 6		
ECL80	10 6		

SETS OF VALVES

Ten EF50 (Ex-Brand New Units). 5/- each ... ...45/- Set

6K8G, 6K7G, 6Q7G, 5Z4G, 6V6G ...37/6 ..

1R5, 1S5, 1T4, 1S4, or (3S4 or 3V4) ...27/6 ..

TP25, HL23/DD, VP23, PEN25 (or QP25) ... ...25/- ..

6K8G, 6K7G, 6Q7G, 25A6G, 25Z5 or 25Z6G ... ...37/6 ..

12K8GT, 12K7GT, 12Q7GT, 35Z4GT, 35L6GT or 50L6GT 37/6 ..

12A7GT, 12SK7GT, 12SQ7GT, 35Z4GT 35L6GT or 50L6GT 37/6 ..

CRYSTAL MICROPHONE INSERTS

8/6 POST FREE

8/6 POST FREE

Ideal for tape recording and amplifiers. No matching transformer required.

Brand New R.F. UNITS

RF24 20-30 mc/s **15/-** post free

RF25 40-50 mc/s **19/6** post free

RF26 50-65 mc/s **35/-** post free

MORSE PRACTICE BUZZER

Complete with tapper and 4 volt buzzer on baseboard, **6/-**, brand new. Post paid.

R.F. OSCILLATOR COIL UNIT

6-18 kV., including EY51 valve, **37/-.**

CRYSTALS

200 kc's, 2-pin (U.S.A.) ... **10/-**

465 kc.s, 2-pin (U.S.A.) ... **10/-**

500 kc's, 2-pin (British) ... **15/-**

T.C.C. .1 5/7,000 v. wkg. Type CP58Q0. Bakelite Case, **7/6** each.

INDICATOR UNIT TYPE 182A

This unit contains VCR517 Cathode Ray 6in. tube, complete with Mu-metal screen, 3 EF50, 4 SP61 and 1 5U4G valves, W/W volume controls, resistors and condensers. Suitable either for basis of T/V or Oscilloscope. "Radio Constructor" "Scope constructional circuit included. **67/6** (plus 7/6 carr.).

Kit of necessary parts, including "182A" Unit, for constructing "Radio Constructor" Oscilloscope, **£8/18/6.**

CATHODE RAY TUBES

(Brand New)

VCR97 (slight cut-off ... **15/-**

VCR97, guaranteed full T/V Picture ... **40/-**

VCR517C, guaranteed full T/V Picture ... **35/-**

VCR139A, guaranteed full T/V Picture ... **35/-**

3BP1, guaranteed full T/V Picture ... **30/-**

Carr. & packing on all tubes, **2/-.**

DENCO F.M. FEEDER UNIT

Finest Audio available. Complete kit of parts, including drilled chassis. 5 valves: types 6AM6, 12AH8, EB91 and 2 6AB6. Also complete circuit and wiring diagram. **£6/7/6.** Or assembled and aligned, **£8/10/-.** Alignment only, **7/6.** Demonstration daily.

23-page Catalogue, 3d. Open Mon.-Sat. 9—5. Thurs. 1 p.m.

5 HARROW ROAD, PADDINGTON, LONDON, W.2 **TEL: PADDINGTON 1008/9. 0401.**

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXX, No. 578, DECEMBER, 1954

EDITOR : F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH

BY THE EDITOR

The New "Fury Four"

THIS issue contains preliminary details of the New Fury Four, exhibited for the first time at this year's Radio Show. It attracted a great deal of interest, especially among those who built the original Fury Four in the early 30's. It will, no doubt, be built in large numbers and we propose, as with the original receiver, to produce alternative versions of it. Full-sized blueprints will be available in due course.

A COMPREHENSIVE VALVE TESTER

IN response to requests received over the past two years we this month commence publication of constructional details of a comprehensive valve tester. This instrument although it may be built by amateurs is a professional job, and it will accurately test all of the functions of the valve such as emission, mutual conductance, etc., measurements which are necessary, not only in connection with service work, but in checking up after a receiver has been built.

The Editor and Staff Join in Wishing Every Reader a Very Happy Xmas

LICENCE EVASION

IT is often suggested that to prevent wireless licence evasion, people should obtain their licence through the retailer, or at least show him a licence as a preliminary to purchase. This could apply to both sound and TV licences. The Post Office has carefully examined this suggestion, but in making regulations they can only use the powers at present vested in them under the Wireless Telegraphy Act, which makes it an offence to install or use wireless apparatus without a licence. It does not make it an offence to buy or own apparatus without a licence. The Post Office there has no right whatever to demand that a person shall have a licence before he buys a set, unless he actually installs or uses a set which he has bought. Anyone can buy a motor car, but he may not use it without a Road Fund Licence, and he cannot obtain that without a certificate of insurance and a driving licence.

If the law were to be altered so that the P.O. could compel a person to have a licence before he could purchase a set, there still remains the fact that one licence covers more than one person, and it would be wrong for each man, woman and child in a family to be compelled to possess a personal licence of his own. If that were not done, a great number of people would still be entitled to listen to the wireless and watch TV without having a licence in their own name. If those people were made to show a licence before they bought a set, they would be forced to show somebody else's and this would mean that radio dealers would be given quite intolerable powers of inquiry into people's private affairs. The public at present are complaining of the incursions which are continually made into the liberty of the subject.

Wireless dealers present another problem. The P.O. has no power whatever to make wireless dealers sell licences or inspect licences. Whilst many of them would co-operate, many would not. Controversial legislation would be necessary to bring wireless dealers into the scheme which would need another band of inspectors to keep the dealers up to scratch. The P.O. has reached the opinion that there seems to be no means of providing by legislation for a direct tie-up. It would impose a great burden on the vast majority of the listening and viewing public in order to bring a comparatively few people to book. No doubt the detector cars are helping to eliminate the problem.

CAUSES OF ELECTRICAL ACCIDENTS

THE Annual Report of the Factory Department of the Ministry of Labour on Electrical Accidents and their Causes points out that portable electrical apparatus at mains voltage has again been responsible for a high proportion of fatal and serious electrical accidents. The socket outlet, the plug, the flexible cable, the connections and terminal arrangements within the portable apparatus and, last but not least, the earth continuity system and the earthing arrangement in the fixed installation to which the portable appliance is connected, each takes its toll.—F. J. C.

Round the World of Wireless

By "QUESTOR"

B.I.R.E.

THE following meetings of the above institution will be held during November :

Scottish Section.—Thursday, November 11th, 7 p.m., at the Department of Natural Philosophy, The University, Edinburgh. "Nuclear Fission and Nuclear Fusion" —Prof. N. Feather, F.R.S.

North-western Section.—Tuesday, November 30th, 7 p.m., at Reynolds Hall, College of Technology, Sackville Street, Manchester. "Electronics and the Wind Tunnel" —G. J. Scoles, B.Sc.(Eng.), (Associate Member).

North-eastern Section.—Wednesday, November 10th, 6 p.m., at Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Stereophonic Sound"—R. A. Bull, B.Sc.(Eng.).

South Wales Section.—Wednesday, November 17th, 6.30 p.m., at Cardiff College of Technology, Cathays Park, Cardiff. "The Techniques of Power Measurements from D.C. to 5 Mc/s"—G. F. Lawrence.

London Section.—Wednesday, November 24th, 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1. "The Development and Design of Direct-coupled Oscilloscopes for Industry and Research"—M. J. Goddard.

Transatlantic Calls in 1957

WORK has commenced on a new cable which will link this country with America, supplementing radio telephonic communication and enabling telephone subscribers in Britain and the U.S.A. to talk to each other as easily as on a local call.

The cable is expected to be ready for use by the end of 1957.

Miss Tessa Fenton, B.Sc., adjusts the amplifiers on the stereophonic sound system, which has been installed at a Kennington cinema.

Radio Hire

MANY of Britain's radio sets are earning dollars and other hard currencies without leaving the British Isles. The 500-vehicle London car-hire specialists, Victor Britain, Ltd., are hiring out Pye attache-case battery portables at a charge of five shillings a day.

The demonstration caused by hiring often results in the sale of a radio or car by British or overseas stores and motor agents.

Stereophonic Sound Adviser

MISS TESSA FENTON, B.Sc., aged 21, of Claygate, Surrey, has been appointed by Mr. S. L. Bernstein, chairman of Granada Theatres, Ltd., to explain to his patrons how the new stereophonic sound system works in his cinemas. The new sound device employs four magnetic sound tracks and 24 loud-speakers which enable the sound in a film to be heard from the part of the wide screen where the action is taking place. Miss Fenton can also answer questions put to her by interested cinema patrons on the new development.

Overseas Airlines Order British Radio

FURTHER evidence that British radio equipment is highly respected throughout the world is reflected in current orders received by Marconi's Wireless Telegraph Co., Ltd.'s Aeronautical Division. They include orders from the U.S.A., India, South Africa and France. More than 40 airlines and over 20 Air Forces now use Marconi acronautical equipment.

Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences issued during the year ended August, 1954. The grand total of sound and television licences was 13,421,629.

Region	Number
London Postal ...	1,538,506
Home Counties ...	1,419,560
Midland	1,218,108
North Eastern ...	1,604,442
North-western... ...	1,239,025
South-western ...	992,623
Wales and Border Counties	620,848
Total England and Wales	8,633,112
Scotland	1,035,209
Northern Ireland ...	219,610
Grand Total	9,887,931

New Branch Office

THE Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, announce the opening of a new branch office and depot at 2, St. Nicholas Buildings, Newcastle-on-Tyne, 1, under the management of Mr. R. Fenwick. Stocks are carried of P.V.C. wiring cables and flexibles, radio frequency and broadcast relay types of cables. The branch also handles enquiries for other Telcon products, in-

cluding paper-insulated mains cables, having copper or aluminium conductors and with either lead or aluminium sheathing, and products of Telcon's Plastics Division.

Mr. L. A. Sawtell

LEONARD A. SAWTELL recently celebrated his twenty-fifth anniversary with Mullard Ltd., after more than 30 years in the radio industry.

Mr. S. S. Eriks, managing director of Mullard Ltd., presented Mr. Sawtell with a gold watch and a cheque on behalf of the board of directors and, with other Mullard directors and executives, entertained Mr. and Mrs. Sawtell to lunch. Mr. Sawtell is a Companion of the British Institution of Radio Engineers and a committee member of the Radio Industries Club.

"Ted Ray Time"

THE new Ted Ray show, which began in the Home Service on October 25, introduces some new names in sound variety as well as more established favourites. Harold Berens and the multi-voiced Kenneth Connor need no introduction to listeners, but for Audrey Jeans and Don Peters, who have made an impression in other fields of entertainment, it is the first major sound series.

Each week, Ted Ray will have a star guest. Production, as in the last series, is by George Inns.

Increased Sales in West

AT the official "switch ing-on" of a new major electricity supply point at Woodcote, near Axminster, recently, Mr. S. F. Steward, chairman of the South Western Electricity Board, said "After years of austerity and restrictions, there is an unprecedented boom in the sales of electricity and labour-saving electric appliances in the West Country."

So far this year, he stated, sales were over 20 per cent. higher than the record set up last year and there appeared to be no letting up in the demand.

Premium Awards

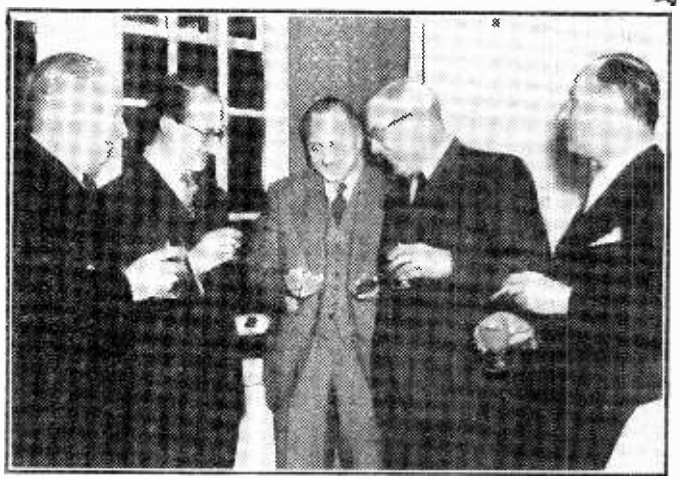
THE Council of the British Institution of Radio Engineers has announced the recipients of Institution Premiums for papers published during 1953.

The premier award, *The Clerk Maxwell Premium*, was presented to three joint authors: W. Saraga, Dr. Phil., D. T. Hadley and F. Moss, B.Sc. for their paper "An Aerial Analogue Computer," published in the journal for April, 1953. The awards were presented by the president at the annual general meeting of the Institution in London on October 27.

Derby Show Success

THE Derby Radio Show, organised by the Derby Centre of Radio and Television Retailers, again proved a great attraction and attendances were higher than last year.

Traders with stands at the show reported good business and it is estimated that orders taken were three or four times as large as they would have been in the normal course of trade in the shops.

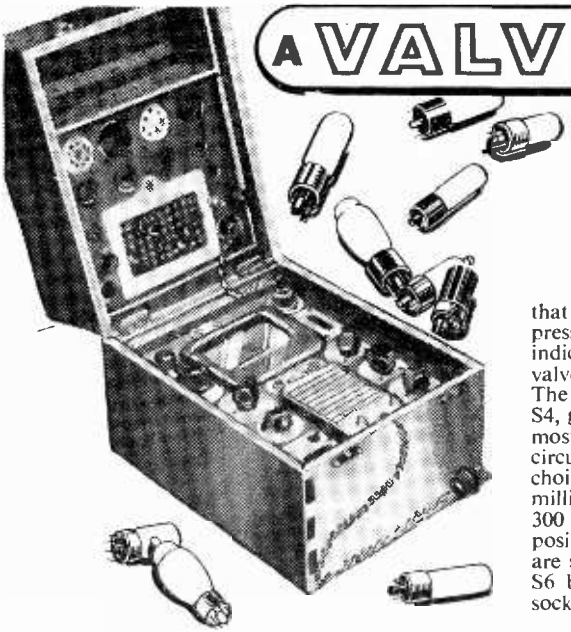


Mr. L. A. Sawtell shows some of his colleagues the gold watch presented to him by Mullard, Limited.

Radio Journalism

WHEN the recent newspaper strike began, BBC officials immediately drew up plans whereby leader writers for the different national dailies would be given the opportunity to broadcast their comments over the air, presenting listeners with the political opinions that would have been published normally in the newspapers.

A VALVE TESTER



A COMPREHENSIVE TEST UNIT WHICH MAY BE USED ALONE OR IN CONJUNCTION WITH AN OSCILLOSCOPE

By R. Wilkinson

THE tester has been designed for simple operation, providing a very useful portable instrument. For simplicity A.C. volts are used for the main supplies, and on all tests the meter indicates the average of the current pulses resulting from the self-rectification of the valve under test.

The tester is in two sections, closing together for portability. Circuit connections are made to the valve being tested on the pin-connection panel. This panel, the valve bases, and neon shorts test circuit are fitted in the lid section, connections being made to the other section by an 8-way cord and octal plugs and sockets. Anode and screen supplies from 0 to 250 volts A.C. are in steps of 50 volts, and are supplied from a common winding on the mains transformer. The grid supply is obtained from a 15-volt winding which, after rectification, gives a voltage drop across VR2 of approximately 12 volts; this potentiometer is calibrated in one volt steps for the grid supply. Adjustment of VR1 is made so that when "mutual conductance" switch S7 is pressed, a grid "shift" of one volt occurs, and an indication related to the mutual conductance of the valve is obtained by the change in anode current. The filament supply is obtained from a 12-way switch S4, giving a choice of 2 to 50 volts, which covers the most common values in this range. The meter circuit is associated with a range switch S5, giving a choice of milliamps, volts and ohms ranges as follows: milliamps: 1.5, 3, 6, 9, 15 and 30; volts: 150, 300 and 600; ohms: 0 to 50 kΩ, with two spare positions. Anode, screen, grid and cathode circuits are switched according to the test selected by switch S6 before being connected through to the linking sockets.

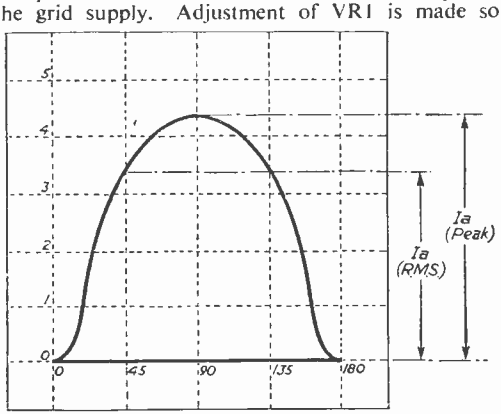


Fig. 3.—The chart for fitting to the 'scope

Uses

In position 1 of S6, the meter is connected for use as a simple multimeter, and test leads for external use are connected to the appropriate sockets. Position 2, diode test; position 3, rectifier test;

COMPONENT LIST

M. Meter. 1.5 mA F.S.D.
T.1. Mains transformer (see text).
F.1. 1 amp. fuse.
L.1. Post Office type lampholder. Wedge type pilot bulb. 12 volt.
M.R.1. Bridge rectifier (see text).
N.1. Neon, type "G" Osram.
Switches:—
S1-S2. Single pole 6-way.
S3. D.P.D.T. 250 volt, 1 amp.
S4-S5. Single-pole 12 way.
S6. 7 pole 5-way.
S7-8-9. Plunger key switches—spring return.
Condensers:—
C1. 25 μF. 25 volt working. Wire ended.
C2. 1 μF. Mansbridge type.
C3. .001 μF. Moulded mica.
Resistors:—
R1. 1 megohm.
R2. 15 KΩ.
R3. 200 ohm. } 1 watt.
R4. 7 KΩ.
R5. 140 ohm.
R6. 350 ohm. 1 watt (approx.)
R7. 50 ohm.
R8. 1 MΩ.
R9. 950 ohm.
R10. 10 ohm. } Stoppers.
R11. 100 ohm.
R12. 10 KΩ
R13. 5.7 MΩ.
R14. 2 MΩ.
R15. 400 KΩ. (1 watt)
R16. 200 KΩ.
R17. 100 KΩ
(All $\frac{1}{2}$ watt, except where stated.)
Potentiometers:—
VR1. 200 ohm. wirewound.
VR2. 2,000 ohm. wirewound.
VR3. 100 ohm. wirewound.
Miscellaneous:—
Plugs and sockets, 2 terminals, neon holder, 2 octal plugs and sockets, miscellaneous valve sockets as required. Hinges, clips and handle.

position 4, cathode leakage test (for indirectly-heated valves only); position 5, valve tests (other than diodes and rectifiers) in which tests are applied for "gas" and "mutual conductance" Facilities are included for the connection of an oscilloscope, for further and more exacting tests. On all tests, filament volts are set and connections made on the pin-connecting panel, as required for the valve under test. For double and triple valves, each section is tested separately; the unused sections being connected to the cathode circuit. Anode, screen and grid volt settings are only required in the "valve test" position of S6.

Test details are as follows :—

Diodes : The meter, connected in the cathode circuit of the valve, has a full scale deflection of 1.5 mA. The diode rectified current for an applied 50 volts A.C. is limited to 1 mA. for good valves by load resistors R2 and R4.

Rectifiers : The meter is again in the cathode circuit, but shunt R6 is across meter and R4 in series, giving a full-scale deflection of approximately 30 mA. Valve emission is limited to approximately 25 mA. by the values of R3, 4 and 6 for a good valve. On rectifier tests, one side of the filament is connected to the cathode so that direct and indirectly-heated valves may be tested without extra switching.

Cathode leakage : anode, screen and grid circuits are strapped together in this switch position. A 50-volt A.C. supply is connected via the meter in series with R5 to one side of the filament of the valve under test; the other side of the supply goes to the anode. C3 is connected between the filament connection and the cathode and completes the circuit. The valve rectified current is limited by the high impedance of C3, and limited to approximately 1.35 mA. by R2 and R5 when C3 is short-circuited. Any leakage across C3 is indicated on the meter, and can be calibrated by substituting various values of resistance across C3, and marking the scale accordingly. Use any good amplifier valve to supply the rectified current.

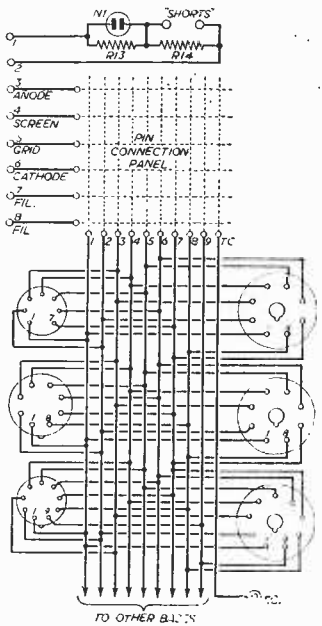


Fig. 2.—Wiring to the valveholders.

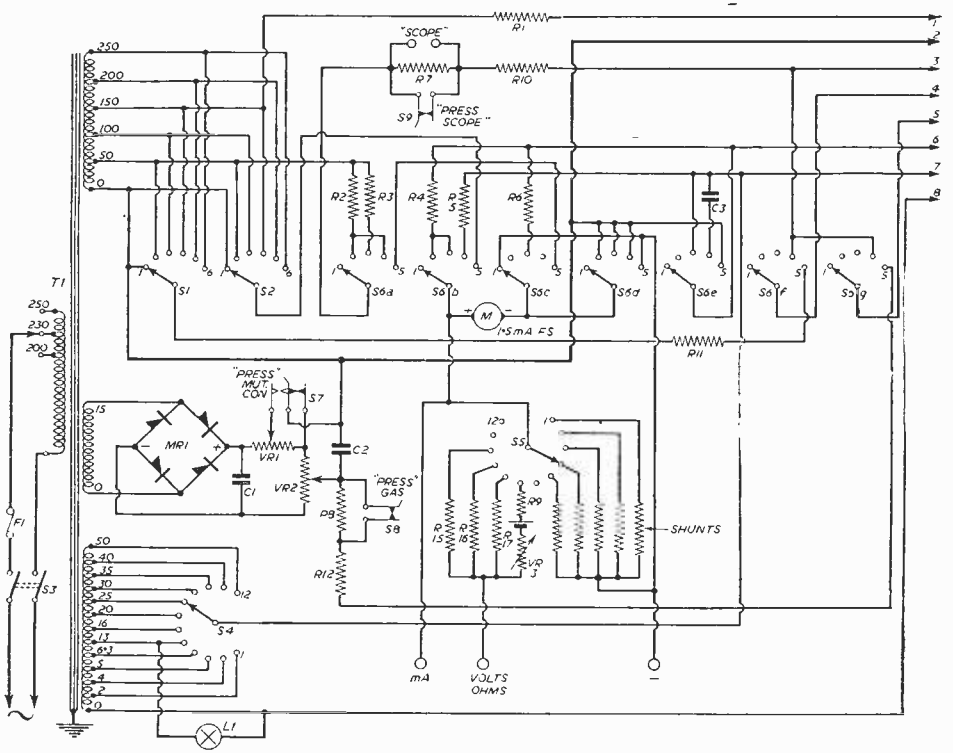


Fig. 1.—Theoretical circuit of the main part of the tester.

Valve Tests : All settings are made so that the valve has the correct voltages applied to all electrodes. The meter is connected in the anode circuit and range switch S5 is operative, allowing the milliamps range to be set to cover the anode current for the type of valve being tested.

When switching on, the anode current rises and the meter indicates the average current flowing. Usual tests for softness are included, " gas " switch S8 being pressed to insert a 1 MΩ resistance in the grid circuit. Indication of a soft valve is given by excessive rise in anode current on this test. On pressing " mut.-con." switch S7, the resulting drop in anode current is related to the mutual conductance of the valve for the applied volts, giving a useful indication of the " goodness " of the valve.

Working Voltages

For general tests of valves other than diodes and rectifiers, it must be borne in mind that the meter reading is only the average of the anode current pulses, and a reading should be obtained in the region of half the normal current that would be expected for D.C. working applied volts to the electrodes. When determining the electrode voltages to be applied to compile data, attempts should be made to obtain readings of anode current such that the meter reads 2/3 full-scale deflection for a good valve. The " good," " query," " bad " section of the scale is then operative. The limits of the " query " range representing drops in anode current of approximately 10 to 35 per cent. This can be arranged by choosing normal working anode and screen volts, and reducing the grid volts until a convenient reading is obtained. Lower anode and screen volts can be used if the grid volts have to be reduced too low below the normal working value to get this reading. It is advisable to test power valves at anode and screen settings of about 100 volts in order to keep the anode current low enough for the meter ranges provided.

The values of average anode current and " mut.—con." are tabulated on a data chart, which includes pin-connections and voltage settings for the valve types. These are used as a standard of comparison for future valve tests. (Good valves are necessary when compiling data.) The " scope " sockets are connected across a resistance R7 in the anode circuit which is brought into circuit when the " scope " switch S9 is pressed, on any valve test position.

Using a 'Scope

With an oscilloscope connected, the shape of the anode current pulses can be observed, and with the use of a graduated scale, accurate measurements can be made of the anode current and mutual conductance. With a timebase of 100 c.p.s. the pulse shape is shown the full width of the timebase sweep, whilst the non-conducting half cycle provides a base-line trace. Fig. 3 shows the scale for fitting to the oscilloscope screen, the anode current for the applied R.M.S. voltages being measured vertically on the 45 and 135 deg. lines. This application is also useful

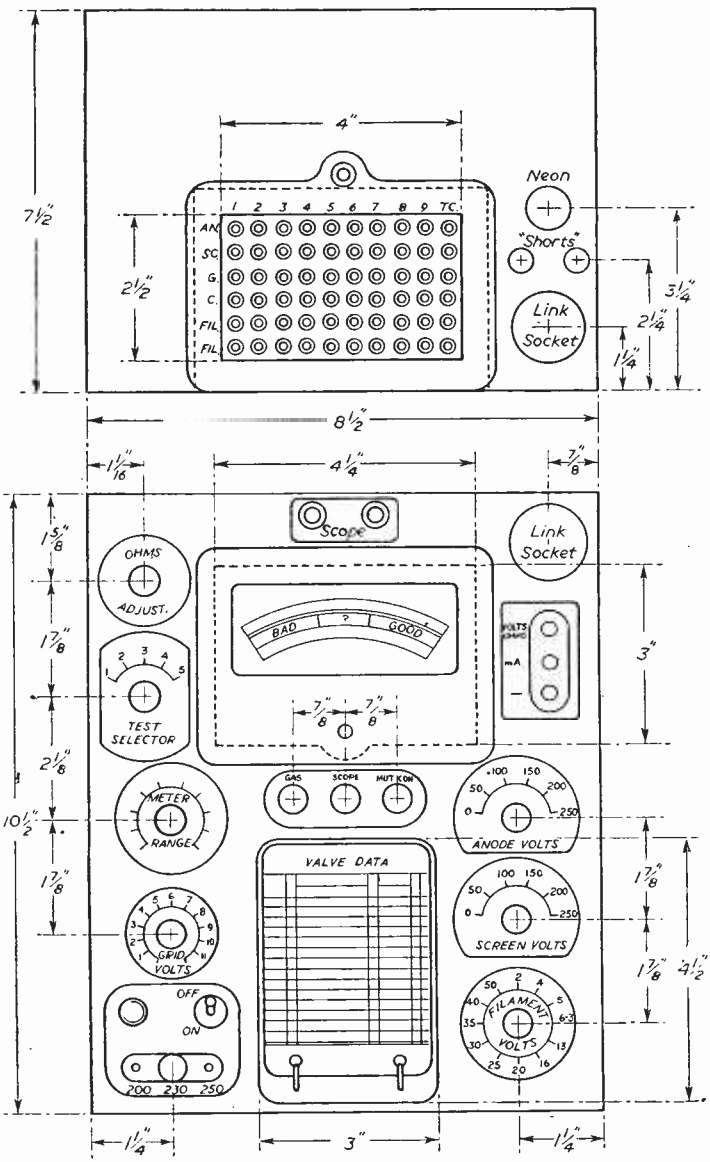


Fig. 4.—Details of the panel layout. *See the illustration on page 714.*

as an indication of any noise generated in the valve. Directly-heated valves must have one side of the filament connected to the cathode circuit on the pin-connecting panel, as no provision is made for this connection on S6, except for rectifiers. Testing of suspect valves must be proceeded by a "shorts" test. Leads are connected to the "shorts" terminals and a search made for electrode shorts on the valve base. This neon circuit is arranged so that a low test voltage is applied and there is no danger of false indicated shorts due to fine wire grids being pulled together.

Any leakage across the test leads results in the few extra volts required being supplied to strike the neon.

Constructional Details

The main items required are: 1, Meter. 2, Mains Transformer. 3, Pin-connecting Panel. 4, Rectifier. 5, Switches.

1. Meter. The choice was an ex-Government Western Electrical thermometer marked "air temperature indicator—model 606." This meter encloses a basic 1 mA movement and it is not difficult to fit a new scale, longer pointer, and to zero the pointer to the left-hand end of the scale. The new pointer is a sliver cut from the edge of 18 s.w.g. "hard" aluminium, beaten out and polished with emery paper until a thin section is obtained. The pointer is then cut to shape, and should be 2¼in. long, and 1/16in. wide, tapering towards the tip, spade-shaped at the other end, which is formed to a tube to slide over the pointer stub. A 90 deg. twist is inserted in the pointer ¼in. from the tube formed. This forms the pointer into a knife edge over the scales. Check the balance before fixing the pointer. The scale can be made in any of several ways, which have been fully covered in previous PRACTICAL WIRELESS articles, after marking it should be fitted to the movement.

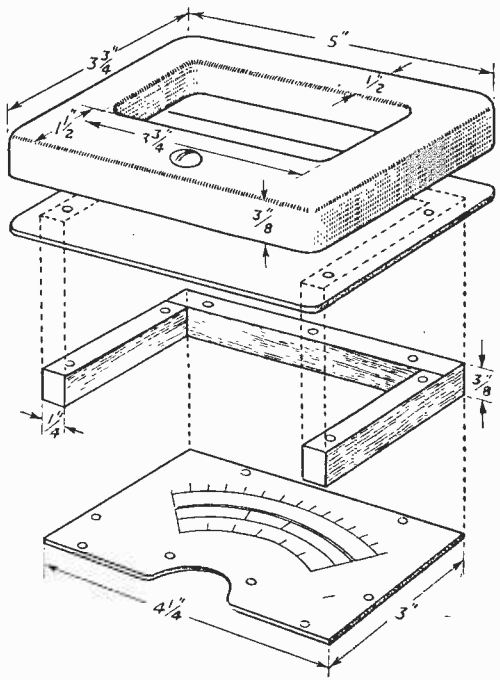


Fig. 5.—Details of the dial mounting.

Hair springs at each end of the movement balance one another in the zero position, and in shifting the zero to the left-hand end of the scale, both spring anchors must be moved through the same distance in the same direction. This ensures that the torque required to move the pointer off zero remains the same for the new position. Check the balance by tilting the movement from the horizontal to the vertical position, changes in position of the pointer indicating off balance.

Pieces of fuse wire can be wrapped round the balance arms until balance is achieved. Almost certainly after modification, the meter will require more than 1 mA for full-scale deflection, and it will be necessary to shunt the meter with a suitable resistance to give a full-scale deflection of 1.5 mA, this value being the basis on which the scale is designed. The dial is made of hardwood and a Perspex window is fitted, to the dimensions shown, to which movement and scale are fixed.

(To be continued)

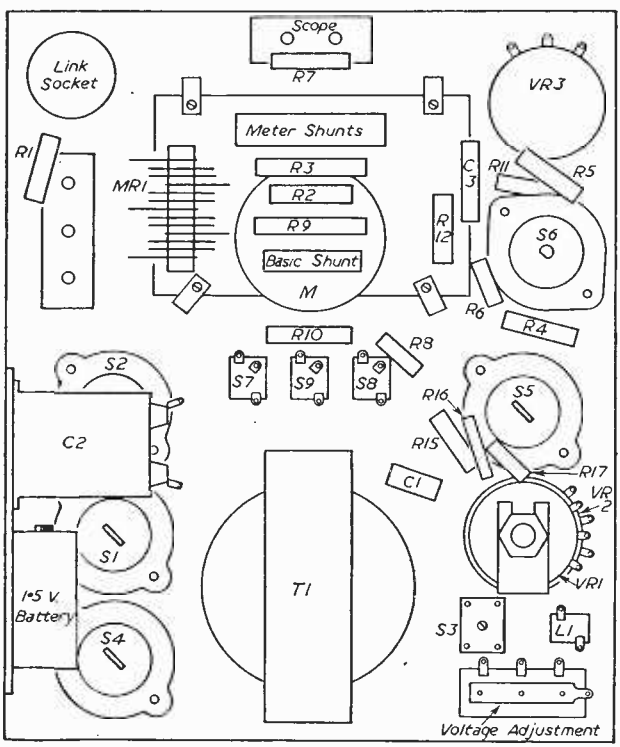


Fig. 6.—General view of the layout of main components.

DETAILS OF A USEFUL TYPE OF AID FOR THE EXPERIMENTER OR SERVICEMAN

By W. N. Stevens (G3AKA)

IT often happens that a certain component (or combination of components) in a receiver or other piece of equipment being constructed or serviced needs checking to ascertain if it is in good order. Also, and especially in experimental hook-ups, various components may be critical as to value, so that trial and error procedure is adopted until the best all-round practical values have been found. The components concerned are, of course, largely resistors and capacitors.

The experimenter also finds that certain resistance/capacitance combinations can be critical. A combined substitution box, enabling selection of both comparative resistance and capacitance values, is invaluable

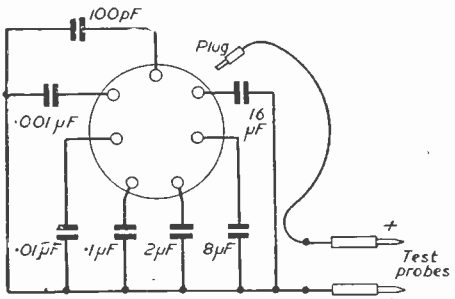
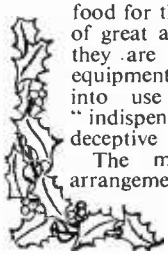


Fig. 1.—The simplest form of capacitor substitution panel.

in such circumstances and can greatly speed up the preliminary tests—a flick of a switch or the insertion of a plug into a socket is much quicker than tedious soldering and unsoldering of the affected component(s).

Although these notes are written primarily for the guidance of newcomers, the experienced constructor who has never used a substitution box may find them food for thought. Such a simple unit can be of great advantage on the test bench. True, they are about as simple as any piece of equipment can be, yet once built up and put into use they will become one of the "indispensables." Their very simplicity is deceptive and disguises their true usefulness.



The most flexible and easy-to-handle arrangements naturally obtained by building up the selection box around a multi-contact rotary switch, but a very simple idea is shown in Fig. 1. This is, in fact, a capacitor substitution circuit using a British seven-pin valveholder as the "selection panel," with a different value capacitor wired from each pin to a common return line. One test probe is connected to this common return point and the other to a second terminal—the latter also being connected to a short length of flex terminating in a banana plug which is used as the selection plug. To select any of the values provided, the banana plug is inserted into the appropriate valveholder socket. Note that if a metal box is used to house the circuit, the positive test prod terminal must be insulated from the chassis. It is advisable to use the type of valveholder suggested in view of the larger diameter socket holes—octal valve pins are much smaller and some difficulty may be experienced in obtaining suitable plugs to fit the socket holes.

The values shown are merely suggestions; any other combination could be used to suit individual preference. Resistors could also be used if required or a combination type, using two valveholders—one for resistors and one for capacitors—could be easily constructed.

Switching

A quick-selection substitution box can be built up round a multi-way switch, the only difference being that the switch replaces the plug and socket arrangement (Fig. 2). Two advantages are that selection is easier and quicker and that a greater variety of values are possible in a given space. Assuming the use of a twelve-way rotary switch, the values given in the diagram are probably the most useful for general

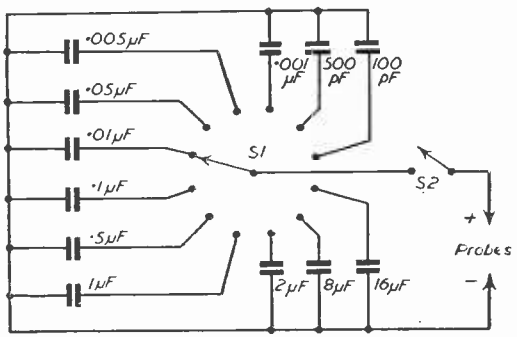


Fig. 2.—A switched version of a capacitor selector.

purposes. The number can be reduced or increased, or the values changed, according to individual taste and requirements.

A similar arrangement for resistors can be used, but here it will be found that for maximum versatility and usefulness a greater range of selection values will be needed. In this case two separate switching units can be used—one for high values, one for low values. The circuit of Fig. 3 shows how this can be arranged ; suitable values are given. This arrangement has the added advantage that by using separate units in conjunction with each other intermediate values can be obtained. Using a shorting link, terminals 1 and 4 are joined together and terminals 2 and 3 become the test connections. By so doing it is possible to place any two resistors (providing they are in separate boxes) in series, thus obtaining extra values not initially provided for.

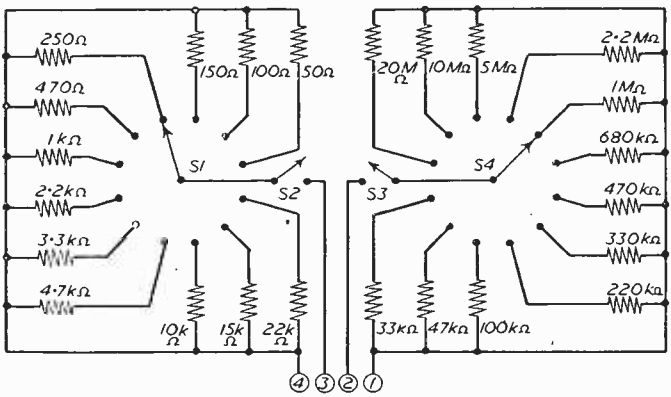


Fig. 3.—Low and high values are selected in this arrangement.

The resistance substitution box is amenable to a number of variations, despite its simplicity. For instance, if the unit is to be used for the calibration of test equipment, precision resistors could be used. For general-purpose testing, however, ± 10 per cent. tolerance components are suitable. Generally speaking, one-watt resistors should be used up to values of around 100,000 ohms, thereafter half-watt ratings (or quarter-watt for the megohm values) are usually safe.

Combined Components

For a really "self-sufficient" test box, both capacitance and resistance units can be incorporated in one box. It is not intended to discuss the actual housing arrangements since readers will have their own ideas on the subject. One suggestion, however, is to use a small inverted metal chassis with a wooden or ebonite control panel. The switches can be fitted with a simple indicating "dial" marked with the appropriate values. A carrying handle made from webbing or a simple strap will add a nice touch to the finished job if the unit assumes more than vest-pocket proportions.

A variation on the theme is the decade box which, as the name implies, provides a selection of values (of resistance usually) in steps of 10 ohms. For this it is usual to use three rotary switches and a collection of resistors as shown in Fig. 4. Although generally used for calibrating test equipment and other precision purposes, it can be used much in the same way as the substitution boxes already described. If accuracy is the aim, the S1 can comprise the "tens" (that is, each resistor is 10 ohms), S2 the hundreds (each resistor 100 ohms), and S3 the thousands. Thus, by suitable adjustment of the three switches any value from 10 to 11,100 ohms (to the nearest 10 ohms) can be selected. Although commercial precision resistors with a tolerance of ± 0.01 per cent. can be used, this is an expensive way of doing things, and most readers would make up their own resistors using Eureka wire and observing the usual precautions against inductive effects and so forth.

For more general application, as with ordinary substitution boxes, standard resistors can be used. One suggestion is that one bank can be used for 100's, one for 1,000's and the third for 10,000's. This would give a range of values from 100 to 111,000 ohms (to the nearest 100 ohms). A fourth switch could be added to increase the overall range of the unit to beyond a megohm. Note that although 10 resistors are used in each section, 11 contacts are required—thus a 12-way switch is generally necessary.

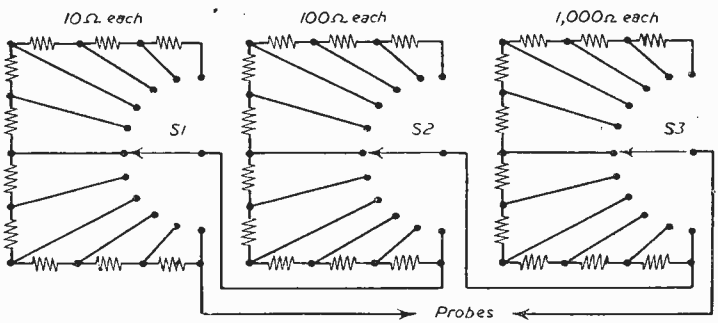


Fig. 4.—A decade selector box.

P.O. Board

Another way of laying on specific values of resistance is the Post Office resistance board. This has the virtue that only a small number of resistors are needed and in the example shown in Fig. 5 that number is only four. The resistors are mounted on a flat board with the five terminal points provided in addition to a jumper or shorting link. The whole thing is done on the plug-and-socket principle.

To use the board one refers to

a table which depends on the basic resistance values fitted. To take an example from the table shown below: a resistance of 600 ohms is needed. Simply take the test connections to terminals 2 and 4. Again, if a value of 250 ohms is wanted, the nearest on the list is 242 ohms, and to obtain this one test prod is connected (or plugged into) terminal 2 and the other to terminals 3 and 4 (these two having been joined together). In all cases, one test lead is taken to the first terminal given; the second test lead is taken to

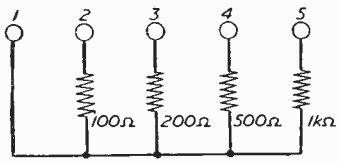


Fig. 5.—The arrangement used in the P.O. box.

Ohms	Test probes to	Ohms	Test probes to	Ohms	Test probes to
55	1 2345	242	2 34	591	4 25
58	1 234	266	2 35	600	2 4
62	1 235	277	3 245	666	4 35
66	1 23	283	3 24	700	3 4
77	1 245	291	3 25	1000	2 5
83	1 24	300	3 2	1058	5 234
91	1 25	333	1 45	1066	5 23
100	1 2	433	2 45	1083	5 24
125	1 345	500	1 4	1100	2 5
142	1 34	533	3 45	1142	5 34
166	1 35	562	4 235	1200	5 3
200	1 3	566	4 23	1500	5 4
225	2 345				

a more representative selection from which to choose. A few simple calculations will enable all manner of variations to this scheme to be worked out. A reference chart (similar to that shown with Fig. 5), could be pasted on the actual board for quick reference.

Combined Panel

Going back to substitution boxes, a brief description of a combined resistance/capacitance panel made up by the writer years ago may be of interest. The circuit is given in Fig. 6 and it is so simple that it is a good proposition for beginners. There are 15 resistors and 15 capacitors arranged in much the same way as previously described but with a few extra "spare" terminals. These are very handy because they can be used to provide any arrangement of parallel capacitance, parallel resistance, or a combined parallel R/C combinations. Also, of course, it will be obvious than any series R/C combination can be used.

This type of substitution box or panel proves that although switched units are probably more convenient in use they have certain limitations. For instance, to select any one capacitor (or resistor), the test probes are connected to the "common" socket and to the appropriate socket of the required value. Combined parallel sets of capacitors can be obtained simply by plugging in shorting jumpers where required (i.e., to get 175 pF, join up the 100, 50 and 25 pF outputs). Again, any series pair can be obtained by inserting the test prods into the free ends of the required pair. The fact that series or parallel resistance/capacitance combinations can be obtained on tap will be of great help to those experimenting with filters and similar work.

A very useful test box can be built up in the form

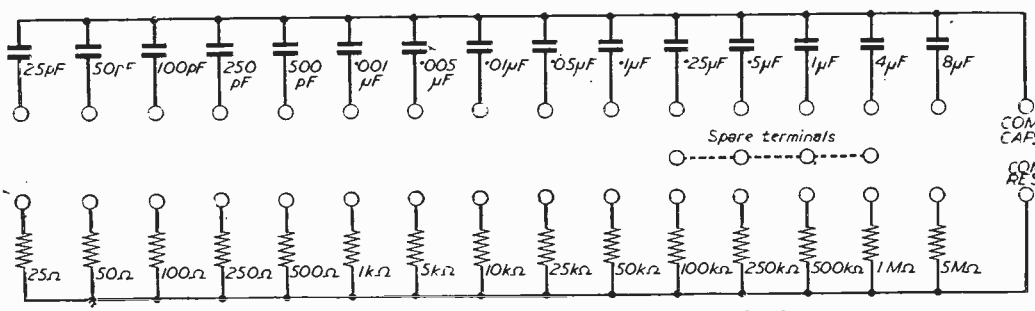


Fig. 6.—Capacitors and resistors are available in this box.

the *combined* shorted terminals in the second group of figures—assuming that more than one figure is listed. In other words, the four basic resistors are used in a variety of series and parallel connections. With four resistors, 37 different values can be obtained.

Although this system gives a fairly wide range of values to choose from, the overall limits are somewhat small as will be seen from the chart. To overcome this, the answer is to have a series of such boards. Using a simple example, resistance values of 10 times those already shown (and using the same connections) are obtained by using basic resistances of 10 times the value (i.e., 1,000, 2,000, 5,000 and 10,000 ohms). The range can, by this method, be extended in either direction. Perhaps a better scheme would be to use resistors of greater difference so as to obtain shown in Fig. 7. The basic unit, based on a multi-contact switch, consists of the usual standard resistors and capacitors but has additional provision for two volume (or tone) controls, since it is often desirable to be able to check a suspected variable resistor in a faulty receiver; this enables it to be done without the need to wire in a new control. The various switch positions may, of course, accommodate any component the user considers would be of help. For instance, if a small neon lamp is included this will enable a quick check to be made on "live chassis" receivers that the mains are connected in the safe position. An output transformer could be fitted—this could drive a bench speaker. A choke is another possibility.

With the single switch the unit is quite useful but, it can be greatly improved by the addition of another switch assembly. In the single switch version any

volume controls fitted must have a third separate contact socket. But with the addition of another switch, the third contacts of the potentiometers can be connected to contacts on the second switch—the idea being shown basically in Fig. 7. The main advantage, however, is that by using two switch units (not ganged, of course), two separate components may be inserted into two separate circuits, simultaneously, thus greatly increasing the flexibility of the box. In use, test leads are plugged into the output sockets of the substitution box and placed into the required circuit by their free ends terminating in crocodile clips. Naturally, the purpose of each switch position should be clearly marked on the panel of the box.

In these few brief notes, various types of substitution boxes have been discussed. No two people have the same ideas on what they consider necessary inclusions in such aids, the final selection of values and scope of the unit being largely dependent on the type of work normally carried out. However, with the suggestions given, the make-up of a substitution box to suit individual tastes should present no difficulties.

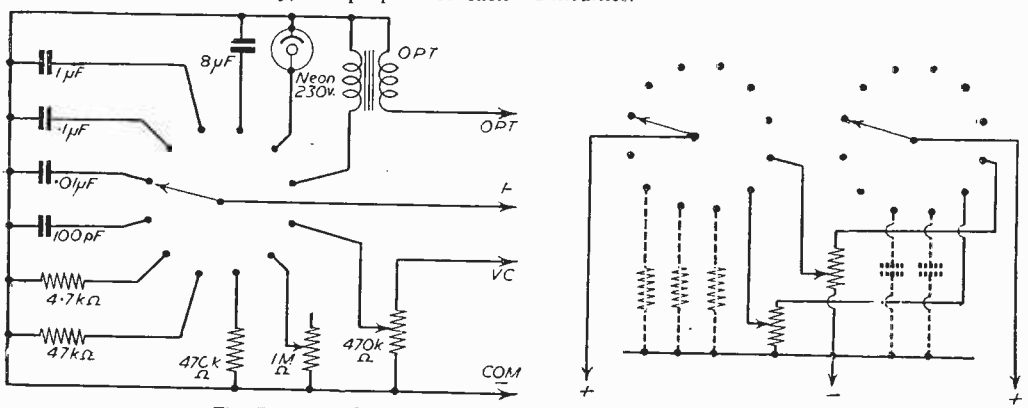


Fig. 7.—A useful basic test unit, and a suggested modification.

R.S.G.B. Exhibition

THE Eighth Annual Amateur Radio Exhibition, organised by the Radio Society of Great Britain, will be held as in former years at the Royal Hotel, Woburn Place, London, W.C.1, from Wednesday, November 24th, to Saturday, November 27th, both dates inclusive. The exhibition will be opened at 12 noon on the 24th by Mr. H. Faulkner, C.M.G., B.Sc.(Eng.), M.I.E.E., F.I.R.E., director of Telecommunications, Engineering and Manufacturing Association. Mr. Faulkner was, until recently, deputy engineer-in-chief of the G.P.O.

As in past years, the exhibition will be supported by companies who specialise in the provision of valves, components, metal work and publications for the radio amateur. In addition, the Services will be represented.

Members of the R.S.G.B. will exhibit a wide range of home-constructed equipment of modern design, including miniaturised, portable and mobile transmitter-receivers for use in connection with the Radio Amateur Emergency Network. Amateur television will be represented by the actual equipment used by Messrs. W. R. and J. Royle, G2WJ, for their historic 70 cm. tests. Single side-band equipment will be featured, as will V.H.F. and V.H.F receivers and transmitters.

New editions of "A Guide to Amateur Radio" and the "R.S.G.B. Amateur Radio Call Book" will be on show on the R.S.G.B. stand together with examples of amateur-built equipment, which has been or is to be described in the Society's journal.

The exhibition will open at 11 a.m. and close at 9 p.m. each day. Admission 1s.

Bel Sound F.M. Tuner

BEL SOUND PRODUCTS have produced a kit for a superhet F.M. tuner, with wide-band I.F. amplifier and stable oscillator, running at 90-110 Mc/s. A ratio detector with infinitely variable A.M. rejection is provided. The first of three identical high-gain V.H.F. R.F. pentodes acts as R.F. amplifier. It is matched by a pi-network to that portion of V2 which acts as I.F. amplifier. The third valve feeds the discriminator, which is the latest type of ratio detector. The A.F. output appears as the in-phase resultant in a bifilar winding, and tertiary winding, and the demodulators are two matched germanium crystals. De-emphasis is incorporated, or can be omitted, resulting in a 6 db octave rising characteristic. Booklets are available at 2s. Weak field strengths do occur, in steel buildings, or immediately behind hills, and an I.F. stage may be added in such cases.

The kit is available with all miniaturised components fully worked chassis finished in Admiralty Blue glossy enamel. The coils are prealigned, although an alignment service is offered at 10s. 6d.

Miniature Parts

The minimum of valves and components ensures absence of background noise, no drift complications, alignment permanence, incidence of valve failure and small power consumption. In addition the receiver utilises all miniaturised components and a separate Power Pack is available. The price is £7 5s. with valves, or ready assembled and tested for £11 17s. 6d.

FREQUENCY MODULATION

AN EXPLANATION OF THE PRINCIPLES AND CIRCUITS COMMONLY USED

By A. Thomson

(*Concluded from page 686 November issue*)

IT is rather early to give a detailed report on the design that FM receivers in this country will follow, and so a short survey of the types of receivers that are being used in the U.S.A. and Germany will be given. These countries have had a FM system operating now for a considerable period.

Receivers

In the U.S.A. most receivers are of the two-band type capable of receiving the broadcast band (this is equivalent to our Medium Waveband) and the V.H.F. band for FM reception. They are designed to use as far as is possible the same valves for FM as they do for AM, and designers have got up to some very clever schemes. Not all of these receivers are capable of giving the highest fidelity of reproduction that was mentioned at the start of this article. Their big advantage is the freedom from noise and from interfering stations on either side of their carrier frequency, so that FM affords an overall improvement in reception over the congested broadcast bands. Of course, some of the larger sets are designed expressly for the highest quality of reproduction and reproduce faithfully the audio frequencies up to the highest limit (usually 15 Kc/s).

In Germany a large number of super-regenerative receivers have been produced, and the danger from these receivers is the oscillation sent out on the aerial and the interference caused to other sets. However, the authorities have issued stringent regulations to prohibit this occillation taking place.

The majority of sets in both countries have followed the superheterodyne types and they have been combined to receive AM and FM. The tuning condensers for FM consisting of a unit of approximately 10 to 15 pF are built in with the main tuning condensers. Tuning condensers of this type were shown by British firms last year. There appears to be no difficulty in the designing of I.F. and discriminator transformers and the arrangement in these combined sets is that an I.F. transformer for 470 Kc/s and one for 10.7 Mc/s are used. These are switched into circuit dependent on which Band it is desired to use. Many of these receivers employ a ratio discriminator and so do away with the limiter stage, but they sometimes have to add an extra I.F. stage so that a large amount of signal will be fed to the ratio discriminator. However, as most of these sets work in the service area the one I.F. stage is usually found sufficient.

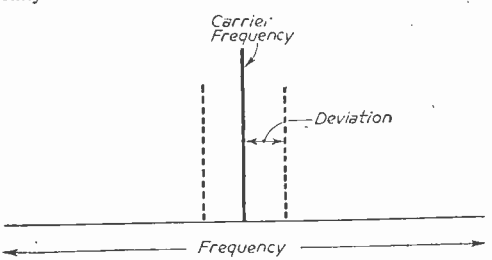


Fig. 9. — Diagram illustrating the deviation obtained in F.M.

A form of permeability tuning used in some German receivers for tuning the V.H.F. band was shown last month. The drive cord is attached to the main tuning drum.

In this country we have not been standing still in the field of FM on the V.H.F. band and our valve manufacturers have given us special valves for use in these receivers. A circuit which will be popular will be the earthed grid input or R.F. stage using a triode valve. The other half of the double triode can be used as an additive mixer stage. This valve, the Mullard ECC85, has very extensive screening between the triode sections and the use of such a valve in the circuits mentioned will reduce radiation from the oscillator to the aerial. Other valves in this range released by Mullard are the ECH81 triode heptode which can be used as a frequency changer on conventional AM bands and switched over to function as 1st I.F. amplifier on FM. A valve specially designed for I.F. work on FM is the EF85. This valve can also be used as an I.F. amplifier for AM reception. Most constructors are familiar with the double diode triode, and now in FM we meet the triple diode triode, the EABC80. The EABC80 can be used in a combined AM/FM set as a ratio detector and 1st AF amplifier when receiving FM, and as an ordinary detector and 1st AF amplifier when using AM.

Converting A.M. to F.M.

What of converting present-day AM sets to receive this new band? Convertors will most likely take the form of a tuner or feeder unit which will plug into the audio circuit of the present set. The feeder unit will consist of an R.F. stage, frequency changer, I.F. stage, limiter and discriminator stages. Do not forget the need for a power pack as not many sets will supply the power requirements for the feeder unit.

Aerials

What about aerials? These will for the most part be simple dipoles erected indoors in the loft or outside on the window frame. In the outer areas a dipole with reflector may be necessary for good clear reception, but it is the intention of a FM service that only simple dipoles will be needed to give good reception within the service area of the V.H.F. transmitters. No doubt the aerial manufacturers, who have served us so well with TV aerials, will provide aerials for Band 2 which can be fitted indoors in the room, in the loft, or for attaching to our present TV aerial masts.

FM introduces new problems in the servicing and alignment of these sets, but a description of these must wait until a later article.

A Criticism of Critics

EVERY journalist likes to receive not only letters of praise, but letters of criticism. It is his hope that the letters in praise will be greatly in excess of those of criticism. Such has been my experience, and it has been my custom always to deal with the latter, whereas it is *de trop* to deal with the former, on the principle that self praise is no recommendation.

Criticism is stimulating and informative, provided that it is made *bone fide* and couched in reasonable terms. On a very few occasions letters of criticism are received which are neither *bona fide* nor written in reasonable language. Polite letters invite polite replies, but the malicious letter writer, the waspish critic, the critic with the adder fang can hardly expect the contributors concerned to turn the other cheek, even though the gentle answer is expected to turn away wrath.

A few weeks ago a bombastic letter was received from one, C. C. Lewry, who hails from the salubrious district of Hanworth. He says: "I wish to protest in the strongest possible terms on the way in which I and at least three other members of my department were 'caught' to-day by the front cover page of PRACTICAL WIRELESS dated November (on which was depicted the P.W. Tape Recorder). This just advertises the P.W. Tape Recorder, and naturally we expected to be able to construct a tape recorder complete. It turned out, however, that all were disillusioned. The article dealt with an amplifier for a recorder already in existence. The laws of libel forbid me to say more, but I shall be very sure to steer clear of your periodical in the future and I am sure that my friends will do the same."

The cover conveys no such suggestion. It merely says "The P.W. Tape Recorder," several articles on which have already appeared. When our cover draws attention to constructional articles it is the custom to say "Building the. . . ." The constructional details of the P.W. Tape Recorder have already appeared, and therefore Mr. Lewry's letter discloses the fact that he is not, as some might claim, "A regular reader from No. 1." It is obvious that he is just one of those casual readers. Every editor and journalist is accustomed to the phrase "I and my friends are disgusted with etc., etc., and we have all agreed not to take your journal etc., etc." Such letters are never sent by regular readers. They usually emanate from those who haunt free libraries or from those who are not regular readers. Mr. Lewry seeks to ignore the fact that a tape recorder consists of a tape deck and accompanying amplifier. In previous designs, we have utilised commercial tape decks as these are in general beyond the ability of the amateur to construct. A tape recorder design, then, consists of a suitable amplifier with switching gear, to suit the particular tape deck, plus the necessary interconnection scheme for the heads, etc. In the tape deck design in question, we used the deck specified for the "Sound Master," as this may be obtained in separate parts by the home constructor and assembled at home, or purchased as a ready-made unit. Our readers, however, have asked for an even cheaper design and the present one has been produced to satisfy those readers. It has the further advantage that it may be converted if desired to the first-class amplifier originally used. Instead of writing a reasonable letter inquiring about the matter, Mr. Lewry dips his pen in vitriol and slashes off the letter I have quoted above. Whilst I as a contributor like to be on the friendliest terms with readers, a state of affairs which has existed for over 21 years, I prefer to be without the casual offensive sort. R. P. Harvey, of Gordon House, Bromsgrove School, Worcs, is another would-be critic of this type. This critic sets himself up as an unpaid corrector of the technical press and in a recent offensive missive criticises in general terms some of our technical matter. He gave no specific examples, but with a supercilious sneer suggested that he would be able to put the matter right. Of course, schoolboys will have their joke, and it turned out that R. P. Harvey is just a schoolboy in the seat of learning I have named. It is obvious that he had not purchased either this journal nor any of our technical books, probably having access to them in the school library. When tackled, this bumptious youth at once caved in, and failed to justify his criticisms when pressed to do so. Naturally, this journal is concerned if criticisms are made, and the matter was taken up with the Principal of Bromsgrove School, who speedily assured us that Master Harvey was merely expressing his own views. It has been pointed out to him that students who write offensive letters on school notepaper can bring discredit on the school, as well as landing them in for other trouble. Splenetic letters are seldom based upon reason. They are conceived in hate and bred in malice, and must be dealt with as such.

Schoolboy Harvey admitted in his letter that he had very little technical knowledge! By this time, I am certain, he has learned the error of his ways.

If you wish to write a letter of criticism, couch it in reasonable language; do not automatically presume that you are right and that the contributor is wrong. There is always the other point of view, and it is my experience that in the majority of cases it has been the critics who are wrong.

TUNING FEEDERS

SOME SUITABLE DESIGNS FOR USE WITH STANDARD AMPLIFIERS

By F. G. Rayer

THE usefulness of an amplifier can be considerably increased by using a tuner unit to permit radio reception, and such units need not be of complex design. Many amplifiers have a far better frequency response than the usual receiver of general type, and excellent reception with high-quality reproduction can then be obtained. The tuner may have pre-set or fully variable tuning, and be for local station or distant reception. For local stations, a number of T.R.F. circuits can be used, while a superhet circuit is best when occasional long-distance reception is required, or if the BBC transmitters are poorly received in the locality where the equipment is used. With a superhet tuner and a powerful amplifier, a large number of stations can be received at excellent volume, and with a degree of quality satisfactory for all general purposes.

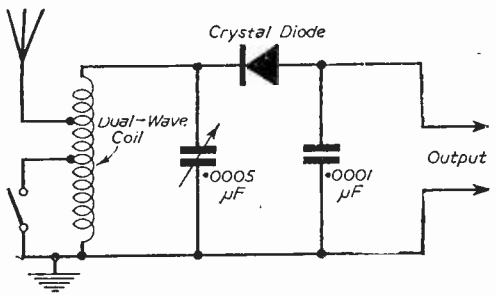


Fig. 1.—A simple crystal diode tuner.

In general, it is possible to derive current for the smaller type of tuner from the amplifier itself, so that no additional mains section is required. But with larger tuners having more than one valve, the transformer and rectifier ratings of the amplifier should be checked to see that no overloading takes place. If insufficient current is available, then a power-pack for the tuner should be made. This can employ a small mains transformer of suitable rating, and preferably a full-wave rectifier.

The simplest circuit is shown in Fig. 1, and employs a crystal diode. It is only suitable for use where a reasonably good aerial and earth can be provided, and in localities where the local BBC stations are well received. Under such conditions, excellent results can be obtained. A dual-wave coil is suggested, for reception of long- and medium-wave stations, but a coil for medium waves only may be used. In some Midland areas reliable reception, at ample volume and interference-free, may be obtained from Light, Home and Third Programme transmitters with such a circuit.

An earth is almost essential, and volume is very much reduced without it. An outdoor aerial is desirable, but quite good results are possible with a fairly long indoor aerial. Apart from its low cost and simplicity, this circuit has the advantage that no current is required from the amplifier, and no power-supply leads have to be arranged. In suitable areas, for local station reception, it has a definite practical utility.

1-Valve Tuner

If an earth cannot be provided, and the aerial is poor, a tuner using valves becomes essential. It is also necessary in areas where the BBC transmitters are not well received. If simplicity and low cost are important, the circuit in Fig. 2 can be used with success. It employs a standard medium wave (or dual-wave) tuning coil, with reaction. It is in no way a "quality" tuner, but nevertheless can give good results, while the use of reaction very considerably increases range and selectivity. It is particularly suitable for small two or three valve amplifiers which are not designed to give high quality reproduction. With them local and other stations can be received at good strength and satisfactory quality.

As current for one additional valve can usually be derived from the amplifier, the valve should be chosen with this in view. For 6.3 volt A.C. operation, or .3 amp. A.C./D.C. operation, the 6J7 type is satisfactory. It is desirable to arrange a socket strip or similar connector on the amplifier, so that H.T. and heater currents can be drawn by plugging in the tuner. For A.C. operation from a mains transformer, the heater current will be taken from the 6.3 volt heater secondary of the transformer. For A.C./D.C. operation, such as employed in some very simple amplifiers, the tuner valve heater should be connected between chassis and the heater of the first valve in the amplifier. In this case, the circuit will have to be completed when the tuner is not in use, or the heaters of the valves in the amplifier will

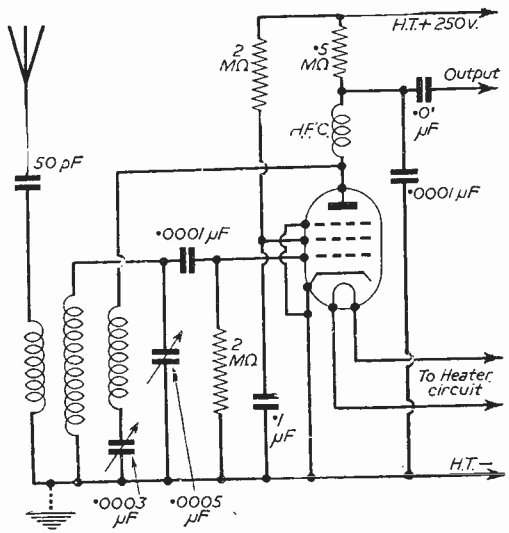


Fig. 2.—A simple one-valve tuner.

remain dead. It is also necessary to take the usual precautions required with all A.C./D.C. equipment, since the supply points (and usually chassis) will be common to one main. Chances of severe shocks will be much reduced by assuring that the low-potential, "earthed" or —ve main is the one going to chassis. With A.C./D.C. equipment, no direct earth must be used on the tuner. If an earth is used, a condenser of about .05 μF, 750 volt working, should be included in series with the lead. A condenser of ample voltage working must also be included in series with the aerial, to keep mains voltages out of this wire.

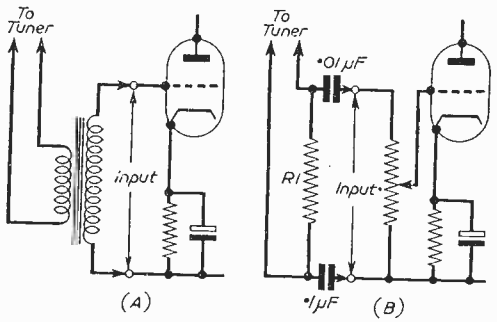


Fig. 4.—Two types of input circuit.

An R.F. Tuner

A circuit for this type of tuner is given in Fig. 3, and though its range is no greater than that of the one-valve tuner in Fig. 2 the standard of reproduction is higher. It may, therefore, be used with high-class amplifiers, and as there is only one valve it should still be possible to derive current from the amplifier.

Pre-set tuning is indicated, stations being selected by means of a push-button switch or rotary switch. This provides simple and accurate tuning, while it should be remembered that the tuner is in any case unsuitable for long-distance results. The pre-sets are switched in in pairs, and each pair adjusted for best results from the appropriate station. For stations of fairly low wavelength, .0001 μF to .0002 μF maximum capacity pre-sets will be suitable. Those stations of higher wavelength in the medium-wave band (up to about 400 metres) will require .0003 μF maximum capacity condensers, while .0005 μF will be required to reach the high wavelength end of the band with standard coils. For the latter dust-cored components may be used.

The layout of this tuner is more critical than with those previously described. Leads should be reasonably short and direct, and the coils should be screened or situated one above and one below the chassis. If this is not done, instability is likely, especially when the gain control is set at maximum.

Long waves could be provided for in this circuit, either by using dual-range coils, or by using separate coils for this band. Additional contacts will be required on the switch, so that the appropriate coils are selected for L.W. or M.W. stations, as the case may be.

Coupling Circuits

Some simple amplifiers have no grid input load, it being intended that this be provided externally, by magnetic pick-up or microphone, etc. With these, a grid load must be provided, either in the form of a resistor of about .5 megohms, or a transformer secondary.

Such a stage is shown at "A" in Fig. 4, where transformer coupling between tuner and amplifier is illustrated. The transformer should be of the intervalve coupling type, of about 1 : 3 or 1 : 5 ratio. This is a simple method of coupling the tuner in Fig. 1, when maximum volume is required, and the amplifier is of small type, of moderate gain, and not primarily intended for high-quality reproduction. In these circumstances very satisfying results are obtainable.

The circuit at "B" in Fig. 4 shows capacity coupling, it being assumed that a volume control is already present in the amplifier, as is usual in all but the very simplest equipment. For the tuner in Fig. 1, R1 may be 100 k. The presence of two condensers isolates the tuner from the amplifier voltages. If the amplifier is of A.C. type, with chassis earthed, the .1 μF condenser may be omitted.

For coupling the tuner shown in Fig. 2, it is only necessary to take the "Output" lead to the input socket in Fig. 4 "B" to which the .01 μF condenser is connected. R1 and the two condensers in Fig. 4 are not required.

With the circuit in Fig. 3, either of the methods given for the tuner in Fig. 1 may be used. However, in order to achieve the highest degree of quality, capacity coupling is desirable, while the .1 μF condenser will in any case have to be omitted since a continuous and direct connection is required to furnish H.T. to the valve.

To avoid unnecessary hum and possible instability, the leads from tuner to amplifier should be reasonably short, and leads carrying A.C. should not be near

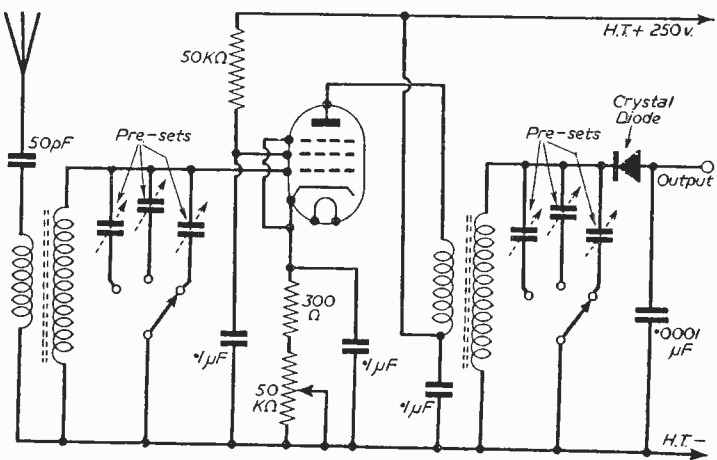


Fig. 3.—An R.F. detector Pre-set tuner.

those carrying the A.F. signal. If necessary, the A.F. signal lead from detector to valve grid or associated circuits may be screened, the braiding being earthed. This will guard against instability and hum.

A Superhet Tuner

With the tuners so far described, lack of high sensitivity largely contributes towards the avoidance of interference. In some areas, however, additional selectivity and sensitivity are essential, and a tuner with two R.F. stages, or of superhet type, becomes necessary.

Such a tuner is shown in Fig. 5 and employs three valves. The coils may be standard aerial and oscillator types, for 465 kc/s intermediate frequency, or a ready-made coil-pack can be employed. If the latter has a short-wave range, the usefulness of the tuner will be further increased. As a general purpose unit, it is sensitive, selective and stable, and will give much better results than the tuners previously described.

The valves may be operated with heaters in parallel, from a 6.3 volt transformer, or with heaters in series, for A.C./D.C. .3 amp. circuits. (In the latter case, no direct earth must be used.) No volume control is provided, since it is assumed that this is already present in the amplifier, as shown at "B" in Fig. 4. If no such control is present, then it may be added to the tuner. To do this, a .5 megohm potentiometer will be required, and will be wired from "output" lead to H.T.– lead (Fig. 5). The output to the amplifier will then be taken from the potentiometer slider (centre tag).

The band-width of this circuit may be increased by slightly staggering the I.F. transformers, or by connecting resistors in parallel with some of the windings. For the latter, values of 3 k in parallel with the secondary of the first transformer and primary of the second transformer are suggested. Lower values may of course be used.

Finally, if a triode is available instead of the double diode, the circuit in Fig. 6 can be adopted, and is a good one. With this, it will be necessary to abandon the AVC circuit, or to use a H.F. rectifier for this, unless a diode is also to be made available by using a fourth valve in this capacity.

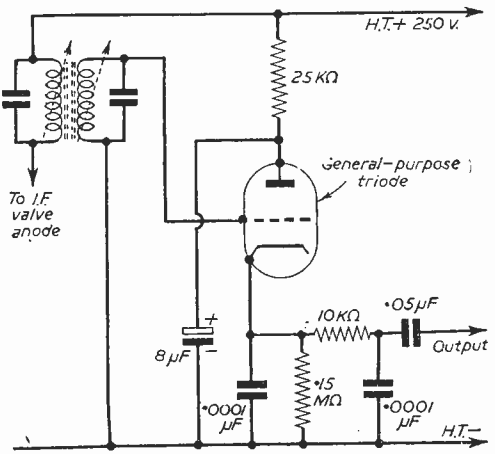


Fig. 6.—The well-known infinite impedance detector.

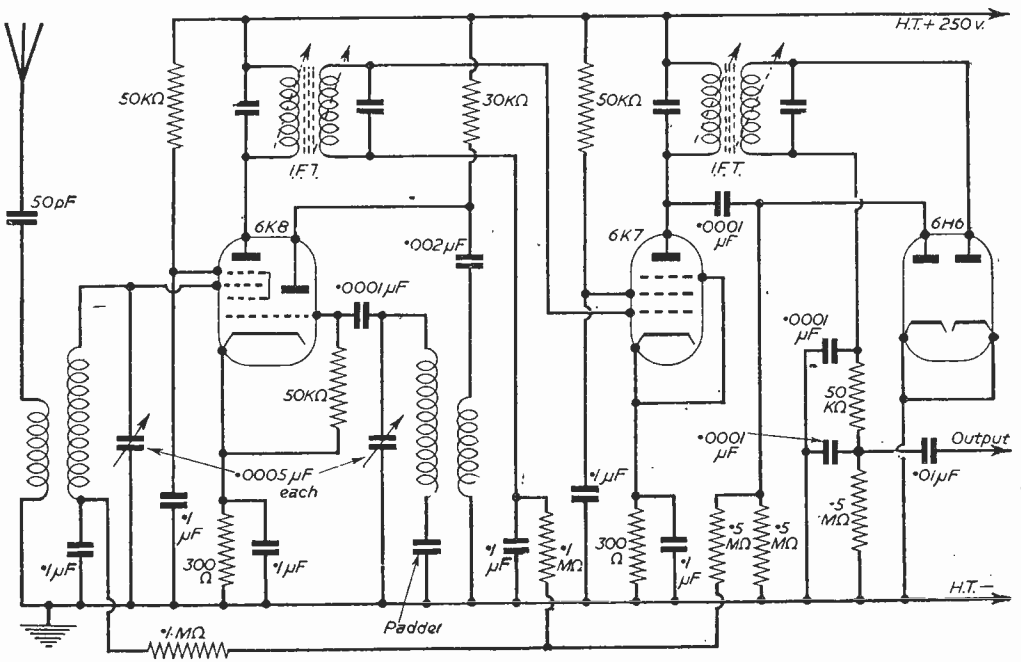


Fig. 5.—A superhet tuner.

The Beginner's Guide to Radio

The Twentieth Article of a Series Explaining the Fundamentals of Radio Transmission and Reception. Further Notes are Given on Valves Characteristics and on the Correct Use of Loudspeakers

By F. J. CAMM

UNDISTORTED output is the most important of valve details, as it gives a true indication of the power which the valve will deliver. For example, if we know that a particular valve will give an undistorted output of 500 milliwatts (or .5 watts) and that another valve gives an undistorted output of 1,000 milliwatts we know that the latter valve has twice the undistorted output.

Transformer Curve

In addition to the valve curves the makers of L.F. transformers also publish similar curves which indicate the degree of amplification which may be obtained with those components at various frequencies. It is thus a simple matter to design the amplifier so as to obtain even amplification by choosing two transformers so that the deficiencies of one are compensated for by a high performance of the other. That is to say if one transformer curve shows that that particular component falls off above 2,000 cycles it is possible to choose a second transformer which has a rising characteristic at that point, and by careful matching overall response will be even.

Pick-up Characteristics

The makers of gramophone pick-ups also publish curves, which are similar in principle to those mentioned above. That is to say, they indicate the level of the response which the pick-up gives, and their use is the same, namely, to enable the amplifier to be designed so that even reproduction of all frequencies is obtained.

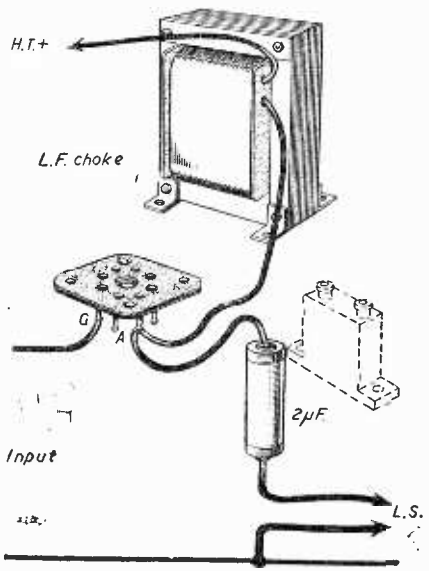
The type of the above-mentioned curves is such that they have for their ordinates frequencies usually extending from about 20 cycles to 10,000 cycles, and the co-ordinates are given in terms of amplification. The performance of the component is then indicated by a heavy line running across the graph, and the straightness of the line shows its goodness.

Very few manufacturers of complete receivers or amplifiers issue characteristic curves of the complete apparatus, and manufacturers of loudspeakers are also not, as a rule, willing to issue such a curve. The design of the set may, therefore, only be worked out with respect to the choice of the transformers, pick-up, valves and, in some cases, the condensers. The above remarks should, however, be sufficient to enable a really straight-line reproducer to be designed in such a manner that all component deficiencies are compensated for.

The Loudspeaker

The loudspeaker is the instrument in the set which transmits to our ears the result of what has been happening within the set itself. No matter how carefully a set has been designed or made, if the speaker is wrongly matched or unsuitable for the set, the result as far as the ear is concerned is unsatisfactory.

The sounds we hear are set in motion by means of the loudspeaker cone, and therefore the position of the speaker in a room in relation to curtains and furniture is very important. When, as is mostly the case to-day, the speaker is built into the receiver, it is sometimes difficult so to site the set that best results are obtained. Mostly a set is placed near a window to facilitate the fitting of short aerial and earth



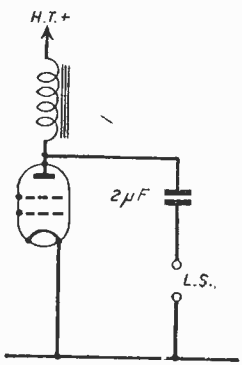


Fig. 90.—A choke-coupled output arrangement. The choke may be any standard L.F. smoothing component.

leads, and so the best position for the set cannot be used. The design of the receiver itself often means that the speaker is not located in the best position in the cabinet. Its position is often decided by that of the tuning control and the gramophone turntable. These are positioned for convenience of operation, and this means that the speaker has to be placed at the bottom of the cabinet and close to the floor.

We are accustomed to hearing the sound of the human voice from a point at an average height of from 5ft. to 6ft. above the ground, and therefore the best height of the speaker is between 5ft. and 6ft. If the speaker is fixed low and the cabinet is standing on a thick pile carpet, close to heavy curtains, as is often the case, the air vibrations are bound to be damped considerably, and will affect the tone of the reproduction. Those who seek after high fidelity reproduction still prefer to have the speaker separate from the set, and away from it, so that the best possible position for it can be found. A corner can often be utilised to advantage owing to the reflection caused by the diverging walls and frequently more pleasing results are obtained when the speaker is placed fairly high so that there is a fair amount of sound reflection from the ceiling.

The Output Filter

There are two reasons why an output filter is fitted to a set; first, that the filter properly arranged will help to match the impedance of the speaker with that of the output valve and, secondly, the filter isolates the speaker from the anode current flowing in the output valve. Only the low-frequency signal current passes through the loudspeaker, and this is important

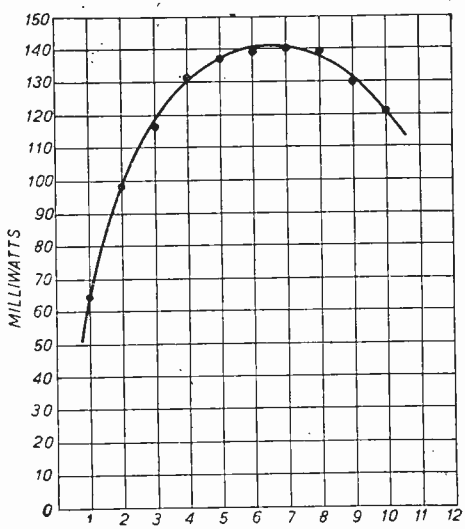


Fig. 92.—Plotting a graph for the output stage.

in mains sets. It not only eliminates all chance of shock if the L.S. terminals are accidentally touched, but in some cases it will minimise hum. Fig. 90 shows a typical output filter arrangement.

There are two types of output filters—the output choke and the transformer.

Fig. 90 shows the choke method which has the advantage of low cost since the only components required are the output choke and a fixed condenser. The output choke generally should have an inductance of about 20 henrys, and the condenser should be of 2 or 4 μF capacity. The advantage of this scheme is that when long extension leads are used it is only necessary to run one wire from one of the fixed condenser terminals of the output filter to the speaker and the other wire from the speaker to the nearest earth point.

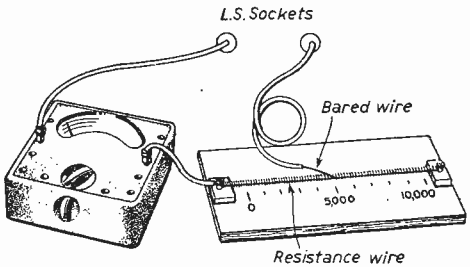


Fig. 91.—A simple output measuring device. The resistance may be made up by using bare resistance wire wound over a thin former.

The Output Transformer

When a transformer is used the latter component should be of first-class manufacture. The impedance of the secondary is often less than that of the primary, but in some models the primary and secondary are exactly the same. In some cases a drop in signal strength may be noticed when using a 1-to-1 transformer as compared with a choke output. This is often due to a poorly designed transformer.

Matching the Speaker to the Output Valve

It is first necessary to remember that there is a certain current passing through the speaker, and that there is a certain voltage across its terminals. We have seen in an earlier article that volts multiplied by current in amps equal watts, and that watts are a measurement of power. We want to get as much power or as many watts as possible into the speaker. Take two extremes. If the speaker has a negligible resistance we should obtain a large current but practically no voltage across the terminals and therefore zero watts. But the other extreme is, if the resistance of the speaker is very high, we should get a high voltage but no current. The result as before would be zero watts. Somewhere between these two extremes there is a value which will give maximum watts, and correct matching of the speaker depends upon finding that value, (which depends upon the characteristics of the output valve termed the optimum load) for that valve.

The only instruments required for testing are a milliameter and a wire-wound resistance of, say, 10,000 Ω. The meter should have as low resistance as possible so that we can ignore its resistance in arriving at results. The resistance is usually marked somewhere on the instrument but it should not exceed 200 Ω.

Now, disconnect the speaker, and connect up the milliameter and the resistance to the output terminals of the receiver as shown in Fig. 91.

(To be continued.)

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MISCELLANEOUS. OZ4, 6/- ; 2X2, 5 - ; 4D1, 2/9 ; 954, 2/- ; 955, 4/9 ; 956, 3/6 ; 9001, 6/- ; 9002, 6/- ; 9003, 6/- ; 9004, 6/- ; EF8, 6/6 ; EK32, 8/- ; VR150/30, 8/- ; VR105/30, 9/- ; AC6/PEN, 5/6 ; E1148, 2 - ; EF36, 6/6 ; H30, 8/- ; KT2, 5/- ; PX25, 15/- ; MS/PEN, 5/- ; PEN25, 8/- ; VP23, 5 6 ; PEN46, 8/6 ; PEN220A, 4/9 ; QP22B, 7/6 ; U22, 8/- ; U25, 15'- ; EF39, 8/6; EBC33, 7/6 ; 8P61, 3/9 ; 8P41, 3/6 ; EF50, 6/- ; EF50 (8Pl), 8/- ; EF54, 7/- ; EC52, 5/9 ; VU111, 3'6 ; VUI20A, 3'6 ; X65, 10/-.

RECTIFIERS. VU64 (U14), 8/6 ; VU39 (MU14), 8/6 ; U18/20 (FW4/500), 9/9 ; 35Z4GT, 8/6.

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B7G RANGE. EF91, 7/6 ; EF92 8/6 ; EB91, 7'- ; EL90, 9/- ; EL91, 9,- ; EY91, 9/-.

B9A RANGE. PL81, 13/6 ; PL82, 11'6 ; PY80, 10/6 ; EBF80, 11'6 ; EF80, 11/6 ; ECL80, 11/6 ; PY81, 10/6 ; PY82, 10/6.

12A6, 6/9 ; 12C8, 6/- ; 12K7, 9/- ; 12Q7, 9/- ; 12K8, 9/- ; 12SG7, 5/6 ; 12SH7, 5/- ; 12SJ7, 7/6 ; 12SK7, 6/6 ; 12SQ7, 8/6 ; 25A6G, 9/- ; 25L6GT, 8/6 ; 25Z4, 9/- ; 25Z6, 8/6 ; 35L6GT, 8'9 ; 35Z4, 8/6 ; 50L6GT, 8/6 ; 10LD11, 11/- ; EF55, 10/-.

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JUST A FEW LEFT
Type 6L and 233. Indicator Units. Less tube and valves. Suitable for stripping, 12/6 ea. Carriage 5/-

WIRE WOUND RESISTORS
Available in the following values :— 25Ω, 50Ω, 100Ω, 150Ω, 200Ω, 250Ω, 350Ω, 500Ω, 1,000Ω, 1,500Ω, 2,000Ω, 2,500Ω, 3,500Ω, 5,000Ω, 6,800Ω, 10,000Ω. Tolerance plus or minus 10 per cent. Ratings 5 watt, 1/- ea. ; 10 watt, 1/3 ea. ; 15 watt, 1/9 ea.

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MISCELLANEOUS

6C9	...	8/-	10P9	...	10/6
6L1	...	11/6	10P13	...	11/6
6X4	...	8/-	10P14	...	11/6
6F14	...	12/6	20L1	...	10/-
6P15	...	11'6	20D1	...	10/-
6L18	...	11/-	20P4	...	11/-
6L19	...	12/6	20L1	...	10/6
6D8	...	7/6	HL2	...	6/-
6U4GT	...	15'-	PM2B	...	5/6
10F1	...	10/-	PM22B	...	5/6
10C2	...	10/6	HP21C	...	7/6
			PCF82	...	11/-

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Type CLR. Low resistance 120Ω, 7/6 pair.
Type CHR. High resistance 4,000Ω. 11/6 pair.
Type DHR, a super job, 13/9 pair
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8 x 24 mfd. 350 v.	...	...	3/-
8 x 32 mfd. 475 v.	...	...	3/9
12 x 4 mfd. 450 v.	...	...	2/-
16 mfd. 450 v.	...	...	3/-
16 x 8 mfd. 350 v.	...	...	4/-
16 x 16 mfd. 350 v.	...	...	3/3
20 x 20 mfd. 500 v.	...	...	4/9
24 mfd. 450 v.	...	...	2/9
25 x 16 mfd. 350 v.	...	...	3/6
32 x 8 mfd. 350 v.	...	...	3/6
32 x 16 mfd. 350 v.	...	...	4/6
32 x 32 mfd. 450 v.	...	...	6/11
32 x 32 x 8 mA. 350 v.	...	...	5/6
32 x 32 mfd. 350 v. 25 mA.		25 v.	5/9
64 mfd. 350 v.	...	...	2/-

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B.R.1650 16 mfd. 500 v.	... 3/3 ea.
B.R.2650 20 mfd. 500 v.	... 3/6 ea.
8 x 8 mfd. 500 v. ...	... 4/- ea.
B.R.591 50 mfd. 12 v.	... 1/9 ea.

Midget Metal Types

2 mfd. 350 v.	...	...	1/9
8 mfd. 350 v.	...	...	1/1
8 x 8 mfd. 350 v.	...	...	3/-
8 x 8 mfd. 450 v.	...	...	4/-
16 mfd. 350 v.	...	...	2/9
16 x 8 mfd. 450 v.	...	...	4/-
16 x 16 mfd. 450 v.	...	...	4/6
16 x 24 mfd. 350 v.	...	...	4/9
24 mfd. 350 v.	...	...	2/9
32 mfd. 350 v.	...	...	1/9
32 x 32 mfd. 350 v.	...	...	4/9
250 mfd. 12 v.	...	...	1/9

TERMS : Cash with order or C.O.D. Postage to be added to orders as follows : 9d. up to 10/- ; 1/- up to 20/- ; 1/6 up to 40/- : 2/- up to £5. MAIL ORDER ONLY : Send 6d. in stamps or illus. catalogue.

ALPHA

S★T★A★R BARGAINS

- ★ **POCKET TEST METER.** Ex-Govt. volt meter, two ranges, 0-15 volts, 0-250 volts, D.C., 17/6 each.
- ★ **COLLARO AC37 GRAM MOTOR.** Governor] controlled manual adjustment type for 78 r.p.m. Suitable for 100/125 v. 200/250 v. Complete with EMI pattern 10in. turntable. Price 46/- ea. Post, etc., 2/6.
- ★ **TELEVISION PRE-AMPLIFIER.** by Plessey, complete with valve (EF42), a small compact modern unit for London frequency. Price. 13/6.
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- ★ **ROTHERMEL SILENT PILLOW LOUDSPEAKER.** Type BA301. List Price, 42/-. Complete with full instructions, 17/6 ea.

The IDEAL PRESENT

Walnut finished loudspeaker cabinets. Metal speaker fret, rubber feet fitted, complete with back. Price for cabinet suitable for 6½in. speaker, 15/6. Price for cabinet suitable for 8in. speaker, 19/6. Post 1/6 ea.

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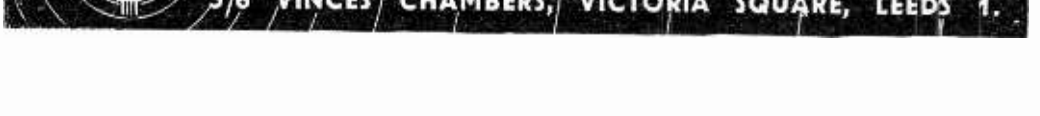
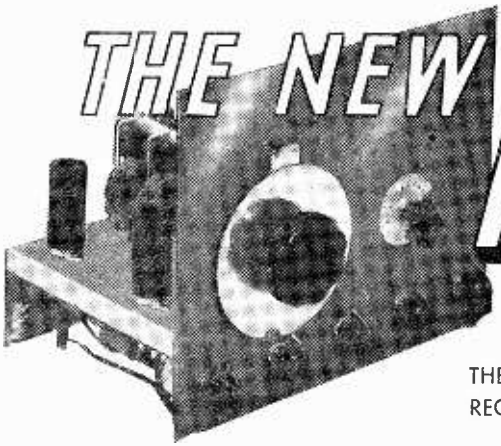
Conttol knobs, clearly engraved in gold. Size "A" diameter 1½in. ; Size "B" diameter 1¼in. Both in two colours, Walnut or Cream. Inscriptions available.
RADIO : "Volume," "Vol./On/Off," "Wavechange," "On/Off," "Tuning," "SML Gram" "Radiogram," "Tone."
TELEVISION : "Contrast," "Brilliance On.Off," "Focus," "Brightness."
AMPLIFIER : "Treble," "Bass" (Plus any above).
TAPE RECORDER : Record/Play. Prices : Size "A," 1/6 ; "B," 1/2. Plain knobs can be supplied in either size, 1/- each and 8d. each respectively.

WHEN ORDERING PLEASE QUOTE "DEPT. P.W."





THE NEW Fury Four

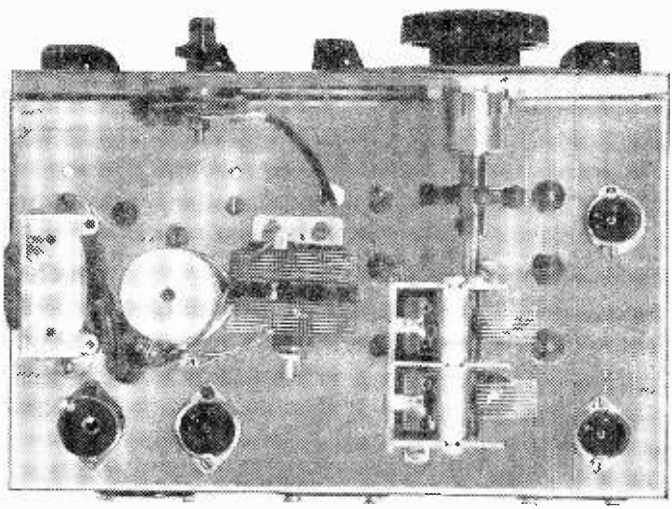
THE LATEST VERSION OF OUR POPULAR TWO-R.F. RECEIVER, WHICH IS FULLY ADAPTABLE FOR MANY PURPOSES

IN introducing the new Fury Four we have endeavoured not only to produce an up-to-date version of the original Fury Four circuit, but also to try to produce a design which may be adapted according to the particular needs of the majority of our readers. In January, 1933, we introduced a receiver circuit employing two H.F. stages, as a large number of readers had expressed a preference for the straight receiver rather than a superhet. Although the superhet is very popular many readers hesitate to build one in view of the probable difficulty of alignment. The question of expense is also often raised. It was, therefore, thought desirable to produce a straight type of receiver which went beyond the usual H.F.-detector arrangement, and again to use two H.F. stages. Normally it is extremely difficult to design a stable receiver with more than one H.F. stage, as elaborate screening becomes necessary, but in the new receiver this difficulty has to a large extent been overcome by using only one tuned circuit in the two stages.

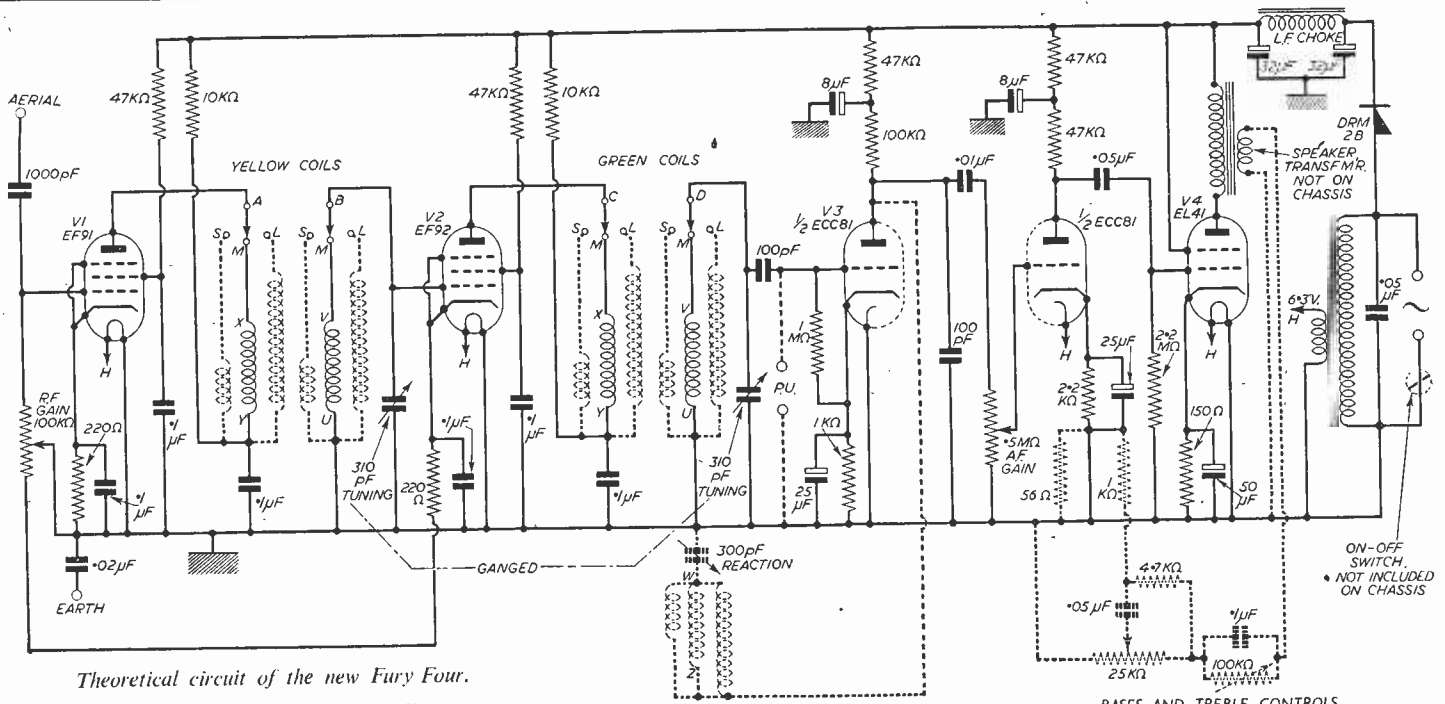
When preparing this design we were also rather concerned to try to cater for a large variety of special needs. When we introduce a design we are usually flooded with inquiries asking how the receiver may be modified to take care of some particular circumstance—one group of readers want tone control, others do not. Some want to use the receiver for record reproduction mainly, whilst others have no interest in this branch of radio but prefer to spend all their spare time searching for long-distance stations. Again, one group of readers want short, medium and long-wave tuning, whilst others have no interest in the short waves. It will be appreciated, therefore, that it is very difficult to design a receiver which can fill all these individual requirements, and usually two or three different models have to be produced. In the new Fury Four we have tried to make the design as flexible as possible, without introducing unnecessary complication, and we therefore present a circuit which may be built as a three- or four-valve receiver ; with or without reaction ; with or without tone control ; for one band or three, and as a special set for the amateur "den" or as the family radiogram.

The Circuit

Examination of the circuit on page 734 will show that several parts have been indicated in broken lines. These are the optional parts of the circuit and may be included or left out as desired without in any way interfering with the performance of the receiver. Taking the receiver stage by stage we see that it starts off with an untuned H.F. stage using a modern B7G type pentode. Isolation is effected for the aerial and earth leads by fixed condensers which must be rated at 750 volts or more, as the mains side of the receiver employs A.C./D.C. technique which leaves the chassis "live" to one side of the mains. The potentiometer which is used in place of the first



The top of chassis is clean and tidy with a minimum of wiring.



Theoretical circuit of the new Fury Four.

BASES AND TREBLE CONTROLS

One 150Ω	One 2.2 KΩ	Two 10 KΩ
Two 220 Ω	One 4.7 KΩ	One 100 KΩ
One 56Ω	Five 47 KΩ	One 1 MΩ
Two 1 KΩ		One 2.2 MΩ

All the above ½-watt type

- One 1,000 pF. (Type M3U—750 v.w.)
- One .02 μF (Type 743—750 v.w.)
- One .05 μF (Type 743—750 v.w.)
- Seven .1 μF (Type 343—350 v.w.)
- Two 100 pF. (Type CM2ON—350 v.w.)
- Two .05 μF (Type 343—350 v.w.)
- One .01 μF. (Type 346—350 v.w.)
- Two 25 μF. (Type CE31B—12 v.w.)
- One 50 μF (Type CE32B—12 v.w.)
- Two 8 μF (Type CE17LE—350 v.w.)
- One 32-32 μF (Type CE27LE—350 v.w.)

} T.C.C.

- Mains transformer 6.3 v. 2 amps
- Choke 80 mA 10 H

} Radio Supply Co.

- Two B7G valveholders and screens
- One B9A ,, ,,
- One B8A ,, ,,

} Clix or McMurdo

- Chassis type CH10 (10in. by 6in. with 2½in. runner)
- Coils (see text)
- Panel 10in. by 8in. (see text)

} Denco

- One 25 K. potentiometer
- One 500 K. ,,
- Two 100 K. ,,

} Egen

- One 310 pF. two-gang condenser with L/M feet (Type E.4507)
- One .0003 μF solid dielectric condenser (see text)

} J.B.

- EF91
- EF92
- ECC81
- EL41

} Mullard Valves

- One DRM2B SenTerCel rectifier.
- One drive (Type 843)
- One flexible coupler (Type 529)
- One dial and knob (Type 425)

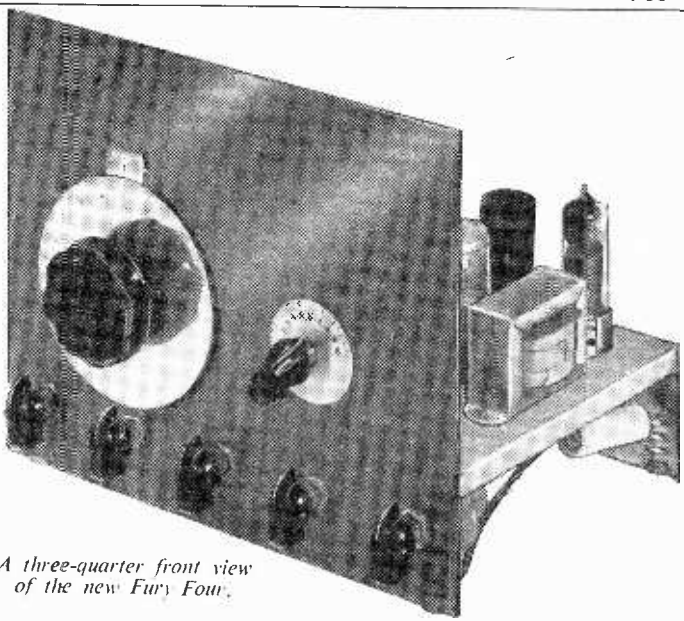
} Eddystone

- Five knobs Type K.107
- One mains connector Type P.350
- One switch Type S.438 (see text)

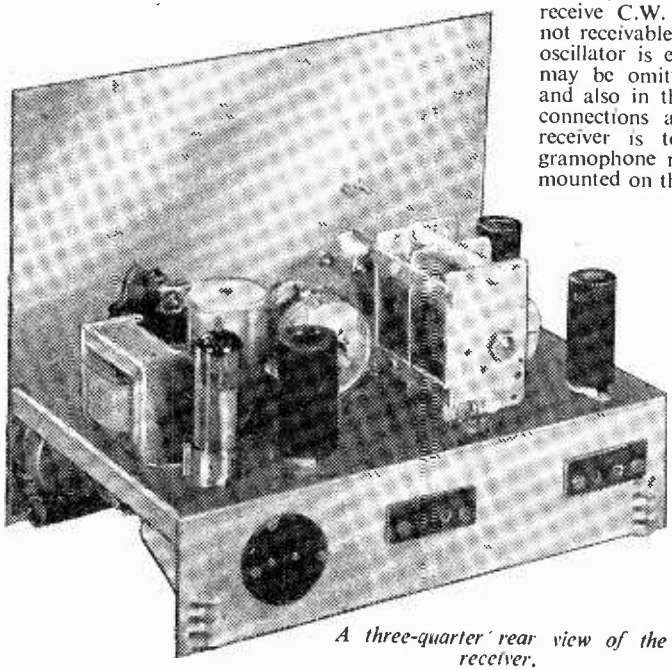
} Bulgin

One A.E. socket strip.
One P.U. socket strip. One 5-way tag strip.
Three grommets. Flex, coaxial cable, screws, etc
Loudspeaker (see text).

tuning circuit enables the first valve to operate with considerable gain at all frequencies, and thus makes up for an inefficient aerial, or, if a good aerial is used, gives an appreciable gain to all signals, rather than to one particular frequency, which would be the case if the aerial circuit were tuned. The signals are tapped off by means of the potentiometer, thus providing an effective H.F. or R.F. volume control, and in order to give full efficiency to this form of control it is linked back to the cathode circuit of the second R.F. stage. Thus, as the input is varied, so is the bias on the second valve, which is of the variable-mu type, and the combination acts very effectively in preventing overloading of the detector—a necessary feature if one desires good quality. Coupling between the first and second R.F. stages is effected by a normal H.F. transformer, and here we have employed separate coils rather than a commercial coil unit so that the necessary flexibility may be introduced. The coils are the Maxi-Q products by Denco, and they are easily fixed by means of their one-hole fixing nuts, and have an iron-core for matching. They are tuned by a 310 pF condenser instead of the usual 500 pF, and this improves performance on the short waves. It will be seen in the circuit diagram that a three-way switch is used for each coil (these being in the form of a six-position, three-way Bulgin component), and instead of using a short-, medium- and long-wave coil at each position, the constructor may use two or three short-wave coils, may cut out the switch entirely and use just the medium-wave coil, or otherwise modify the coil combination. The Yellow range of coils is used between the two R.F. stages, and to feed the detector stage a Green coil is used as this has a reaction winding. Again, this winding can be ignored if desired, and it is included as it enables the user to receive C.W. transmissions—which are, of course, not receivable on a superhet unless a beat-frequency oscillator is employed. The entire reaction circuit may be omitted including the reaction condenser, and also in the detector stage will be seen pick-up connections also shown in broken lines. If the receiver is to be used for the reproduction of gramophone records the pick-up sockets should be mounted on the rear runner and connected between grid and earth. A change-over switch may be included if desired, or the entire previous part of the receiver may be omitted and the receiver built from the pick-up terminals onwards, as a record player.



A three-quarter front view of the new Fury Four.



A three-quarter rear view of the receiver.

It has been mentioned that the R.F. gain control is used to reduce the strength of signals fed to the detector stage so as to avoid overloading, and the output from this stage may even still be sufficient to overload the first A.F. stage. The output from the pick-up may also, with some records, be too great for the first A.F. stage, and therefore an audio or A.F. volume control has been included. The detector and first A.F. stage form the two triode sections of a double triode, and although an ECC81 has been specified for this, in some localities it may be possible to use an ECC82,

A REPLACEABLE shaft on the top of the deck enables the user to obtain either of the three speeds which have now been standardised for tape recordings, namely 3¾in., 7½ or 15 inches per second. In addition the main switching control is interlocked so that there is little risk of inadvertently erasing a valuable recording. The switch control has to be linked to a further switch control in the amplifier and details of this together with the amplifier wiring and assembly are given below.

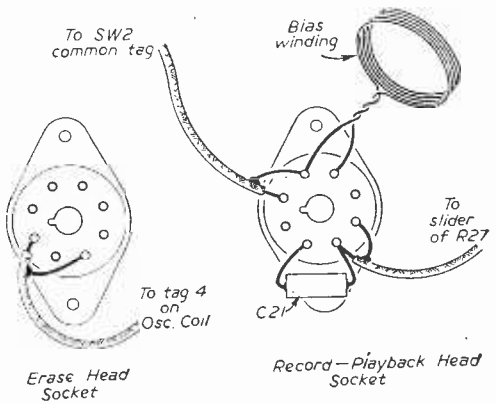
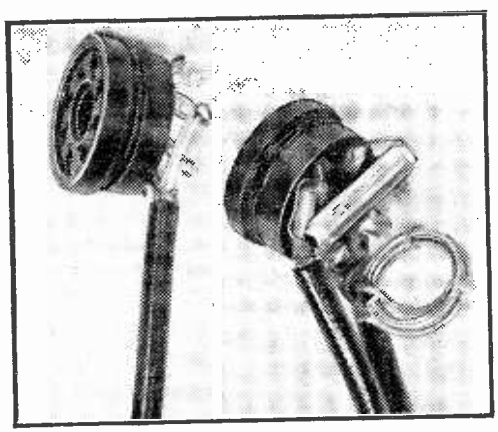


Fig. 2.—Details of the head connecting leads shown below.

Construction

From the illustrations it will be seen that the change-over switch is mounted to line up with the "Sound-Master" deck selector switch. Suitable brass pillar supports are also fitted for supporting the deck and line up with the appropriate holes in the deck. The holes for these mounting pillars can readily be seen in the illustration of the top of the amplifier.

The layout of the amplifier, as well as the necessary wiring, should be adhered to closely to ensure freedom from instability. Only one small screen is required,



The screened leads and plugs for the two heads.

THE PW TAPE

CONCLUDING DETAILS OF THE NEW AMPLIFIER

(*Continued from page 673 November issue*)

this being close to the oscillator coil to screen it from the bias control and level indicator. Very little screened wiring is necessary so long as there are no large deviations from the recommended

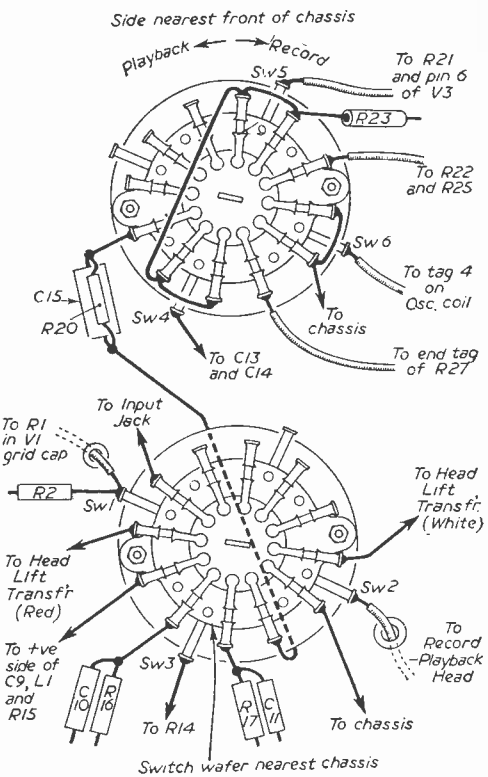
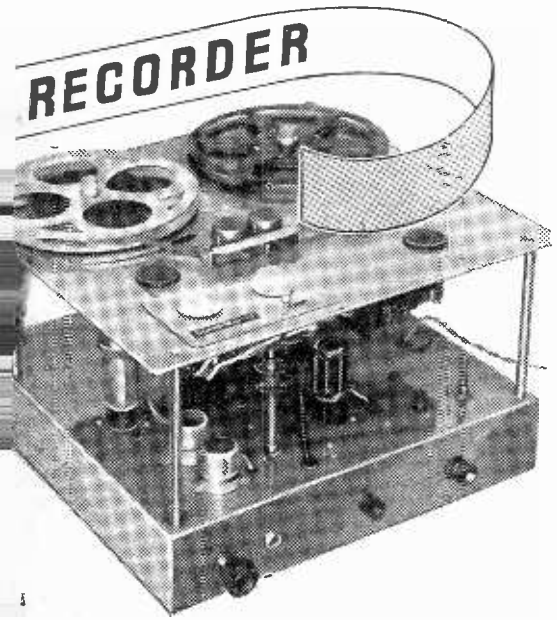


Fig. 3.—Details of the switch connections.

layout, and a careful study of the wiring diagrams of the switch and bottom of the chassis will be well repaid.

The press-button switch for bringing in the level indicator SW7, is shown on the front of the amplifier and is a micro-switch. Any type of press-button switch may be used, this particular specimen having been on hand. To the left of the micro-switch will be seen the neon indicator, which is an Osram Type "G"



neon. This has been fitted with a piece of rubber sleeving for protection only.

Little more need be said about construction except again to emphasise the fact that the layout and the wiring should be strictly adhered to.

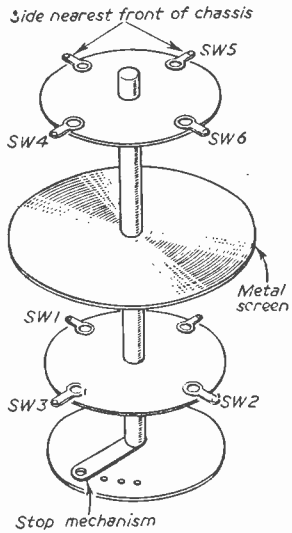
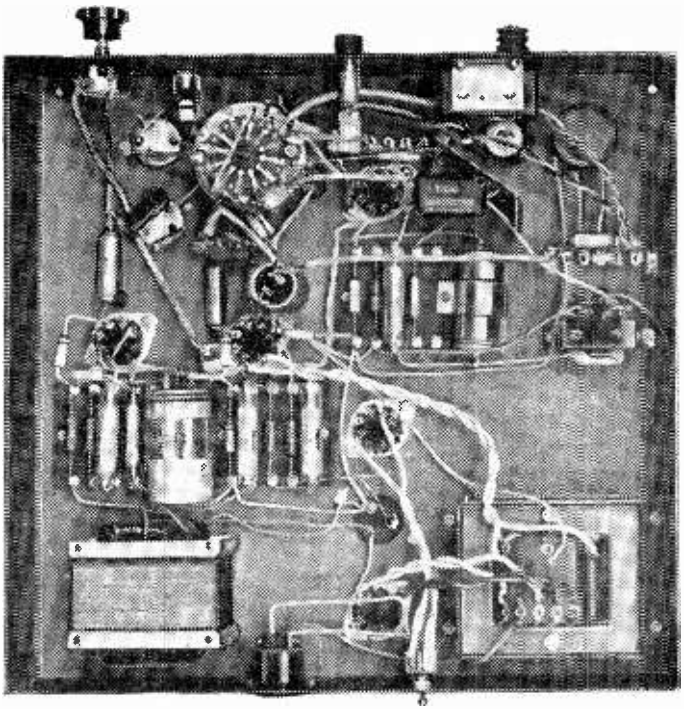


Fig. 6.—How the switch assembly is made up.

Incidentally in comparing the wiring diagram, Fig. 5 (page 738), with the theoretical diagram, published last month it will be noted that the rectifying valve is shown in one diagram with a cathode and in the other without a cathode. We have actually used a 6X5 which has a cathode, and if an alternative type of valve is employed of the directly-heated type the H.T. positive connection will be taken to one side of the heater instead of to cathode. All other wiring details may be gathered from an examination of Fig. 5, and the illustration of the underchassis view below.

Testing

When the amplifier has been completed, tests may be carried out, initial checks being made to ensure that there is no direct short in the H.T and heater circuits. Valves may then be inserted and with the selector switch in the centre position, checks can be carried out using a microphone or gramophone pick-up. If these checks are satisfactory, the record and erase heads should be connected to the tape deck and preparations made to produce a recording. Perhaps the most important adjustment which has to be carried out is the setting of the level control priming voltage to the neon indicator, but this can only be done after experience has shown to what level the amplifier has to be set. The best way of arriving at the correct level setting is to make several recordings at different levels and determine which is the best, if necessary also making some adjustments



Below chassis view of the wiring.

to the bias control, commencing with this in the mid-position. Having determined the best recording level, then a further recording is made, this time with the level indicator switched in and the control adjusted until the neon flashes on peaks. An incorrect setting of this control will cause the neon to strike continuously or at low audio levels, and it is essential for good recordings that the level control be correctly adjusted. Once this setting has been found it need never again be adjusted unless some modifications are made to the amplifier itself, and in use it is switched in only when first setting up, the recording level adjusted until the neon flashes on audio peaks, the push-button switch released, and so long as there are no wide variations in the audio input the recordings will be free from overloading yet will have adequate output.

Performance

The lack of tone controls has not been found at all serious as in practice there are very few recordings that have shown an excess of top or bass, and in only one case has it been found necessary to reduce the high-frequency response due to the "toppy" nature of the recording, and this was done by connecting a .01μF condenser in series with a 50,000Ω variable resistor between the anode of V3b and chassis.

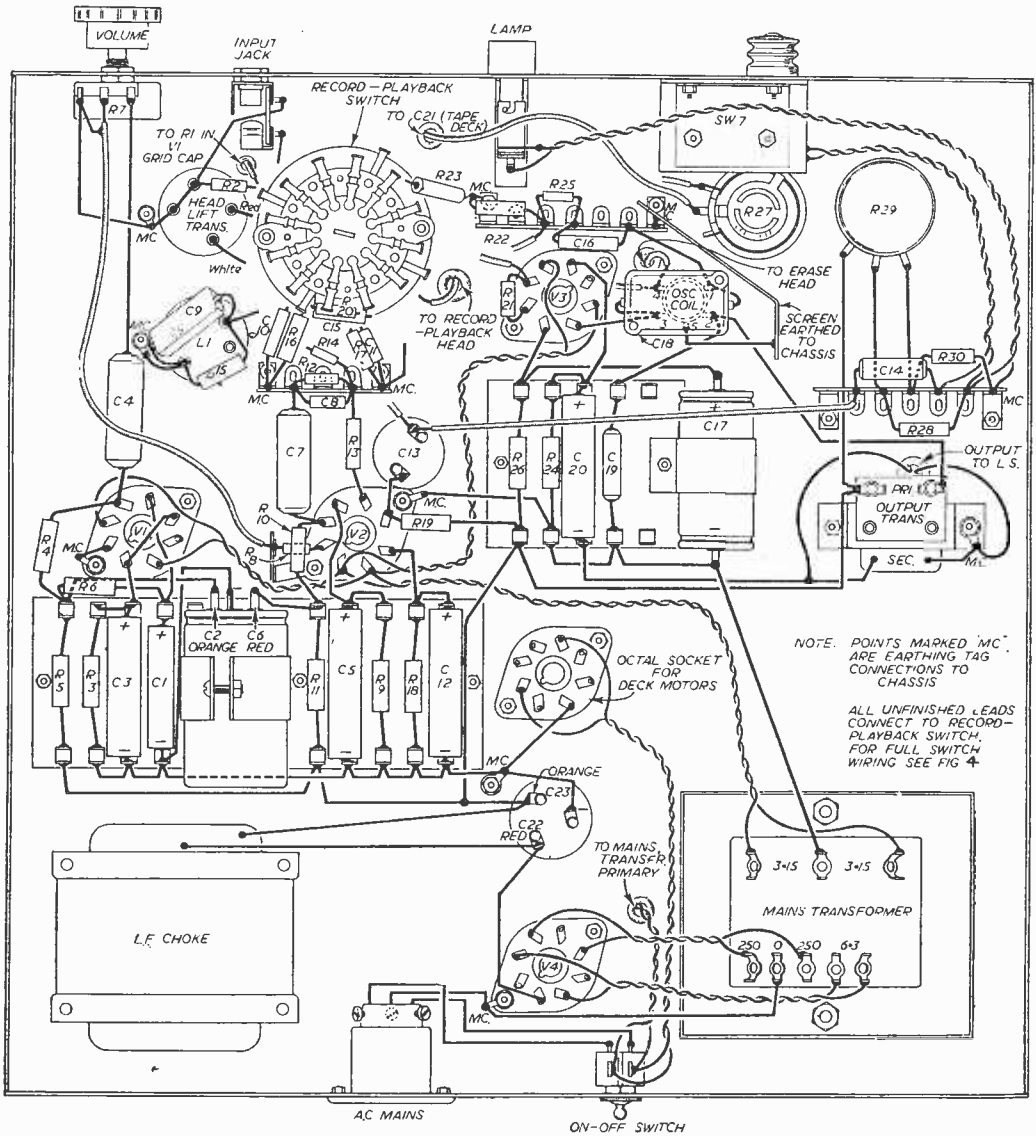
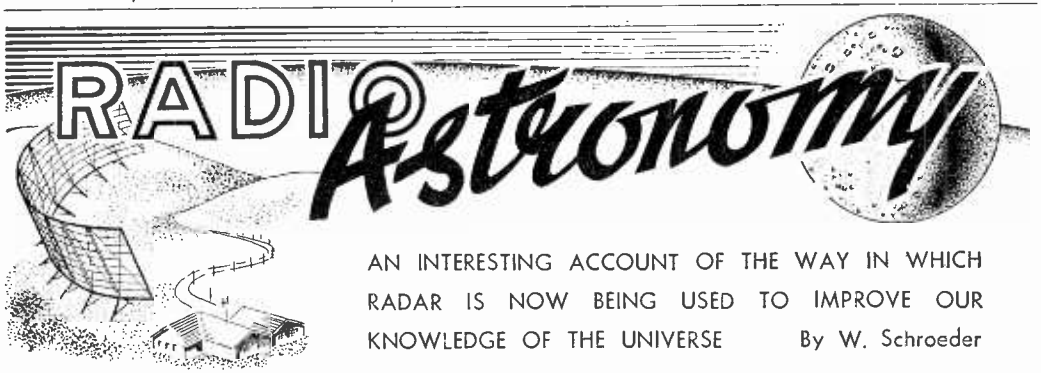


Fig. 5.—Wiring diagram of the amplifier. Note that R24 should be 220Ω and not 220K as shown in the list of parts.



AN INTERESTING ACCOUNT OF THE WAY IN WHICH RADAR IS NOW BEING USED TO IMPROVE OUR KNOWLEDGE OF THE UNIVERSE By W. Schroeder

SINCE K. G. Jansky, an American scientist, first received a radiation from some source in outer space in December, 1931, radio-astronomy has become a recognised branch of science. The significance of his discovery was not realised at the time, and its development took place only after the last war.

Jansky was investigating atmospherics on a wavelength of 15 metres, when he discovered that the intensity of aerial noise did not vary according to the time of the day but with a period of 23 hours and 56 minutes—corresponding with the earth's rotation relative to the stars. The source of the noise was finally traced to the Milky Way, but Jansky failed to detect any emission from the sun.

So far, all our astronomical knowledge had come through the "window" in the earth's atmosphere which admits the visible light, corresponding to a range of wavelengths covering three-and-a-half octaves. It was now evident that there was another, much larger window, covering 10½ octaves, i.e., wavelengths from 1 centimetre up to 15 metres. Molecular absorption limits the window at the high-frequency end and, towards the longer wavelengths, the ionosphere bars the "view." This wide range is a clear advantage of radio-astronomy over classical astronomy, and there is also the fact that the weather puts no restriction at all on the use of our radio-elescopes.

When in February, 1942, British Army radar equipment, working on a wavelength of 4 to 6 metres, was suddenly and seriously interfered with by the occurrence of an extremely high noise, it was feared that the Germans might have discovered some new form of jamming. The source of interference, however, was traced to be the sun which, just then, showed an extremely large sunspot. The observations made at that time finally gave the impetus to the systematic investigations which began in 1946.

Early radio-telescopes consisted of an array of half-wave dipoles, but their power-gain, even when used with a reflector, rarely exceeded 100. Their resolving power also left much to be desired, but this depended on the nature of the received waves. With increasing wavelength the resolving power decreases and at 60 centimetres it is already about one million times smaller than that of quite a small optical telescope.

Considerable improvement, however, was achieved by using several aerials, widely separated and feeding them to a common input at the receiver. These "interferometers" have been constructed with base-lines as long as six miles, and in Australia an interferometer for the investigation of solar radiations has been erected which consists of 32 aerial systems. The resolving power of this instrument is about one minute of arc.

Naturally, these aerial systems have to be rebuilt every time a change of wavelength is desired. A more versatile type is the parabolic mirror with a half-wave dipole at its focus. These can be easily constructed as the mirror need only consist of tinplate or wire-mesh because of the long wavelength, and deviations of up to 1/8 from the true form of the parabola have no ill-effects.

Such a telescope was erected at Jodrell Bank, in Cheshire, in 1947. Its diameter is 218ft., and the receiving dipole at the focus of the mirror is fitted on top of a 126ft. mast which can be tilted in order to displace the direction of the received beam. The mirror of the instrument consists of wire mesh, the separation of the wires being 8in. The leakage of this mirror is 37 per cent. at a wavelength of 2 metres. The fact that the departure of the surface of the mirror from the form of a true paraboloid is about 5in., limits the shortest wavelength receivable at 1 metre.

The rather arbitrary measurements of the instrument were a result of the slender means available to Professor A. C. B. Lovell when he built the mirror, and strangely enough, the height of the rim, which is 23ft. 4in., was actually determined by the height of their ladders.

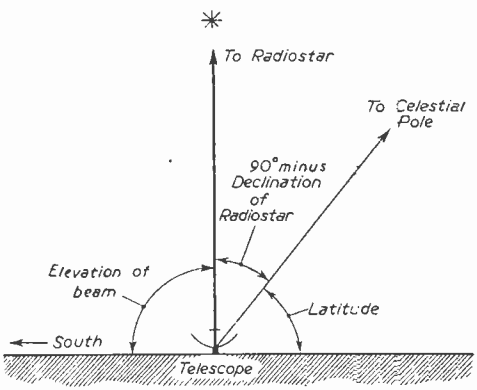


Fig. 1.—Setting up a radio-telescope: The declination of the area of the sky investigated depends on the elevation of the beam and on the latitude of the place of observation.

The results obtained with this telescope were so encouraging that the building of a large, completely adjustable radio-telescope was contemplated which is now actually under construction. Professor Lovell, of Manchester University, is mainly responsible for its design, and the cost of construction is shared between the Nuffield Foundation and the Department for Scientific and Industrial Research.

The mirror of this new radio-telescope will have a diameter of 250ft., and its focal length will be 62½ft. The huge bowl of copper-wire mesh, spaced at 1in. intervals, with its frame and supporting girder weighing in all about 600 tons, can be set to any elevation desired. It is supported by two towers, 185ft. high, which run on a circular railway track, enabling the instrument to be directed towards any part of the sky.

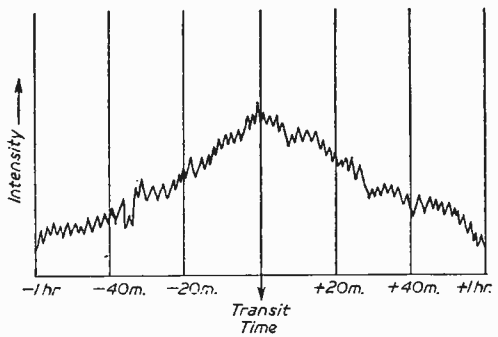


Fig. 2.—Typical recording of the transit of a radiostar, indicating "scintillation."

At a wavelength of 21 centimetres this aerial system will have a power-gain of 100,000, and the beam-width is as small as 12 minutes of arc.

Naturally, these huge instruments are employed to investigate the faintest sources of radio waves reaching us from outer space, but quite small instruments can yield surprising results with nearby sources of the Milky Way and the sun, especially at wavelengths under 1 metre. When receiving very short wavelengths, the dipole at the focus is usually replaced by a wave guide which conducts these microwaves with extremely low losses. The mirrors of these telescopes have diameters of 3 to 6ft., and quite good results have been obtained by amateur radio-astronomers with a 5ft. mirror of 1in. copper-wire mesh, with a dipole at the focus. The wavelengths received were from 15 to 60 centimetres.

The receivers employed in connection with these aerials are always conventional V.H.F. receivers, the only modification being the addition of a field strength recorder either in the anode circuit of an A.V.C. controlled valve, or of the detector valve if a super-regenerative receiver is used. In the latter case, the best circuit is a detector with separate quench oscillator and one R.F. stage, with a valve-voltmeter connected across the anode load resistor of the detector serving as indicator.

Aerials

Usually, the aerials—if not adjustable—are mounted to face south, similar to the meridian circles of the great observatories. As the earth, relative to the stars, makes one revolution in 23 hours and 56 minutes, the telescope sweeps out a complete circle in the sky during that period, the width of which depends on the beamwidth of the instrument. The transit of a source of radio waves is then recorded in a fashion similar to that of Fig. 2. It will be noticed that the curve is not a smooth one, showing a gradual increase in field strength up to the maximum at transit time, and afterwards a gradual decrease, but numerous kicks over and below the average position will be recorded. This "Scintillation" is just like the twinkling of visible stars whose light never is steady either, and the reason for this is in both cases the instability—electrical or optical—of the earth's atmosphere.

The discoveries to which the application of radio-telescopes has led are considerable already. Since Bolton and Stanley in Australia detected the first "radio star," an intense source of emission of very small diameter, in the constellation of Cygnus in 1948, over 100 of these point sources have been discovered. The most remarkable feature of these is that they usually cannot be identified with any visible object in the sky, but the use of the great 200in. telescope on Mount Palomar finally revealed very faint nebulae in an intense state of agitation as the probable sources of radio energy reaching us from a part of the constellation Cassiopeia. The radio star in Cygnus was discovered to be a collision of two galaxies of stars, far beyond our Milky Way system, at a distance of one hundred million light years. A third object has been identified to be the remains of a supernova—a star which exploded in A.D. 1054, an occurrence which was recorded by Chinese astronomers.

The scope of radio-astronomy was considerably extended when I. Ewen and M. Purcell, of the Harvard Observatory, discovered a line-emission, similar to the spectrum lines of visible light, on a wavelength of 21.2 centimetres (1,420 Mc/s) after this had been predicted by the Dutch astro-physicist van de Hulst in 1945. Very sharp tuning was necessary to distinguish this from the continuous spectrum of the radio emissions.

The discovery of this line-emission has been instrumental in the research into the structure of our own galactic system of the Milky Way beyond the point where optical astronomy began to fail, and already the actual distance of a radio star has been determined independently from any optical instruments.

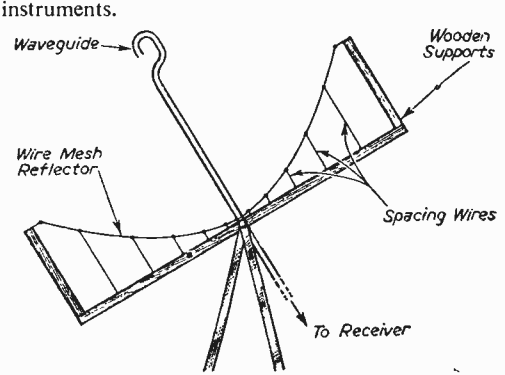


Fig. 3.—Cross-section through a parabolic reflector with waveguide for the reception of radiations in the microwave region.

PLASTIC CABINET as illustrated, 11½ x 6½ x 5½in., in walnut or cream, 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. **37/6**. P. & P. 3/6 with Superhet Chassis. **39/6**. P. & P. 3/6.

Used metal rectifier, 230 v. 50mA., **3/6**; gang with trimmers, **6/6**; M. & L. T.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 (14), **3/6**.

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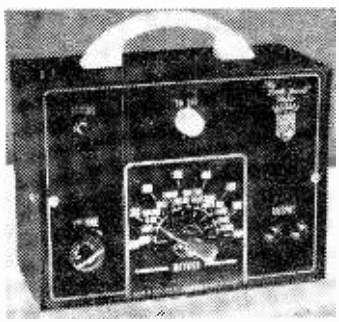
H.F. CHOKES, 6d. Rectifiers, 250 v., 60 mls., 5/-. **Meter Rectifiers,** 1 M/A. Half Wave, 3/6. **Variable Condensers,** air spaced 50 pf., 1/- ; 115 pf., 2/6 ; 500 pf., 5/-. **Speaker Transformers,** 3/6. **Osmor Frame Aerials,** Medium Wave, 2/6.
TYANA SOLDERING IRONS.—Lightweight, with fine bit for radio use, 14/11.
YAXLEY SWITCHES.—2-pole, 6-way (2 Bank), 2/3. Toggle Switches, 1/-.
COIL FORMERS.—1in. with feet, 6/6 dozen, complete with cores. Brass Cores, 1in., 6d. each.
SOLDERING FLUX.—Monster size tins, 1/3.
SERVISOL Switch Cleaner, 3/- Tin.

RADIO KIT 19/6



Build this high quality portable radio in 45 mins. Exceptionally sensitive, twin-triode circuit, using unique assembly system, can be built by anyone. Size only 6¼in. 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 one only self-contained dry battery, cost less than 1d. for 5 hrs. ! **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 :** *"Its performance is almost unbelievable, it gives me stations I've never been able to get on my large radio."*
Send To-day Cheque/CWO/COD, 22/- (includes 2/6, post/packing) for Case, Dial, Handle, Plans. Parts Lists, etc. (Cost of Parts to Complete Radio only 30/-.) **Sent by return.** *(Overseas orders welcomed.)*
BRIGHTON RADIO CO. (Dept. PW7), 69, Preston Street, Brighton, 1.

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SAME DAY SERVICE
All Guaranteed New and Boxed

1.4v. miniatures, 1R5, 1S4, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94, **7/3** ; any 4 for 27/6. 6AL5, 6AM6, 6F12, 8D3, D77. EB91, EF91, Z77, **6/9** ; any 8 for **50/-.**

1A7GT	6K8G 8/6	25L6GT		EL41	9/6
11/6	6K8GT 9/-		8/6	EL91	7/9
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1R5 7/3	9/-		8/6		14/6
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6K7G 6/-	20D1 8/9	EF91	6/9	X78	13/6
6K7GT 6/-	20F2 9/6	EF92	5/6	Z77	6/9

Postage 4d. per valve extra. STA. 4587.

READERS RADIO 24, Colberg Place, Stamford Hill, London, N.16.

A Versatile High Gain Amplifier

The details of the use of positive feedback in audio amplifiers to get a greatly increased gain from valves. A practical circuit is included.

SOME while ago the writer, whilst answering a problem put to him by a student on the subject of negative feedback, wondered if it were possible to use positive feedback to increase the gain of an audio amplifier. Certainly, if positive were substituted in the formulæ greater gains could be calculated. When the formulæ are used for negative feedback, no case can be made where the amount taken out of the circuit is less than the amount put in, i.e., the gain cannot be reduced past unity. On the other hand, with positive feedback, if the fraction fed back is multiplied by the stage gain, and the result is higher than unity, the amplifier will be of no use as oscillation will occur. The formula for the gain

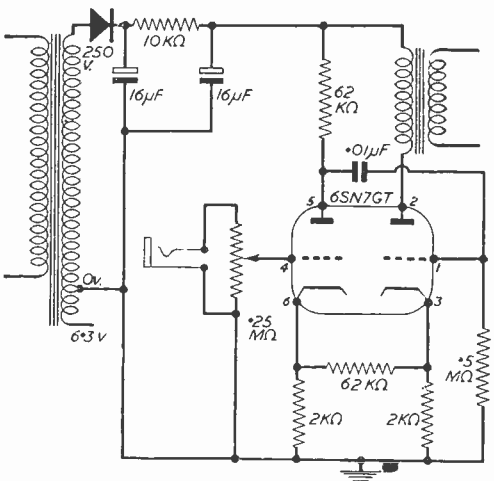


Fig. 1.—Basic theoretical circuit.

of an amplifier with feedback is $\frac{\mu}{1-\alpha\beta}$ where μ is the stage gain without feedback, β the gain to the particular point in the circuit from where the feedback is taken, and α the fraction of the output feedback. In most cases μ and β are equal, but in the case of taking feedback from the cathode circuit it will be seen that the gain across the cathode resistor will be different from the gain across the anode load resistor.

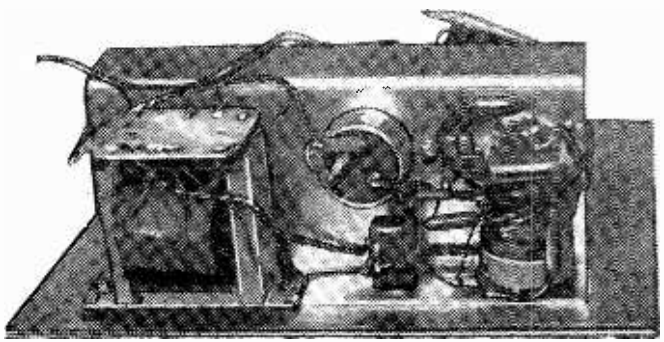
The Circuit

Looking around the stock of valves in the laboratory, the old friend the 6SN7GT was chosen, as one-half is capable of driving a loudspeaker at a power of about ½ watt, and this is sufficient for a very wide range of uses. The simplest type of positive feedback with a double valve is to join the two cathodes together and use a common resistor for the cathode circuit, whilst joining the anode of one to the grid of the other by a condenser, such a circuit is used in resistance-capacity oscillators. A modification of this method has been used. Each valve, or should we say section, has its own cathode resistor and the two cathodes are joined by a suitable resistor. The calculations were made, and the resulting value of resistor for a very high gain tried, but the circuit was very unstable, so one of a lower feedback value was used. It is as well to note that the higher the resistance the lower the feedback value. In the end it was found that with a 6SN7GT, with 2,000 ohms for each of the cathode circuits, and an anode load of 62,000, a coupling resistor of 20,000 ohms gave very good results. In the layout of the circuit great care should be exercised to see that no extra stray feedback is introduced—or it will oscillate. The layout employed as can be seen from the photograph is of the straight line type, i.e., everything is in a straight line, power transformer, smoothing and the amplifier. The mains transformer used is an Elstone TV pre-amp type as it will give ample power for the job. As the anode current is small resistance capacity smoothing is used and this is surprisingly efficient. The smoothing and reservoir condensers are in one unit, the Dubilier double unit can-type, the 161650, being used, joined with a 10,000-ohm resistor. The complete circuit is shown in Fig. 1. The layout of the base of the 6SN7GT is shown in Fig. 2, and the reader can do no better than follow it as close as possible. All the other wiring should, where possible, be twisted so as to keep down both the hum and the unwanted feedback.

The case and front panel were knocked out in the writer's own press-shop, and the front panel and chassis were aluminium, whilst the case was made out of sheet steel.

Uses

There are many uses to which the finished unit can be put. As the sensitivity is so very high it can be used as a baby minder; the writer amused himself by joining it up to the house loudspeaker wiring by a multi-ratio transformer of the ratio of 90 : 1. With



View of the underside of the chassis.

this, it was possible—with the wireless switched off, to hear every sound in the rooms fitted with loudspeakers. Normal conversation came over very loudly and the length of wire used for input to the amplifier made no difference, providing that it was earthed.

As a Signal Tracer

Another use is as a signal tracer. The circuit of a simple probe unit is shown in Fig. 2, and the polarity of the crystal is of no consequence, but the condenser should be of ample working voltage.

With a Crystal Set

One final use, of course, is for running a loudspeaker off a crystal set. For the most part components from the junk box can be used, but the resistors should be of the 10 per cent. tolerance.

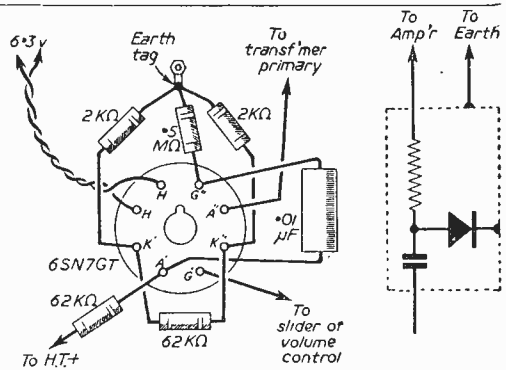


Fig. 2.—Wiring layout and suitable probe unit.

News from the Clubs

SOUTHEND AND DISTRICT RADIO SOCIETY

Hon. Sec.: J. H. Barrance, M.B.E. (G3BUJ) 49, Swanage Road, Southend-on-Sea, Essex.

THE opening meeting, after the summer break, was held at the EKCO Canteen by kind permission of the Directors of Messrs. E. K. Cole, Ltd., when Mr. C. G. Collop (G3AXN), a member of the Society, recently returned to U.K. on the Survey ship *John Biscoe* from an Antarctic Expedition, gave a unique account of the doings of these stalwart explorers in that part of the world where the temperature often reaches 40 below zero.

The subject of Mr. Collop's talk was "Radio in the Antarctic" and he illustrated it with about 100 snaps which portrayed the extreme difficulties of radio; where only high-frequency communication was possible and where the whole aerial system was thickly coated with ice. He also acquainted us with that ice-bound part of the world, which was once tropical, and where even now live volcanos still pour out molten lava, which melts the ice in the mountain crevasses into hot lakes.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: N. Miller, 18, Mascalls Gardens, Brentwood, Essex.

THE Society's winter programme includes film shows, lectures discussions "on the air," evenings with G4KF and the monthly "junk sales."

The Society meets every Tuesday evening at 8.15 p.m. at R.A.F.A. House, 18, Carlton Road, Romford, and all visitors and new members will be warmly welcomed.

Further information can be obtained from the Hon. Secretary.

BRADFORD AMATEUR RADIO SOCIETY

Hon. Sec.: F. J. Davies, 39, Pullan Avenue, Eccleshill, Bradford, 2.

THE November meetings are as follows: November 9th. Display of Members Gear. On November 23rd, there will be a lecture on "The Human Ear" by an ear specialist. Both meetings are at Cambridge House and will commence at 7.30. Copies of the syllabus may be obtained from the Secretary.

BRIGHTON AND DISTRICT RADIO CLUB (G3EVE)

Hon. Sec.: T. J. Huggett, 15, Waverley Crescent, Brighton, Sussex.

THE club meets every Tuesday evening at 7.30 p.m. at the "Eagle Inn," Gloucester Road, Brighton. The transmitter is on the air every month on top band and 80 metres, and many interesting Q.S.O.s have been made on both phone and C.W. Phone is used whenever possible to add interest to those who do not know the code. Young members are especially welcome, and demonstrations and talks on simple equipment for the young S.W.L. are being given during the coming winter months. Morse code classes are also held. A new 100-watt transmitter is also under construction for club use.

CLIFTON AMATEUR RADIO SOCIETY

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

THE Annual General Meeting of the Society was recently held, and the following were re-elected for a further term of office:

Chairman: J. Lambert, G3FNZ; *Hon. Treasurer:* N. Moore; *Hon. Secretary:* C. Bullivant, G3DIC; *Committee Members:* E. Smith, D. Veasey.

The Club Championship cup for 1953/54 has been won by N. Moore.

Programme for November: 12th, Constructional Evening; 19th, "Metropolitan Police Radio System" by W. H. Andrews, G2YG; 26th, Constructional Evening.

Meetings are held at the clubrooms 225, New Cross Road, London, S.E.14, every Friday at 7.30 p.m. Details of membership can be obtained upon application to the Secretary.

NEWARK AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: J. R. Clayton, 160 Wolsey Road, Newark, Notts.

A FILM show organised by Messrs. A. Hall and J. Clayton will be held at the "Northern Hotel," on Sunday, November 7th at 7 p.m., at which several interesting technical films will be shown. The mid-monthly meeting at "Northgate House" will be at 7 p.m., on Thursday November 18th, when there will be a demonstration of a commercial trans-receiver.

All interested are invited to attend.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: L. H. Webber, G3GDW, 43, Lime Tree Walk, Newton Abbot.

AT a recent meeting G3AVF gave a very interesting talk on "Transistors," and brought along his TTX for demonstration. In conjunction with this talk, G3GDW brought along a portable receiver, so that the transistor could be heard working.

At the next meeting, G3GDW will talk on the results of the Low Power Field Day, in which he took part.

A proposal has been made to hold a Dinner Party—at a date near Christmas—for members and their ladies. At the next meeting this will be discussed, and the date, time and place will be fixed.

Meetings are held on the third Saturday each month, at 7.30 p.m., at the YMCA, Torquay. Visitors are always welcome.

LIVERPOOL AND DISTRICT AMATEUR RADIO CLUB

Hon. Sec.: A. D. H. Looney, 81, Alstonfield Road, Knotty Ash, Liverpool.

DESPITE the summer recess, a fair level of activity can be recorded. A D.F. contest has been held but no one found the transmitter in the required time.

A very interesting talk was recently given by Mr. Fitz-Gibbon of the M.O.S. Radio Inspectorate, and the club received a visit from W60DR, over here for a short while. A determined effort is to be made to win the Warrington Inter-club Fone Contest on Top Band and arrangements have been made to have a lecture on "Portable Equipment for RAEN" by G3FNI, and a talk on "Japanese Morse" by G3CSG.

READING RADIO SOCIETY

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

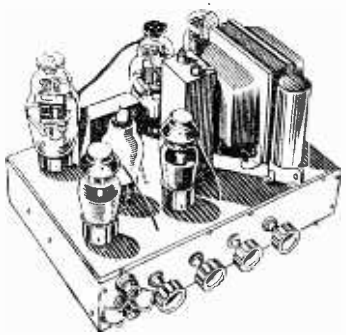
AT the annual Hamfest which is to be held on Sunday, November 21st, the Society has been fortunate in obtaining the services of F. J. H. Charman, Esq., B.E.M. (G6CJ), who will give a talk and demonstration on aerials.

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

We firmly believe our AII "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 14-10-8in. 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. 10 WATT "PUSH-PULL" HIGH-FIDELITY AMPLIFIER A3

Complete with integral Pre-amp. Tone control stage (as AII amplifier), 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 33⅓ 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 **48/9.** 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, 5¼ x 4 x 1¼in.

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 5¼in.

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

Tubular Types			
8µF 350 v.	1/9	8µF 500 v.	2/11
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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. 350 v.	1/3	16-16µF 450 v.	4/11
8µF 450 v.	2/3	16-32µF 350 v.	5/3
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RECORDING TAPE. Best Quality, Plastic, 1,200 ft. Reels only **18/9.**

A PUSH-PULL, 3-4 watt HIGH-GAIN AMPLIFIER FOR £3/7/6. 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. The amplifier can be supplied ready for use for **25/-** extra. Carr. 2/6. Full descriptive leaflet, **7d.**

PLESSEY 3-SPEED MIXER AUTO-CHANGERS with high impedance magnetic pick-up with duo point alloy stylus for long playing or standard records. (Will play 2,000 records before replacement stylus required.) Brand new, cartoned, guaranteed. Limited stocks at only **10 gns.**, plus 5/- carr.

MICROPHONES. Crystal type, good quality. Recommended for use with our amplifiers. Hand type, **59/6** ; Stand type, **£6/19/6.**

VOLUME CONTROLS with long (1in.) spindles, all values, less switch, **2/9**, with S.P. switch **3/9.** D.P. sw., **4/9**

SELENIUM RECTIFIERS

L.T. Types		H.T. Types H.W.	
2/6 v. ½ a. H.W.,	1/9	120 v. 40 mA	3/9
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6/12 v. 1 a.	4/9	250 v. 50 mA	5/9
6/12 v. 2 a.	8/9	250 v. 80 mA	6/11
6/12 v. 4 a.	14/9	RM4 250 v. 250 mA	11/9
6/12 v. 6 a.	19/9		
6/12 v. 10 a.	29/9		

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, ¼ 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.** 8in. R.A. Field 600 ohms, **12/9.** 10in. R.A., Field 1,000 or 1,500 ohms, **23/9.**

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

Interleaved and Impregnated. Primaries, 200-230-250 v. 50c/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
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	21/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	21/9
350-0-350 v. 100 mA, 6.3 v. 4 v. 4 a, c.t. 0-4-5 v. 3 a	22/9
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, 0-1-6.3 v. 4 a, for R1355 conversion	29/9
300-0-300 v. 100 mA, 0-1-6.3 v. 4 a, 0-4-5 v. 3 a	22/9
350-0-350 v. 100 mA, 0-4-6 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. 8 a, 0-2-6 v. 2 a, 4 v. 3 a, for Electronic Eng. Televisor	69/9
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
450-0-450 v. 250 mA, 6.3 v. 6 a, 6.3 v. 6 a, 5 v. 3 a	69/9

ELIMINATOR TRANSFORMERS

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90 v. 10 mA, 7-0-7 v. 250 mA	8/11

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Standard Pentode, 5,000Ω to 3Ω ...	4/9
Standard Pentode, 7/8,000Ω to 3Ω ...	4/9
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Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω	15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-Pull 20 watts, sectionally wound, 6L6, KT66, etc., to 3 or 15Ω	47/9
Economy Quality Amplifier type ...	47/9

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AMPLIFIER DESIGN

9.—UNTUNED AMPLIFIERS—CONTINUED

By R. Hindle

(Continued from page 666 November 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.

UNDER the conditions given last month the time constant is then $\mu F \times M\Omega$ i.e. $.001 \times 50 = .05$ second which s reasonably large compared with the petiod of a 50 cycle note (.02 second).

Distortion

A table of the values of grid voltage and anode current at the various points of interception of the curves by the load line in Fig. 31 can be made and if these are plotted on a graph of anode current versus grid voltage as in Fig. 32 the distortion can be more readily seen. Without distortion this graph should be a straight line and the deviation from straight (the dotted straight line being drawn in so that the curvature can be seen) indicates the degree of distortion. It will be seen that the curve is at one side of the dotted straight line along its length and that it is a single graceful sweep rather like a somewhat misshapen half-cycle of a sinewave. This indicates that the distortion is second harmonic and in fact it is well-known that the predominant distortion in the case of a triode is second harmonic. This is more tolerable to the ear than the third harmonic of a pentode output valve, which would be represented by a distortion curve that crosses the dotted straight line and is thus more like a full sinewave cycle. The percentage distortion can actually be calculated from the distortion curve by measuring the divergence of the anode current at the quiescent grid voltage point (i.e 35 volts in the example) which call I_o. Now, using the maximum anode current I_{max} and the minimum current I_{min} passed by the valve during operation the following formula applies :—

$$\text{2nd harmonic} = \frac{\frac{1}{2}(I_{max} + I_{min}) - I_o}{I_{max} - I_{min}} \times 100\%$$

Output Transformer

One might well wonder why an output transformer is used at all and indeed it would be very convenient beside removing a major source of distortion, if this component could be dispensed with. Unfortunately the practical difficulties in winding the speech coil of a moving coil loud speaker with an impedance approximating to the load required by a valve are too great. The speech coil is carried on the cone as part of the moving system and consequently there are severe limitations on the size and weight permissible. Consequently it is found more satisfactory to accept the disadvantages of the output transformer and to wind the speech coil to a comparatively small impedance. The transformer is then chosen to have a step-down ratio equal to the square foot of the ratio of the load required to the speech coil impedance.

A further complication is that the speech coil impedance is not a constant but actually varies with frequency. The value usually quoted and used for determining output transformer ratio is that at a frequency of 1,000 cycles but as will be seen from Fig. 33 at other frequencies it is much higher. These factors have to be taken into consideration by the valve manufacturer when determining the optimum load for his product and though we shall find the need later to return to this problem, for the time being we will take the easier path of following the maker's recommendations.

Practical Design

Now the first output stage to work with the amplifier previously described will be attempted. This will use a triode to illustrate the principles discussed but later a tetrode design will be given and so, for the sake of economy and to permit the reader to try out both at a minimum of expense a valve that will demonstrate both types of circuit will be chosen. Also, continuing the policy of demonstrating modern technique, the valve will be chosen from the modern miniature range such as is used in all the latest equipment.

A very suitable valve is the Brimar 6AQ5 which is a beam tetrode but by strapping grid 2 to anode the valve works as a triode. There is a further advantage in following this course in that most available output triodes are directly heated and consequently introduce circuit difficulties whereas, of course, the 6AQ5 is indirectly heated. Fortunately also there is an exact equivalent to the 6AQ5 for use in A.C./D.C. circuits and so the basic design that we shall produce will be applicable to this method of working too, and two versions of the amplifier will be given, one using the 6AQ5 in a purely A.C. circuit and the other using the Brimar 19AQ5 in an A.C./D.C. circuit, both operating with the twin-triode amplifier already designed and both capable of being converted for beam tetrode working later for comparison purposes. The Brimar 6BW6 could be used as an alternative on the A.C. version, having the same characteristics but with a B9A base instead of a B7G base.

Valve Data

Fig. 34 gives the anode characteristics for these two valves working as triode. It is proposed to work the valve with a H.T. of 250 volts, this being a convenient

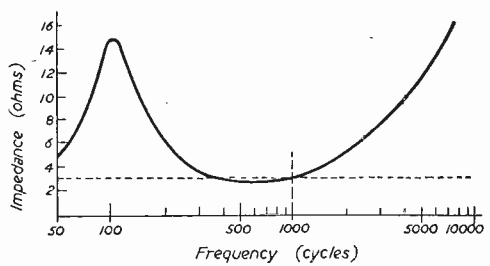


Fig. 33.—Impedance curve of a typical moving-coil speaker, nominally 3 ohms.

and economical value to provide using standard components, and so the working point is on the vertical line representing this voltage. The maximum anode dissipation given by the makers is 12.5 watts and the line representing this dissipation is shown dotted on the diagram. We must see that when the valve is working along the load line this maximum

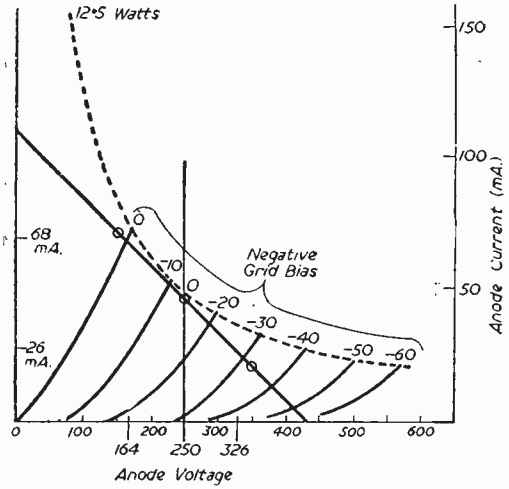


Fig. 34.—Characteristic of 6AQ5; 19AQ5; 6BW6.

dissipation is not exceeded but we shall go as high as possible up the 250 volt line so as to obtain the maximum output.

Following the 250 volt H.T. line vertically it is seen that the grid bias must be at least about 12 volts if the no-signal condition is not to result in the anode dissipation exceeding the permitted maximum and so we are not in the least surprised to find that the makers specify 13.5 volts for this H.T. voltage. Point O can therefore be marked in at 250 volts H.T. and −13.5 volts grid bias, where it will be seen that the anode current flowing is 45 mA. The valve lists also give the optimum load as 4,000 ohms. This load, being in the form of a speaker speech coil with its impedance stepped up to the anode of the valve by means of a transformer, has already been seen to have negligible effect on the no-signal condition but from the point of view of the audio signal currents it is very real and it will have an effect on the instantaneous anode voltage which obeys the ordinary principles of Ohm's Law. Thus supposing there were a signal current of 50 mA peak-to-peak produced in the load, then, by Ohm's Law, there would be a signal voltage across the load of :

$I \times R = 50 \times 4{,}000$ (divided by 1,000 because I is in mA).

= 200 volts peak-to-peak.

Now this voltage would swing about the no-signal condition, equally below and above it, so the anode voltage would go from 250 + 100 to 250 − 100 and the current from 45 − 25 to 45 + 25 mA (the higher the current the greater the voltage lost in the load and therefore the lower the voltage actually at the anode and vice versa). So these two points can be marked on the curves, i.e., 350 volts 20 mA and 150 volts 70 mA. These points will be on the load line and so the line can be drawn in joining these points and extended in both directions and the accuracy of the work is shown by the fact that the line passes through the static point O, as it should do.

Reasonably linear operation is practicable along this load line down to zero grid bias; the signal must not be allowed to go beyond this value or grid current will cause distortion. Thus the peak signal that the valve will accept is equal to the static bias i.e. 13.5 volts. The negative half-cycle of the input signal will be of equal amplitude but will swing in the other direction so that the grid goes to 13.5 + 13.5 = 27 volts negative. E_{min} in the formula already given is the anode voltage at the least negative

(*Continued on page* 753)

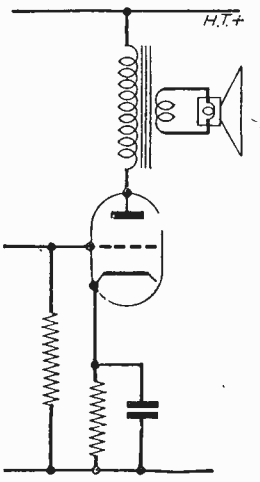


Fig. 35.—Basic circuit of triode output stage.

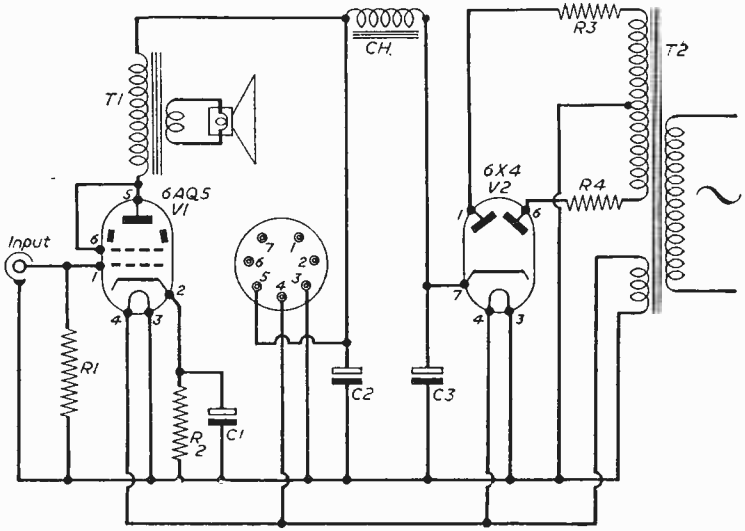
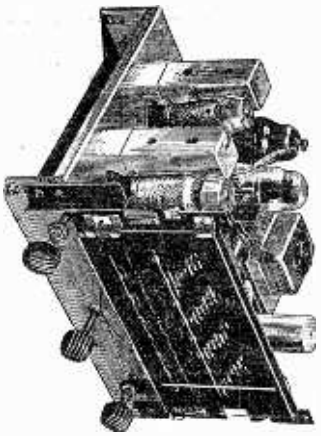


Fig. 36.—Complete circuit for a triode power amplifier—A.C. version.



grid voltage of the working range (Eg = 0 volts), i.e., 165 volts, and I_{min} is the anode current at the most negative grid voltage (27 volts) and is 27 mA. E_{HT} and I_{HT} are respectively 250 volts and 45 mA, so power output is :

$$\frac{250 \times 45}{2 \times 1{,}000} \cdot \left(1 - \frac{165}{250}\right) \cdot \left(1 - \frac{27}{45}\right)$$
$$= .765 \text{ watts}$$

or in round figures ¾ watt. The factor 1,000 that appears in the denominator of the first expression above has to be introduced because I_{HT} is in mA.

Distortion

It is meaningless to talk about power output without indicating the degree of distortion present and there must be distortion with the 6AQ5 as with any other valve. If a distortionless state could be set up the anode swing above and below the static voltage would be the same for a given input grid voltage variation. Thus with a sine wave input of the maximum permissible amplitude (as above) of 27 volts peak to peak the grid swings equally 13½ volts below the steady bias position and 13½ volts above the static condition and so the anode should swing equally above and below the static 250 volts used for the design. In actual fact, however, it is seen that the anode actually swings from 164 volts to 326 volts, i.e., from 88 volts below to 76 volts above 250 volts, so clearly there is a measure of distortion. The makers specify, in fact, 3.5 per cent. total distortion for the working conditions used for this design and if we doubted that information it could be proved by drawing the distortion curve in the form shown in Fig. 31. This amount of distortion is very satisfactory for this simple type of circuit, for in earlier years it was quite common to work with distortions up to 10 per cent.

A.C. Version

The basic power output circuit given in Fig. 35 is developed to include the power and rectifier circuits with the result, for the A.C. case, as shown in Fig. 36. V2 is a normal full-wave rectifying circuit operating from a 250-0-250 volt winding on the mains transformer T2. For the sake of consistency the rectifier valve is chosen from the Brimar range of modern miniature valves and is, in fact, a 6X4 The heater of this valve takes 6.3 volts and not 5 volts, as is provided on the usual mains transformer. The reason is that the heater cathode insulation is made sufficient to withstand up to 450 volts and so the rectifier heater can be connected across the same supply as the other valves in the circuit. From Fig. 36 it will be seen that this is done in the present case and only a single heater winding is required. The transformer chosen has a 5-volt winding as a matter of fact, and this is left disconnected. The choice fell to this particular component, the Elstone type MT/M1, because of its small size enabling the final design to be compact in keeping with the previous amplifier and with modern practice.

The valve data for the 6X4 stipulates a minimum resistance in each anode circuit of 150 ohms. Quite often the transformer winding itself provides this resistance but to make sure in the present design the resistors R3 and R4 are incorporated. Smoothing is conventional and is found quite adequate.

The rectifier is rated to give a maximum of 70 mA. and the output valve, as we have seen, requires only 45 mA., so there are 25 mA. available for other circuits and consequently a power output socket is provided. The heater winding gives up to 1.5 amps., and the two valves on the chassis require only just over an ampere together, so the heater voltage is also fed to the output power socket. The two-stage voltage amplifier previously described had no power supply incorporated and it is intended to take its supply from the present chassis; its needs are easily provided by this power supply.

The 6AQ5 is seen to be strapped as a triode and is biased by R2, which is by-passed by C1; R1 provides the D.C. grid return path. The input signal required to fully load the output valve was seen to be 13.5 volts peak and this is well within the rating of the valve used for the voltage amplifier. By Ohms Law, R2 to give a bias of 13.5 volts with a current of 45 mA should be 300 ohms.

The chassis used is of similar construction to that of the voltage amplifier except that it is made twice as long to accommodate the power equipment. Even

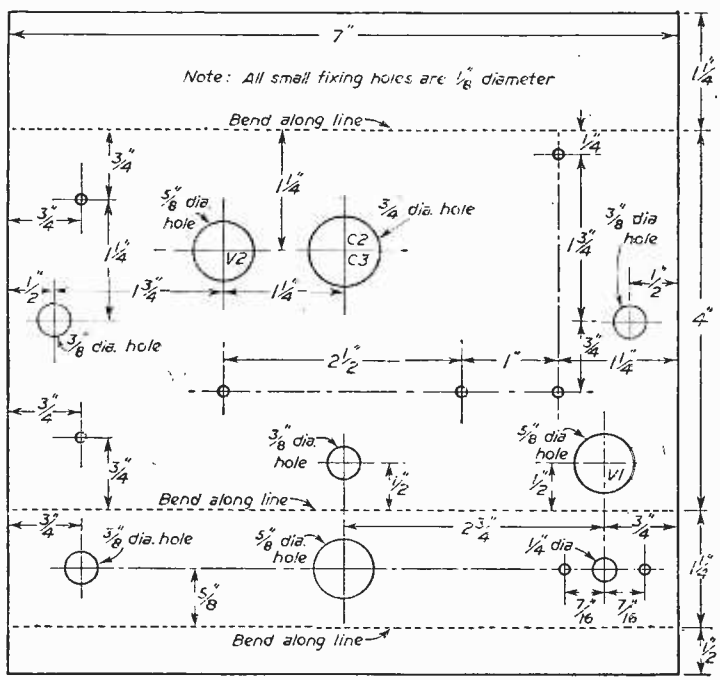


Fig. 37.—Chassis drilling diagram for A.C. amplifier (Fig. 36). Note that the ⅜" holes are for grommets.

then, it is only 7in. x 4in. Fig. 37 gives the drilling data for the components actually used and, as probably most constructors will obtain their chassis ready folded, the markings are as at the outside of the chassis. Perhaps a warning should again be given that the components should be obtained and measured before drilling the chassis (which in the prototype was of aluminium) because the position of the holes might vary slightly. Probably the neatest way is to make a template of drawing paper, marking the positions of the holes. The components can be tried on this and when satisfied the positions can be punched through the template. Notice that at only one point does the earth line contact the chassis, by the input coaxial socket. Apart from this connection chassis returns are not used except for the electrolytic capacitor C2, C3, the case of which is earthed in the usual way via the mounting clip.

Wiring

The wiring diagram is given in Fig. 38 and if the following sequence is followed no difficulty will be experienced.

1. Input socket to pin 1 V1.
2. R1. 220KΩ. From pin 1 V1 to earth tag by input socket.
3. Pin 3 V1 to earth tag to pin 3 output power socket to pin 3 V2.
4. Pin 4 V1 to pin 4 power output socket to pin 4 V2.
5. Pin 6 V1 to pin 5 V1 to tag 3 on output transformer.
6. R2. 300Ω } Both from pin 2 V1 to earth tag.
   C1. 50μF }
7. Pin 5 power output socket to nearest tag on electrolytic to tag 4 on output transformer.
8. Pin 3 power output socket to one side of 6.3 winding on output transformer.
9. Pin 4 on power output socket to other side of 6.3 winding.
10. R3. 150. From pin 1 V2 to pin 2 V2.
11. R4. 150. From pin 6 V2 to pin 5 V2.
12. Centre-tap of mains trf. H.T. winding to pin 3 V2.
13. Outside connections of H.T. winding to pins 2 and 5 V2.
14. Mains lead to tags on mains transformer marked for mains voltage available.

Using the Amplifiers

To connect the two amplifiers together a coaxial plug is fitted to the coaxial output lead from the voltage amplifier and plugged to the input of the power amplifier. A miniature plug is fitted to the power lead from the voltage amplifier. A four-core cable was used for this purpose in order to offer the maximum flexibility in use but for the present case only three inter-connections are required, one side of both heater and H.T. being earthed. Consequently this interconnection is made in the miniature plug, the lead from the earth busbar of the voltage amplifier and one side of the heater being connected to pin 3 of the plug and so to earth.

A peak signal of a tenth of a volt fed into the voltage amplifier with the volume control at maximum will be found to fully load the output stage.

It is intended that the power amplifier be stowed away in the cabinet of the equipment in which it is to be used rather than placed side by side with the voltage amplifier which has to be so mounted that the control is accessible. Later on, when R.F. amplifiers have been discussed a design will be produced to feed into these amplifiers and to be mounted alongside the voltage amplifier.

Universal Mains Version

The complete circuit for the universal version will be given next month. It will be seen that the valve heaters are connected in series and, of course, the voltage amplifier must be suitably wired as explained in the wiring data of that chassis. High-voltage heater valves are employed so that the minimum voltage remains to be dropped in the series resistor (R4, R5). V1 is the 19AQ5 and a half-wave miniature rectifier, the 35W4 matches this and so is used. The important characteristic in series wiring of heaters is, of course, the current taken by the heaters, not the voltage, and both these valves take .15 amps. The specified wiring of the voltage amplifier for universal operation results in the same heater current being taken by the 12AU7. The three valves, then, take 67 volts at .15 amps when connected in series and the dropper has to have a resistance to drop the surplus. Thus, supposing the mains are of 240 volts. The voltage to be dropped is now 240−67=173 volts at .15 amps. By Ohm's Law:

$$R = \frac{E}{I}$$

$$= \frac{173}{.15}$$

$$= 1{,}150 \text{ ohms.}$$

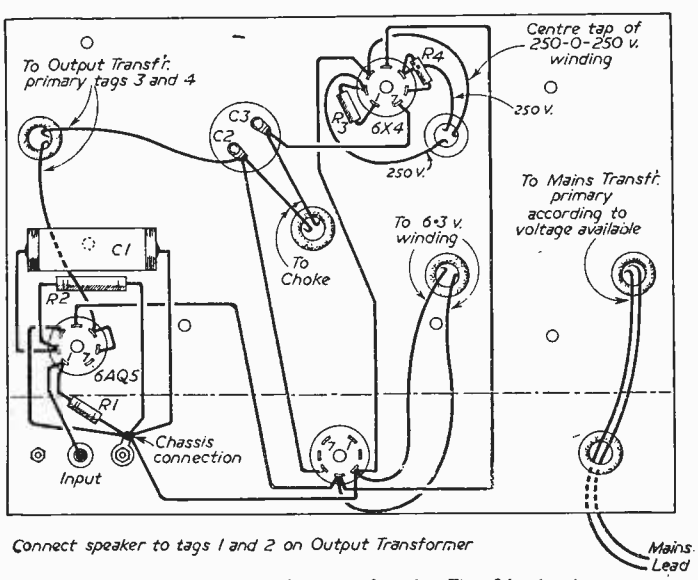


Fig. 38.—Wiring diagram for the Fig. 36 circuit.

(To be continued.)

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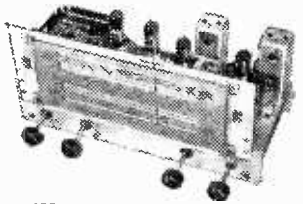

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Brand New and Guaranteed, with 10in. P.M. Speaker, A.C. 200/250 v. Four position Wavechange Switch. Short-Medium-Long-Gram. Slow Motion Tuning. Speaker and Pick-up connections. High Q iron-dust cored coils, 465 kc/s. I.F. Latest circuit technique delayed. A.V.C. and Negative feedback. Output 4.2 watts. 3 ohms output transformer on chassis. Chassis size 13½ x 5½ x 2½in., Glass Dial—10in. x 4½in., horizontal or vertical type available, lit by 2 Pilot Lamps. Colour Black Station names, L.W. Green, M.W. Red, S.W. White. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated. Chassis isolated from mains. PRICE **£10/15/0**. Carriage and Insurance, 4/6. (Without 10in. Speaker, **£9/15/0**. Carr. & Ins., 4/6.)

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SENTERCEL RECTIFIERS. E.H.T. TYPE FLYBACK VOLTAGES.—K3/25 2 kV., 4/3 ; K3/40 3.2 kV., 6/- ; K3/45, 3.6 kV., 6/6 ; K3/50 4 kV., 7/3 ; K3/100 8 kV., 12/6 ; K3/160 14 kV., 18/-. **MAINS TYPE.**—RM1, 125 v., 60 ma., 4/- ; RM2, 100 ma., 4/9 ; RM3, 120 ma., 5/9 ; RM4 250 v. 275 ma., 16/-.

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COPPER ENAMEL WIRE.—¼ lb. 14 to 20 s.w.g., 2/- ; 22 to 28 s.w.g., 2/6 ; 30 to 40 s.w.g., 3/6.

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VIBRATOR POWER PACK (Jeff-Travis-U.S.A.).—Compact Steel Case 7in. x 6in. x 4in. 12 v. Input. Output, 90 v. H.T., 6 v. and 1.5 L.T. Complete, 25/- ; p. & p., 2/6. Suitable Battery Portable Sets.

LOUDSPEAKERS P.M., 3 OHM.
3in. Plessey, 12/6. Goodmans 4in. square, 15/6, 5in., 14/6, 6½in., 16/-. 7in. Elliptical, 18/6. 8in. R. & A. 17/6. 10in. Plessey, 25/-. 6½in. with trans., 7,000 ohms to 3, 19/6.

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465 Kc/s Slug tuning Miniature Circular Can, 2½in. by 1½in. diam. Fits octal valve-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.

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D.C. MULTIMETER KIT for 500 uA meter. Complete kit of six 1% High Stability Resistors, three other resistors, Shunt S505, and full instructions, **26/-.**

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UNIVERSAL SHUNTS. 1% accuracy for any 1 mA or 500 uA meter. Only one simple adjustment to make, no calibrating required. With instructions. Guaranteed one year. S505 (½ mA) covers 1, 5, 25, 100 and 500 mA.S51 (1 mA) covers 2, 10, 50, 200 mA, and 1 amp., **15/-.**

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1T4	6/6	6BW6	6/6	6SH7(soiled)	5/-
IU5	6/-	6CH6	6/6	15D2	4/-
3V4	6/6	6J5	5/-	19AQ5	10/-
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6AL5	7/6	6X5	7/6	EF50	5/-
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A.C. MAINS POWER PACK OUTPUT STAGE.—In black metal case enabling the receiver to be operated immediately without any modification, can be supplied as follows :—Less Speaker. **£4/10/-** ; with 6½in. P.M. Speaker, **£5/10/-.**

DEDUCT 10/- IF PURCHASING RECEIVER & POWER PACK TOGETHER.
Please add carriage costs of 10/6 for Receiver and 5/- for Power Pack.

100 MICROAMPS METERS. 2½in. Circular Flush Mounting. Widely calibrated scale of 15 divisions marked "Yards," which can be re-written to suit requirements. These movements are almost unobtainable to-day and being BRAND NEW IN MAKER'S CARTONS are a snip, ONLY **42/6.**

TRANSFORMERS.—Manufactured to our specifications and fully guaranteed Normal primaries, 425v.-0-425 v. 250 ma., 4.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a. **ONLY 50/-** ; 350 v.-0-350 v. 160 ma., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a. **ONLY 42/6** ; 250 v. 0-250 v. 100 m.a., 6.3 v. 6 a., 5 v. 3 a. **ONLY 32/6,** 350 v.-0-350 v. 150 m.a., 6.3 v. 5 a., 0-4-5 v. 3 a. **ONLY 32/6.** The above are fully shrouded upright mounting. 5.5 kV. E.H.T. with 2 windings of 2 v. 1 a., **ONLY 72/6** ; 7 kV E.H.T., with 4 v. 1 a.. **ONLY 82/6.** PLEASE ADD 2/- POSTAGE FOR EACH TRANSFORMER.

CRYSTALS.—British Standard 2-pin 500 kc/s. 15/-. Miniature 200 kc/s and 465 kc/s. 10/- each.

RECEIVER 25/73.—Another purchase of these very popular receiving sections of the TR.1196. Makes an ideal basis for a mains operated All Wave Superhet, full modification data being supplied. Complete with 6 valves, 2 ea. EF36 and EF39, and 1 ea. EK32 and EBC33. BRAND NEW. ONLY **27/6** (postage, etc., 2/6). On a few less valves, but complete with the 465 kc/s. I.F.s, etc., **8/6** (post, etc., 2/6).

6 VOLT VIBRATOR PACKS.—Made by H.R.O. of America. Output 165 v. 80 ma., 6.3 v. 3 a. Contains 6X5 rectifier and full smoothing. Self contained in black crackled cabinet size 7in. x 7½in. x 6in. ONLY **29/6** (postage, etc., 2/-).

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100 ,,	D.C. 2½in. Flush circular.....	12/6
150 ,,	D.C. 2in. Flush square	7/6
500 ,,	D.C. 2½in. Flush circular.....	12/6
500 ,,	thermo 2in. Flush square ...	5/-
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20 amps	D.C. 2½in. Proj. circular.....	7/6
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WAR SURPLUS VALVES.—Fully guaranteed. All Post Free. 954, **1/9** ; 6K7, **4/-** ; 6K7 Metal, **6/6** ; 6V6GT, **6/6** ; VR91, **3/6** ; VR65, **1/6** ; 1D8, **2/6** ; 6AC7 Metal, **7/-** ; 6L6G, **8/4** ; 6SK7 Metal, **6/6** ; 6H6 Metal, **2/6** ; 807 Yankie, **8/-** ; 6SN7, **8/6** ; 5U4, **7/6** ; 5Z4, **7/6** ; 0Z4, **6/-** ; VS110, **3/6.**

MIXED RADIO PANELS.—Very popular full of resistors and condensers. **4/6.** Post Free. Not to be missed.

YAXLEY SWITCHES.—Two-pole 3-way. One bank. Spindle length 1in., **1/6.** Post Paid.

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VALVES.—Brand New, Every One Guaranteed. 6K7G, VT52 (EL32), CV136 (EL91), N77, 5/- each. 6F6G, **5/6.** 6V6GT, 6X5GT, **6/9** ; **72/-** doz. 12AX7, 6AQ5, **6/9.** 12AT7. **7/-.** 6SN7, **7/6.** RK34, 2C34, **1/9** ; **18/-** doz. 954, **1/6.** ATP4, **2/9.** 6K7G, 3 for **11/6.** 6X4, **6/-.** 6K8G, **8/6.** VR65 (SP61), **2/-** ; 19/11 doz. EY51, short wire ends, **11/6.** CV1053 (EF39), **7/6.** 6K7 metal, **5/6.** 12A6M, **7/6.** 807, **6/3.** R17, **7/6.** P. & P., 4d. 723—A/B.—Brand New, Boxed, **75/-** each. **SET OF 4 BATTERY VALVES.**—Brand New. 1T4, 1S5, 1R5, 3S4 or 1S4—4 for **24/9** ; **6/9** each. P. & P., 6d.

GERMANIUM CRYSTAL DIODES.—G.E.C., Brand New.—1/4 each ; **11/6** doz. Post 3d.

TRIPLETT 1 M/A METER RECTIFIERS.—Brand New, **5/6** ; 3 for **15/-.** P. & P., 4d.

VOLUME CONTROLS WITH SWITCH. SP.—Brand New, 1½ spindle, 1 and 1 meg., **2/-.** 5 meg., **3/6.** Post 4d.

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

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What is HI-FI?

IS THERE SUCH A THING AS HIGH FIDELITY? A CRITIC EXAMINES THE SITUATION AND MAKES SOME SUGGESTIONS

By "Grid Current"

IT is almost an exception at the present time to find descriptions of sound reproducing equipment without the appended descriptive adjective "Hi-Fi."

One of the most curious attributes attached to this label "high fidelity" is the emphasis placed on the ability of such equipment to reproduce the higher range of frequencies, curious because when the folded horn was introduced into the design of the gramophone, thus allowing a considerable extension of bass range of reproduction, and later when the moving-coil loud speaker and baffle still further extended this range, apparently nobody had the brilliant thought of labelling the new equipment as "high fidelity."

Bass reproduction having been obtained with some degree of success, attention was then directed to reproduction of those higher frequencies which play an important part in giving character to the tone character of individual instruments by reason of adequate coverage of a range of upper harmonics and ability to deal with those transients which are important in the accurate reproduction of certain instrumental effects.

Limitations

Two basic difficulties arose when this improvement was attempted. In the case of the radio receiver, certain limitations were imposed by the frequency band normally transmitted by the BBC, and in the case of the record reproducer, needle scratch became horribly apparent and could not entirely be overcome by filters.

In the era when attention was focused on the reproduction of bass frequencies, our enthusiastic friends too often subjected us to demonstrations of "perfect" reproduction consisting largely of bangs, thumps and resonant booms! Since attention has been focused on the higher range, we are now subject to demonstrations which assault our ears with squeaks, screams, hisses, and noises often not far different from that piercing horror which sometimes occurs when a knife edge is accidentally drawn across a dinner plate.

The curious thing about this "high fidelity" reproduction, as so often demonstrated to us by enthusiasts, is that the enthusiast himself appears to be transfixed with the glory of the sounds emitting from the equipment, whereas his family appear to be equally transfixed with horror from the dreadful sounds filling the room.

Perhaps a great deal of this may be put down to excess of zeal and enthusiasm, and a perhaps not too full comprehension of what is really meant by high fidelity—so now let us look at another side of this problem by examining some of the components and circuitry to which this label is from time to time attached. It is obviously impossible in the short space of an article of this nature to analyse such circuits or components, but the reader is invited to spend a few hours carrying out such an examination, and he may well wonder what the term "high fidelity" actually covers. As nobody has set down a definition for the term, it would perhaps be difficult to point an accusing finger in any particular case, and so confusion becomes even more confounded.

Taken literally, high fidelity would mean a high degree of faithfulness of reproduction.

Aim Unobtainable

It is suggested that this idealistic aim is fundamentally unobtainable in most instances. A matter of individual taste even enters into the question—if you are attending a concert in the Royal Festival Hall it may please you to sit in one particular position rather than in another because you prefer the balance of tone of the music which you hear when listening in that position. When you receive the same concert either via a broadcast or via the medium of a record the broadcaster or the recorder has decided for you your physical situation when listening to the music.

Another curious characteristic of the high fidelity enthusiast is that in a considerable number of cases he is unable to give you a demonstration of the reality of his reproduction without turning up the volume to such an extent that your natural desire is to escape from the onslaught at the earliest possible moment. It is rather as though he desired to drive the possibility of any lack of concentration on your part beyond the realms of possibility, and this may possibly be in some way associated with the cacophony of noise hurled upon you by your local cinema at the commencement of a film. I have never discovered whether, in fact, this is done to make it impossible for you to have your mind diverted by conversation with your neighbour at this crucial moment, or whether it is produced as a form of musical mesmerism!

A Definition

Any equipment carrying the label "high fidelity" should:

1. Be capable of accurately handling in their correct proportions those frequencies necessary to produce the characteristic tones of all those sounds it may be called upon to produce.
2. That the apparatus should be free from any cross modulation effects.
3. That at the volume *at which it is required to be used* the tonal balance can be adjusted to that most pleasing for the listener.
4. That it should not reproduce extraneous noises not present in the original performance.

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

"The Farmer of Sant' Agata"

BELIEVE it or not, "The Farmer of Sant' Agata" was not the story of a farmer who enriched Italy with crops and herds of cattle and sheep, but the life of Giuseppi Verdi, one of the world's greatest musicians and operatic composers, who enriched not only Italy but the world with masterpiece after masterpiece. The title seemed an awful cliché, comparable to "the Bricklayer of Chartwell" or "the Premier of Poland.". Surely "Caro Nome" or "Celeste Aida" would at least have had the merit of immediately directing the attention to the subject in hand, as well as being more poetical and romantic sounding.

But, cliché or no cliché, this biographical novel for the microphone based on the life and works of Verdi, by Spike Hughes, read by Felix Felton and produced by Michael Bell, and in five weekly instalments, each an hour's programme, was truly first class and wholly admirable. I rank it the best thing, at any rate of its kind, for months, and easily Spike Hughes' top achievement to date. The story was well told, the parts interestingly balanced, whilst the whole was bound together with a remarkable collection of gramophone records of excerpts of the glorious music.

May we have from Mr. Hughes' pen the fabulous story of Wagner, with the Wagner, Bulow, Cosima triangle unvarnished and the King Ludwig saga complete? Here would be radio entertainment *in excelsis*. We should have the I.T.A. in full pelt after it for exclusive rights!

Two appearances of Sir Thomas Beecham at the Proms—again, happily, a year distant—produced a volume of applause which made one wonder whether the applauders were not starved of good music adequately performed!

Two programmes, each also of an hour's length, "Prelude to War," dealt very much in the manner of the recent Wickham Steed talks with the origins of the two world wars of our time. One felt that we were only being told what good children were wanted to know. For this child at any rate, I already knew everything that was in the programmes and a good bit more. But then I never was a good child. The programmes themselves imparted nothing new. That was not the fault of either the late Professor Temperley or Sir Lewis Namier, the compilers. The programmes had nothing new to convey, but were very well done and very interesting.

Plays

I thought the best play of the month was not a "play" at all, but the radio version of Ivan Goncharov's "Oblomov." A wonderful story of a universal character, as all great books should be about. Oblomov is that person, the laziest person in the world who dodges all life's problems and crises, only to make the best of the baby he is left to carry. The play effectively began with the hero being dragged out of bed and ended with him getting back there to end his story. Robert Eddison was most effective and convincing as Oblomov, Barbara Couper as the girl he lost (although she was wholly "in the bag," as they say) and Susan Richards as the one he gained.

"The Doctor's Dilemma" needs little comment. Even the author's name is too famous to require citation. Jack Allen as Sir Colenso, the Doctor, Maxine Audley as Mrs. Dubedat and Cyril Cusack as Louis Dubedat headed the cast, all of whom put over the play's wit and philosophy with gusto and conviction.

The current serial, "Martin Chuzzlewit," is proceeding with great success. The series of immortal characters are parading before us in all their glory and with great effect.

"Golden Rain" was a pleasant offering from the pen of R. F. Delderfield. A financially harassed country parson is scandalized and morally outraged when he learns that his wife and his cook are sharers in a good slice of the Treble Chance pool. That they have been regular competitors in secret from him only makes his feelings all the more poignant. But religion and love are cleverly reconciled and Ivan Sampson, Ivan Brandt, Rachel Gurney, Kathleen Helme, etc., were very good.

Neville Shute's novel, "No Highway," dealing with the overworking of aeroplanes and their almost certain doom, made good Saturday Night Theatre material for the second time. So did "Random Harvest," James Hilton's story dealing with a first war casualty who loses all recollection of a part of his life until it is brought back by his being cleverly taken to a romantic spot. "Saturday Night Theatre" should be renamed "The Saturday Night Book Club."

Personal Call

The Saturday evening Sports Report has started one of the silliest imaginable minor features, Personal Call. In return for answering a truly babyish question the correspondent is rewarded, amongst other alternatives, with a microphone appearance. The first question I heard asked was "who won last year's England v. Scotland soccer international?" But, incredible as it may sound, the gentleman, presumably a football fan, else he wouldn't be taking any interest in this particular programme, did not know.

"CHIMELITE"

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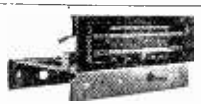

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THE CONTEMPORARY

Also in the modern trend is this very stylish contemporary console. Veneered in oak with contrasting mouldings this has the "G" plan look and is ideal for use with this furniture or with other contemporary fittings or furnishings. The radio and motor board is again uncut and its size 30in. · 15¼in. provides ample room for all equipment. Price **£8.15.0.** Carriage, etc. 12/6.

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ULTRA MODERN TAPE DECK

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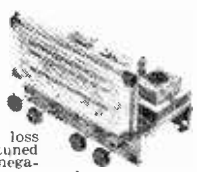

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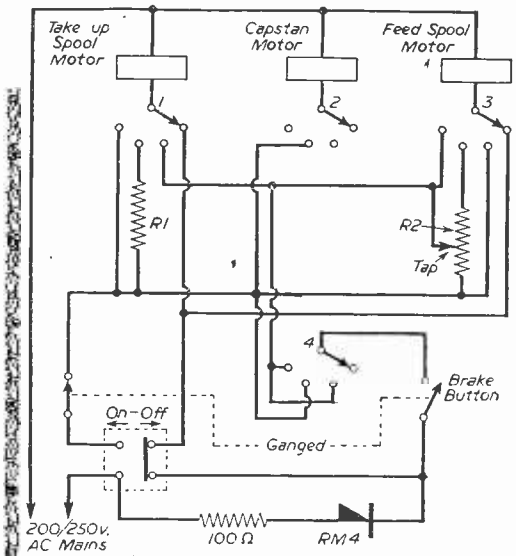
Open to Discussion

Magnetic Braking

SIR,—I have recently built a tape desk with magnetic braking as described in the article "Magnetic Braking on Tape Recorders," PRACTICAL WIRELESS, January, 1953, page 41. The circuit you give can be simplified, however, by eliminating the relay and the rather inconvenient 6 volts D.C. supply. The circuit of my modification, which has proved to be satisfactory, is appended.

The D.C. braking supply is distributed appropriately by the fourth wafer of the rotary switch. The brake switch used was a push-button opening the A.C. and closing the D.C. circuit on pressing. A switch similar to the on/off switch "A" could, however, be used. In the off position, the switch "A" passes D.C. to the spool motors when the rotary switch is turned to the position shown in the diagram. This locks the spools and is useful for tape-threading. No harm is done if switch "A" is pressed as the D.C. is then switched off.

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.



Mr. Johnson's revised magnetic breaking circuit.

The values of the resistors R1 and R2 were found by experiment; both were about 1,000 ohms. A tap on R2 eliminates a third resistor. The smoothing condenser in the original circuit was omitted as the smoother D.C. was found to be unnecessary.—R. P. C. JOHNSON (St. Albans).

Series Modulation

SIR,—Much has been said, written and thought about modulating a P.A. stage, but I haven't seen a thing about series modulation. It seems to me that if you wish to anode modulate a 150 watt P.A. stage you will have to pay out terrific sums for assorted chokes *ad infinitum*. But in S.M. you will need only a single good choke and a couple of high wattage carbon resistors. A point against it is, however, that you need approximately double the original voltage, but with surplus or otherwise mercury vapour rectifiers that causes very little trouble.

Another point is, why are we restricted to 150 watt I.P.? With some of the surplus valves on the market it is possible to have 200 watt modulated carrier. Two VT104s in push-pull, for instance, with a voltage of 1,250, Ia of 250 mA gives 200 watt carrier and I expect there are a good many others in P.P. or otherwise which would double this figure for carrier O.P. above. Why can't the P.M.G. let us have high power stations?—C. MCLEAN (Stoke Poges).

Changing Listening Conditions

SIR,—As a radio enthusiast I have taken PRACTICAL WIRELESS and your other publications for many more years than I care to remember, although this is the first occasion that I have entered into correspondence. What has prompted me to do so now is the changing and worsening conditions of reception on the medium broadcast band. I am, of course, aware that within the next two years we shall have F.M. and V.H.F. reception which will represent an incalculable change and result in extremely good quality reception.

There are, however, many snags. On these bands we shall be confined to listening to programmes from a local station with a choice of three programmes. For the reception of short and medium wave stations it will still be necessary to retain the present known type of receiver—which, in my opinion, should preferably be an entirely separate unit, although a compromise might be made to connect it to a common amplifier.

The tendency nowadays to build separate tuning units, pre-amplifiers-cum-tone control stages and a main amplifier is a step in the right direction, particularly to an amateur constantly making changes in equipment. It is frequently necessary to alter, rebuild or to construct an entirely new tuning unit which,

with this type of assembly, can be accomplished without alteration to the units succeeding the receiver portion.

May I suggest, therefore, in respect of all future receivers published in which the tuning unit might usefully be used with an existing amplifier that designs should clearly show a termination after the detector stage to enable constructors to make use of the tuning portion of the receiver without having recourse to building the complete set. It is appreciated that this represents no difficulty to the advanced and experienced constructor, but I am sure it would be welcomed by others not possessing the requisite knowledge.

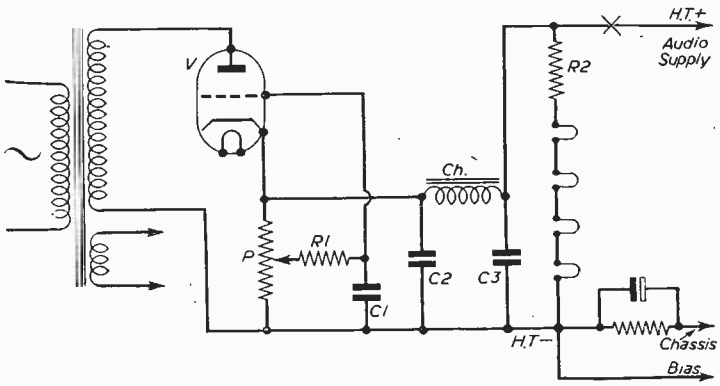
In order to meet present-day conditions, including widespread interference from adjoining stations and television receivers, we have not yet had a design published which includes all features now and in the future more than ever necessary. What I should like to see in PRACTICAL WIRELESS is a receiver with a really elaborate specification.

Mains Surges

SIR,—I have been reading with interest the article "Mains Supplies for Battery Valves" in a recent number, and would like to mention that I have solved the problems of surges, etc., mentioned by your contributor in a far simpler way, with many fewer components, by using the circuit on right. The principle of using a power valve as a grid-controlled rectifier is a most useful one for all kinds of supplies, and deserves to be far more widely known than it appears to be.

Assuming 50 mA for the filament chain and, say, 12 mA at 90 volts for the anode supply V may be any indirectly heated output valve capable of the required emission of 62 mA, and will be conductive on alternate cycles. The transformer can be of any type so long as the secondary provides 250 volts or more at the current needed. P is a wire-wound potentiometer of 25 kΩ or 50 kΩ, of which the slider takes off a suitable bias voltage for the grid. The smoothing can be adequate since C2 and C3 need only be of 120 volt working. R1 C1 form a filter in the bias circuit and may be omitted for extreme simplicity and cheapness. R2 drops the volts necessary to run the filament drain from 90 volt. A low-voltage electrolytic condenser may be wired across the chain, but this again is not vital. I have omitted the shunt resistors in the chain for the sake of clarity.

The slider of P is adjusted so that with the load connected the voltage in the anode line is 90 volt. When switching on the mains the high and low volts rise gradually owing to the time taken for the cathode of V to warm up, and both reach the working figure together. There can be no surges above this figure. When switching off the supply to the rectifier is cut off instantly, and the only energy remaining in the circuit is that stored in C2 and C3, which cannot rise above 90 volt, so owing to the comparatively heavy drain of the filament chain the H.T. will have fallen to a very low figure by the time the filaments have begun to cool off. Should the filament chain fail while running or at any other time the self-compensating action of the cathode follower arrangement of V will prevent the rectified voltage from rising to a figure likely to cause any harm—it may go as high as 110 volt—but it is *absolutely* essential that the H.T. should not rise above 90, it is a very simple matter to include in the filament chain the coil of a relay which will break the anode supply to the set at X if the filament current falls too low.



The heater arrangement recommended by Mr. Guest.

For mains use a mains on/off switch is all that is necessary. For mains-battery use only the simplest of change-over switching is needed.—(Rev.) S. A. R. GUEST (St. Stephen-by-Saltash).

Modifying R1132A

SIR,—I have seen much written in "Open to Discussion" on modifying the R1132A, but after obtaining one of these sets I find I can only receive one station and I would like to know if any of your readers can offer any advice as to how I may improve this?—R. W. HILTON (8, Hogshill Lane, Cobham, Surrey).

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Midget 3-gang with trimmers and perspex cover. Size : 1¾ x 1¾ x 2¼in. ¼in. Spindle..... **12/6**

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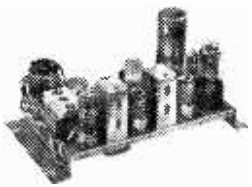

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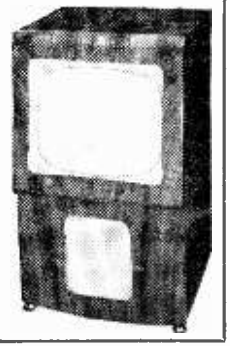

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½ amp.	2/6	½ amp.	3/11
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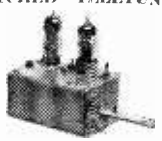

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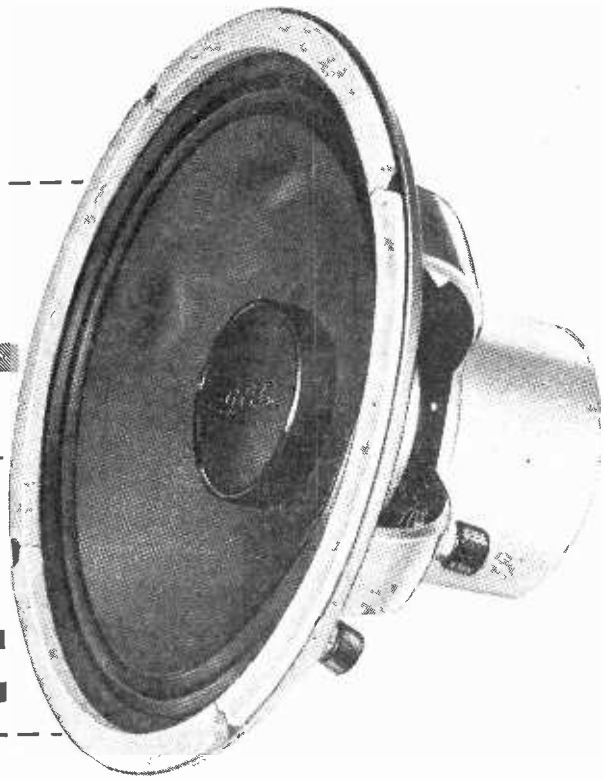

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