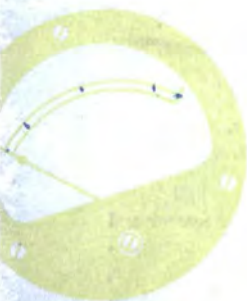


HANDBOOK OF RADIO CIRCUITS No. 3

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BERNARDS RADIO MANUALS ★ No. 91

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by **H. J. SINCLAIR**

25 Complete Circuits and
Schematic Symbols

LONDON
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First published 1950.

*Printed for Bernards (Publishers), Ltd., The Grampians,
Western Gate, London, W.6, by Devonport Press, Ltd.,
8, Devonport Road, London, W.12.*

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HANDBOOK OF RADIO CIRCUITS No. 3

A HIGH FIDELITY PUSH-PULL AMPLIFIER

This amplifier has an output of over 15 watts, and at 10 watts there is less than 1 per cent. distortion. The frequency response depends almost entirely on the characteristics of the output transformer, and for this reason only a high quality output transformer should be used. There are two independent inputs each with its own volume control. Unbalanced inputs (with one side earthed) may be fed into either "Input A" or "B." The operation is as follows: Assume a signal is fed into the "A" input. Part of the amplified signal appears across R.4 and provides an anti-phase voltage on the other input grid, at the same time reducing the voltage on the "A" input grid. Therefore the input double triode receives in effect signals on its grids which are out of phase and of about equal strength. Any remainder out of balance is corrected by R.10 in the next stage.

A balanced input (push-pull) may be applied to the live sides of inputs "A" and "B" and the two volume controls advanced together.

Fig. 1.—COMPONENTS LIST

R.1.	1.0 megohm.	$\frac{1}{2}$ watt carbon resistor.
R.2.	2,200 ohms.	"
R.3.	1.0 megohm.	"
R.4.	47,000 ohms.	"
R.5.	100,000 ohms.	"
R.6.	100,000 ohms.	"
R.7.	1.0 megohm.	"
R.8.	2,200 ohms.	"

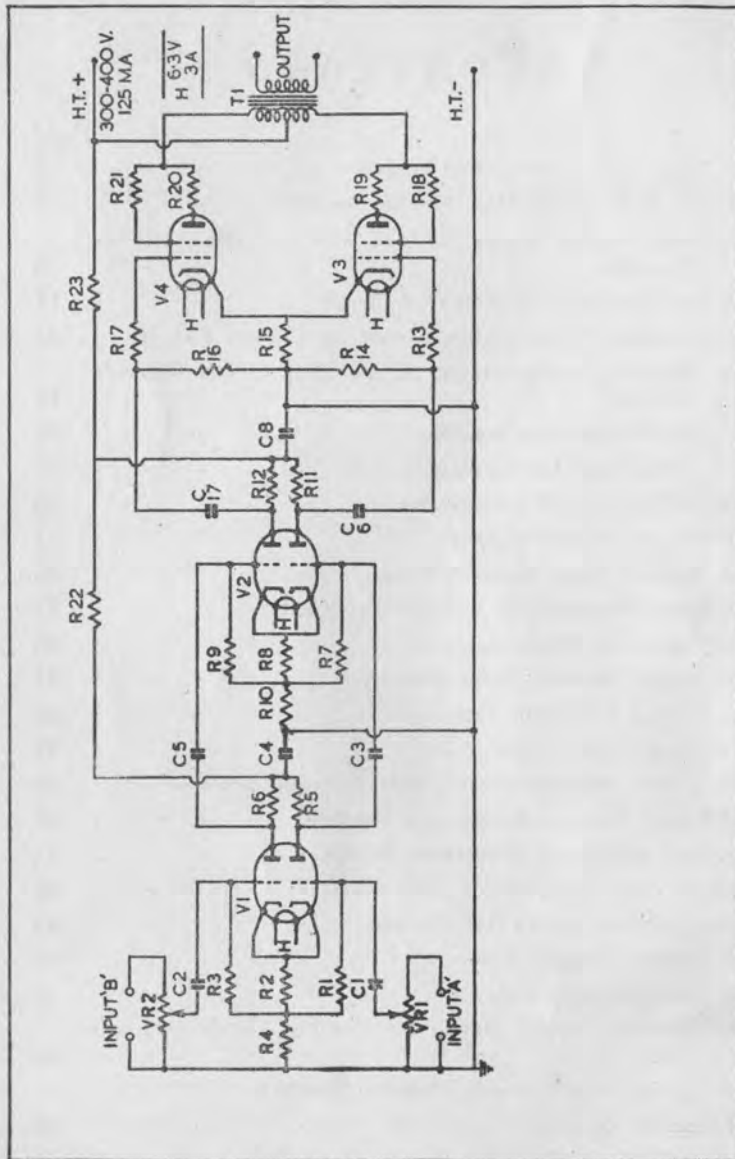


Fig. 1.—A High Fidelity Push-Pull Amplifier.

R.9.	1.0 megohm.	"
R.10.	22,000 ohms.	"
R.11.	100,000 ohms.	"
R.12.	100,000 ohms.	"
R.13.	47,000 ohms.	"
R.14.	220 000 ohms.	"
R.15.	330 ohms.	5 watt wire wound resistor.
R.16.	220,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.17.	47,000 ohms.	"
R.18.	100 ohms.	"
R.19.	100 ohms.	"
R.20.	100 ohms.	"
R.21.	100 ohms.	"
R.22.	33,000 ohms.	"
R.23.	10,000 ohms.	"
VR.1.	470,000 ohms.	Carbon potentiometer.
V.R.2.	470,000 ohms.	"
C.1.	0.01 mfd.	500 v.wg. T.C.C. 543.
C.2.	0.01 mfd.	500 v.wg. "
C.3.	0.01 mfd.	500 v.wg. "
C.4.	8 mfd.	450 v.wg. Electrolytic. T.C.C. C.E.19P.
C.5.	0.01 mfd.	500 v.wg. T.C.C. 543.
C.6.	0.05 mfd.	500 v.wg. "
C.7.	0.05 mfd.	500 v.wg. "
C.8.	8 mfd.	450 v.wg. Electrolytic T.C.C. C.E.19P.
T.1.	15 watt.	Output transformer push-pull 4,000 ohms anode to anode to match to required output im- pedance.
V.1.	6SL7.	Double triode.
V.2.	6SL7.	"
V.3.	6L6 or KT 66.	Beam tetrode (strapped as triode).
V.4.	6L6 or KT 66.	Beam tetrode (strapped as triode).

Four international octal valve holders.

POWER UNIT FOR THE HIGH FIDELITY AMPLIFIER

This power unit is designed for use with the High Fidelity Amplifier but is suitable for use with other apparatus. The additional output at B is intended for feeding tuning units and other apparatus used in conjunction with the amplifier. The voltage obtainable at this point depends on the current being taken, and the value of R.1 may be altered or a variable resistance used in order to get the required voltage at this point.

The heaters are centre-tapped: this is desirable in audio frequency amplifiers but by no means essential. The heater winding may be earthed at one side if this is more convenient.

Fig. 2.—COMPONENTS LIST

C.1.	8 mfd.	600 v.wg.	Electrolytic T.C.C. 922.
C.2.	16 mfd.	500 v.wg.	} Electrolytic T.C.C. 512.
C.3.	16 mfd.	500 v.wg.	
R.1.	4,000 ohms.	5 watt wire wound resistor.	
L.1.	10 henries.	150 mA. smoothing choke.	
S.1.	Double pole On-Off switch.		
F.1.	Double fuse holder with 2 amp. fuses.		
T.1.	Mains transformer.		
	Primary to suit mains supply.		
	Secondary 350-0-350 volts at 150 mA.		
	Secondary 5 volts at 2 amps.		
	Secondary 6.3 volts at 5 amps.		
P.1.	Pilot lamp holder.		
V.1.	GZ32 valve.		
	One international octal valve holder.		

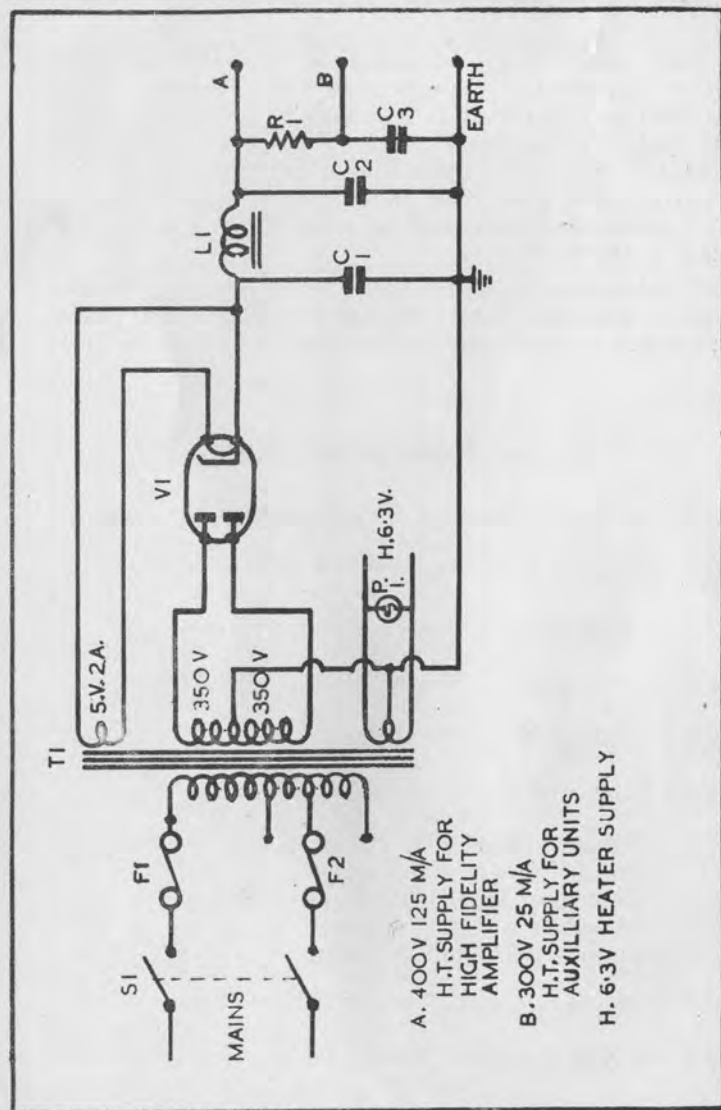


Fig. 2.—Power Unit for the High Fidelity Amplifier.

A LOCAL STATION TUNER FOR USE WITH THE HIGH FIDELITY AMPLIFIER

This unit is intended for use with the High Fidelity Amplifier, and its power supplies are drawn from point B on the power unit.

The circuit has two H.F. stages followed by a diode detector (one triode of the 6SL7 strapped) feeding a cathode follower. Should the 3-gang condenser not be provided with trimmers, three 3-30 pf. Mullard concentric type or similar pattern should be wired across each section of the tuning condenser.

Fig. 3.—COMPONENTS LIST

R.1.	100,000 ohms.	1 watt carbon resistor.
R.2.	1,000 ohms.	$\frac{1}{2}$ "
R.3.	100,000 ohms.	1 "
R.4.	1,000 ohms.	$\frac{1}{2}$ "
R.5.	100,000 ohms.	"
R.6.	100 ohms.	"
R.7.	100 ohms.	"
R.8.	220,000 ohms.	"
R.9.	100,000 ohms.	"
R.10.	4,700 ohms.	"
R.11.	22,000 ohms.	Wire wound potentiometer.
C.1.	0.0005 mfd.	Section of 3 ganged tuning condenser.
C.2.	0.0005 mfd.	Section of 3 ganged tuning condenser.
C.3.	0.0005 mfd.	Section of 3 ganged tuning condenser.
C.4.	0.1 mfd.	350 v.wg. T.C.C. 343.
C.5.	0.1 mfd.	"
C.6.	0.1 mfd.	"
C.7.	0.1 mfd.	"
C.8.	8 mfds.	350 v.wg. Electrolytic T.C.C. C.E.11L.

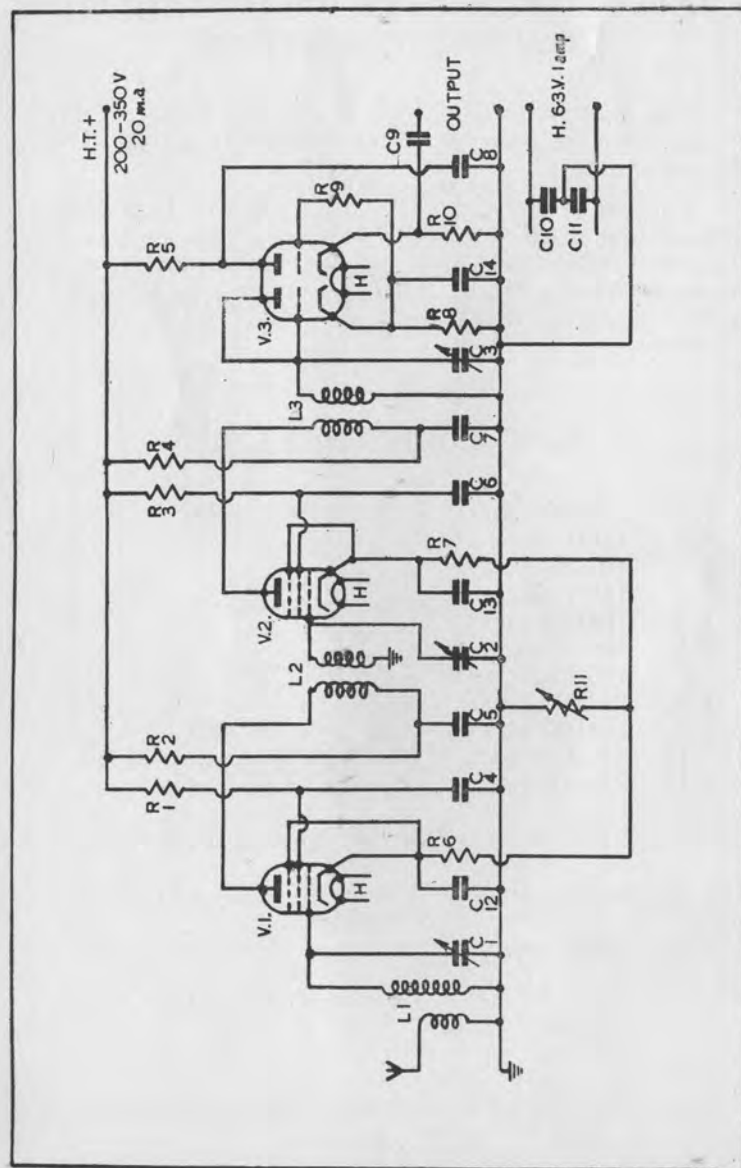


Fig. 3.—A High Fidelity Local Station Tuner.

C.9.	0.5 mfd.	350 v.wg. T.C.C. 343.
C.10.	0.1 mfd.	"
C.11.	0.1 mfd.	"
C.12.	0.1 mfd.	"
C.13.	0.1 mfd.	"
C.14.	100 mmfds.	T.C.C. C.M.20N.

L.1.	Aerial Coil.	Wearite PA2 for 200-557 metres.
L.2.	Intervalve Coil.	Wearite PHF2 for 200-557 metres.
L.3.	Intervalve Coil.	Wearite PHF2 for 200-557 metres.

V.1-2.	6SK7/GT, 6K7-G/GT, KTW63 or EF 39.
	valve.
V.3.	6SL7 valve.

Three international octal valve holders.

A COMPREHENSIVE TONE CONTROL CIRCUIT

This circuit gives a very wide range of tone control and is intended to precede, or to be incorporated in, any amplifier of conventional design.

Fig. 4.—COMPONENTS LIST

R.1.	100,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	100,000 ohms.	"
R.3.	100,000 ohms.	"
R.4.	220,000 ohms.	"
R.5.	220,000 ohms.	"
R.6.	330,000 ohms.	"
R.7.	220,000 ohms.	"
R.8.	1 meg-ohm.	Potentiometer.
R.9.	1 meg-ohm.	"

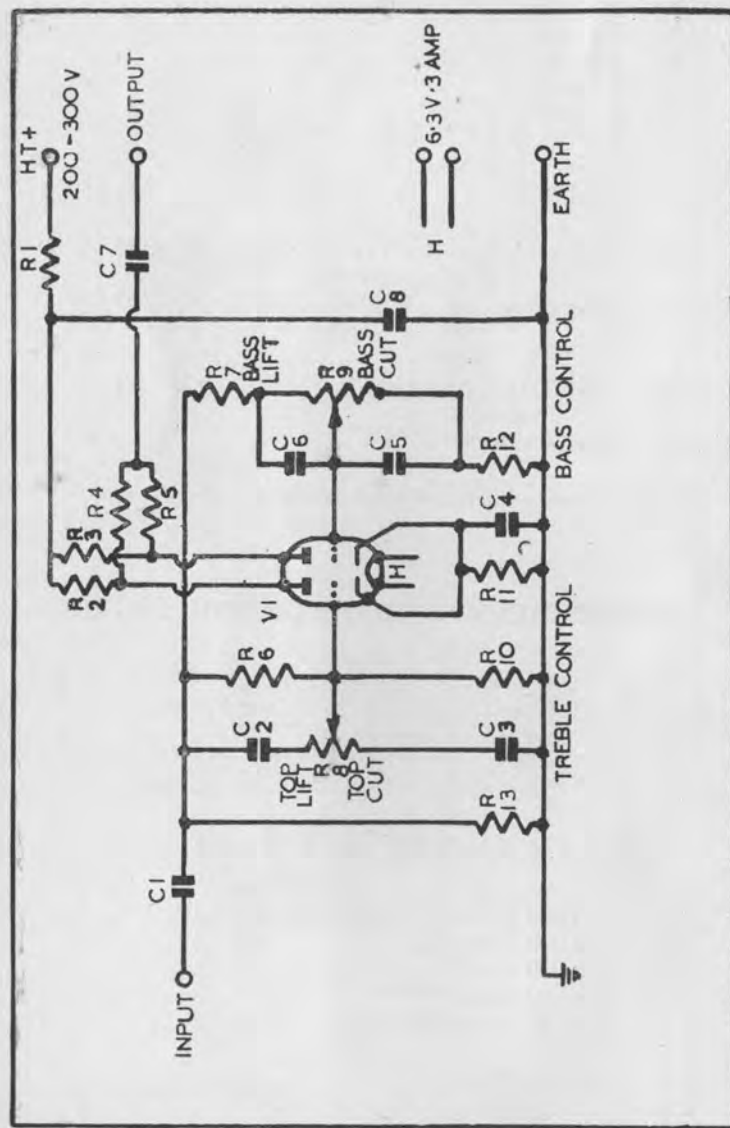


Fig. 4.—A Comprehensive Tone Control Circuit.

- R.10. 100,000 ohms. $\frac{1}{2}$ watt carbon resistor.
 R.11. 1,500 ohms. "
 R.12. 100,000 ohms. "
 R.13. 330,000 ohms. "

- C.1. 0.1 mfd. 350 v.wg. T.C.C. 343.
 C.2. 0.0003 mfd. 350 v.wg. " C.M.20N.
 C.3. 0.001 mfd. 350 v.wg. " C.M.20N.
 C.4. 25 mfd. 25 v.wg. " C.E.32C.
 C.5. 0.1 mfd. 350 v.wg. " 343.
 C.6. 0.001 mfd. 350 v.wg. " C.M.20N.
 C.7. 0.1 mfd. 350 v.wg. " 343
 C.8. 16 mfd. 350 v.wg. " C.E.19L.

- V.1. 6SL7 valve.

One international octal valve holder.

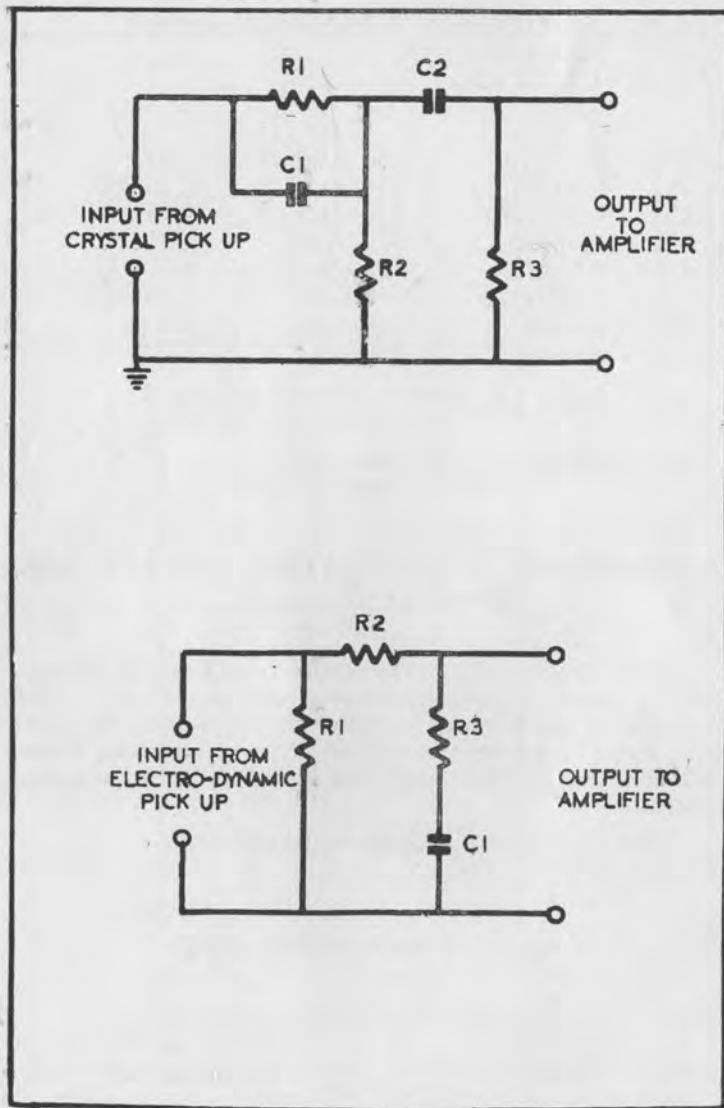
A RECORDING COMPENSATION CIRCUIT FOR CRYSTAL PICK-UPS

Most commercial records change from Constant Amplitude to Constant Velocity characteristics at 250 cps. The principle of operation of crystal pick-ups is such that they have linear characteristics with the type of recording below 250 cps. and require compensation in the high-frequency spectrum.

The circuit given supplies this correction.

Fig. 5.—COMPONENTS LIST

- R.1. 1.5 meg-ohms. $\frac{1}{2}$ watt carbon resistor.
 R.2. 220,000 ohms. $\frac{1}{2}$ watt carbon resistor.
 R.3. 100,000 ohms. $\frac{1}{2}$ watt carbon resistor.
 C.1. 0.0005 mfd. Mica. T.C.C. C.M.20N.
 C.2. 0.005 mfd. Mica. T.C.C. M.3N.



Figs. 5 and 6.—Recording Compensation Circuits.

A RECORDING COMPENSATION CIRCUIT FOR ELECTRO-DYNAMIC PICK-UPS

Moving iron, needle armature and moving-coil pick-ups, unlike crystal pick-ups, display correct characteristics above 250 cps. and require compensation at low frequencies.

The circuit given supplies this correction.

Fig. 6.—COMPONENTS LIST

R.1.	220,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	220,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.3.	22,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
C.1.	0.02 mfd.	T.C.C. 543.

A HIGH FIDELITY PRE-AMPLIFIER

This pre-amplifier may be used with any amplifier of moderate gain when a crystal or moving-coil microphone is used. The input is suitable for most crystal microphones; but a screened input transformer is required with a moving-coil microphone.

No volume control is shown, but R.6 may be replaced by a potentiometer if desired.

Fig. 7.—COMPONENTS LIST

R.1.	2.2 meg-ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	680 ohms.	"
R.3.	100,000 ohms.	"
R.4.	470,000 ohms.	"
R.5.	100,000 ohms.	"
R.6.	470,000 ohms.	"
R.7.	680 ohms.	"
R.8.	100,000 ohms.	"
R.9.	470,000 ohms.	"
R.10.	47,000 ohms.	"

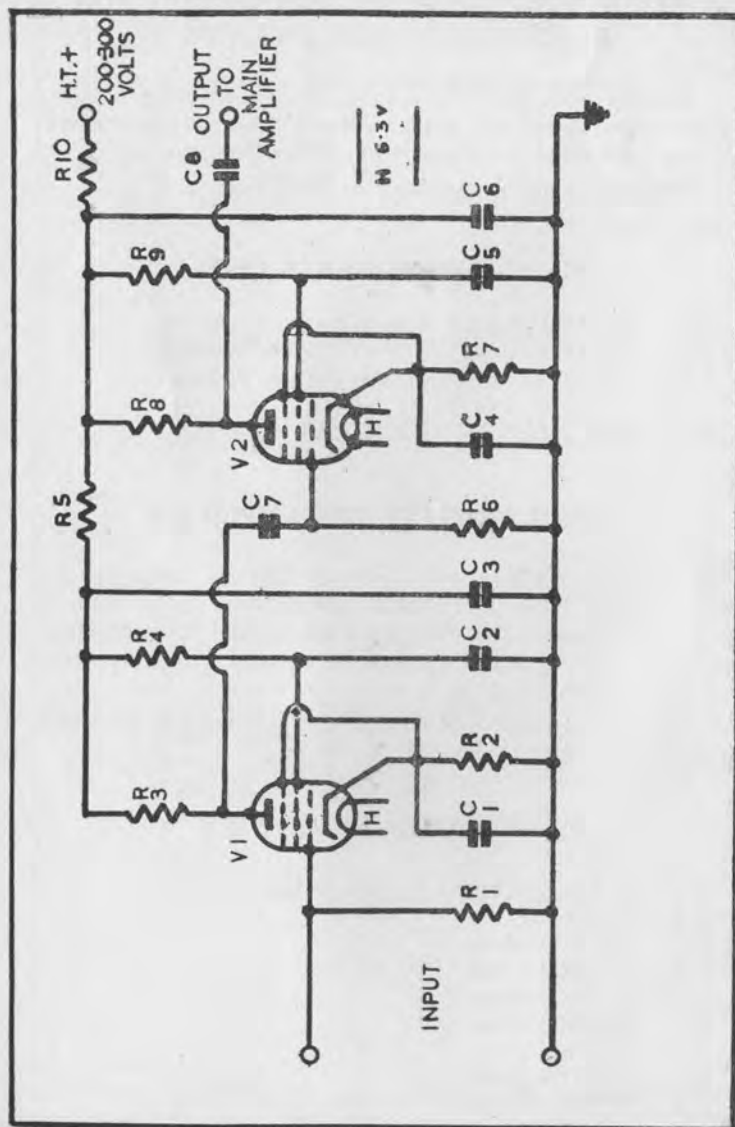


Fig. 7.—A High Fidelity Pre-amplifier.

C.1.	25 mfd.	25 v.wg.	T.C.C.	CE32C.
C.2.	0.1 mfd.	350 v.wg.	"	343.
C.3.	8 mfd.	350 v.wg.	"	C.E.11L.
C.4.	25 mfd.	25 v.wg.	"	C.E.32C.
C.5.	0.1 mfd.	350 v.wg.	"	343.
C.6.	16 mfd.	350 v.wg.	"	C.E.19L.
C.7.	0.005 mfd.	Mica	"	M.3N.
C.8.	0.01 mfd.	500 v.wg.	"	543.

V.1. 6J7, EF37 or KTZ63 valve.

V.2. 6J7, EF37 or KTZ63 valve.

Two international octal valve holders.

Two screened grid caps and leads. Belling-Lee.

AN OFFICE INTER-COMMUNICATION UNIT

The Master Unit is usually situated in the manager's office and may call any of the remote speakers and give instructions and receive replies, each loudspeaker being used as both loudspeaker and microphone. The only limit to the number of remote units is the number of speakers available and the number of positions on the selector switch.

Fig. 8.—COMPONENTS LIST

R.1.	220,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	1,000 ohms.	"
R.3.	100,000 ohms.	"
R.4.	1,000 ohms.	2 watt carbon resistor.
R.5.	1,500 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.6.	100,000 ohms.	"
R.7.	470,000 ohms.	Potentiometer.
R.8.	470 ohms.	$\frac{1}{2}$ watt carbon resistor.

C.1.	16 mfd.	350 v.wg.	T.C.C.	C.E.19L.
C.2.	25 mfd.	25 v.wg.	"	C.E.32C.
C.3.	0.001 mfd.	350 v.wg.	"	C.M.20N.
C.4.	25 mfd.	25 v.wg.	"	C.E.32C.
C.5.	16 mfd.	350 v.wg.	"	C.E.19L.
C.6.	16 mfd.	350 v.wg.	"	C.E.19L.

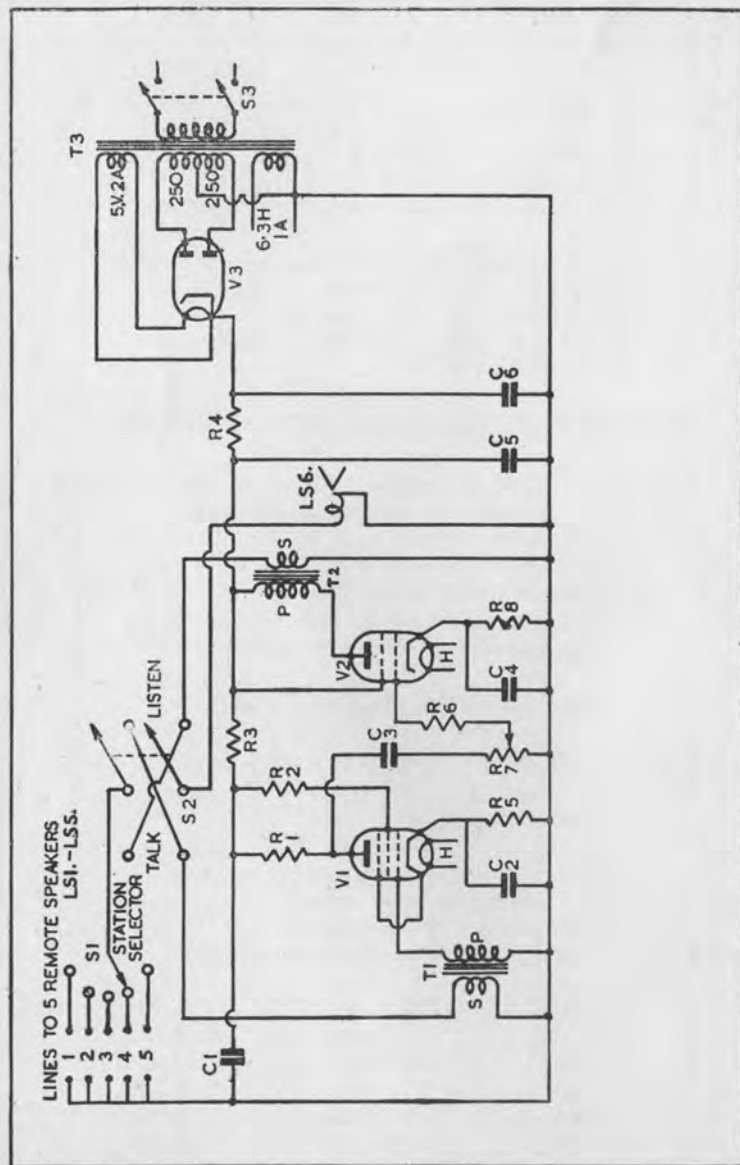


Fig. 8.—An Office Inter-communication Unit.

- S.1. 5-position single pole rotary switch.
 - S.2. Double Pole Double Throw Change-over Switch.
 - S.3. Double Pole Single Throw On/Off Switch.
 - V.1. 6J7, EF37, or KT'Z63 valve.
 - V.2. 6V6-G/GT 6F6-G/GT or KT'63 valve.
 - V.3. 5Z4-G or U50 valve.
 - T.1. 50 to 1 output transformer.
 - T.2. 50 to 1 output transformer. (5,000 ohms to 2 ohms.)
 - T.3. Mains transformer. 250-0-250 v. at 60 mA, 5v at 2 amps. and 6.3 v. at 1 amp.
 - L.S.1. 2 or 3 ohms permanent magnet moving coil speaker.
 - L.S.2. }
 - L.S.3. }
 - L.S.4. } Additional 2 ohms speakers for remote units.
 - L.S.5. }
 - L.S.6. }
- Three international octal valve holders.

Three international octal valve holders.

AN EFFICIENT 30 M/c. CONVERTER

The R.F. stage of this converter is flatly tuned to cover the 30 Mc/s. band, the oscillator frequency is fixed and tuning is performed by changing the I.F. frequency, in other words by altering the frequency of the set used in conjunction with the unit. The best results are given with the receiver tuned somewhere between 2 and 10 Mc/s.

To align the converter decide on the I.F. frequency. Let us assume 5 Mc/s. is chosen. Feed a 30 Mc/s. signal into the unit and adjust L.2 for maximum with the receiver tuned to 5 Mc/s. 30 Mc/s. now tunes at 5 Mc/s. and 29 and 28 Mc/s. should tune at 4 and 3 Mc/s. respectively. The

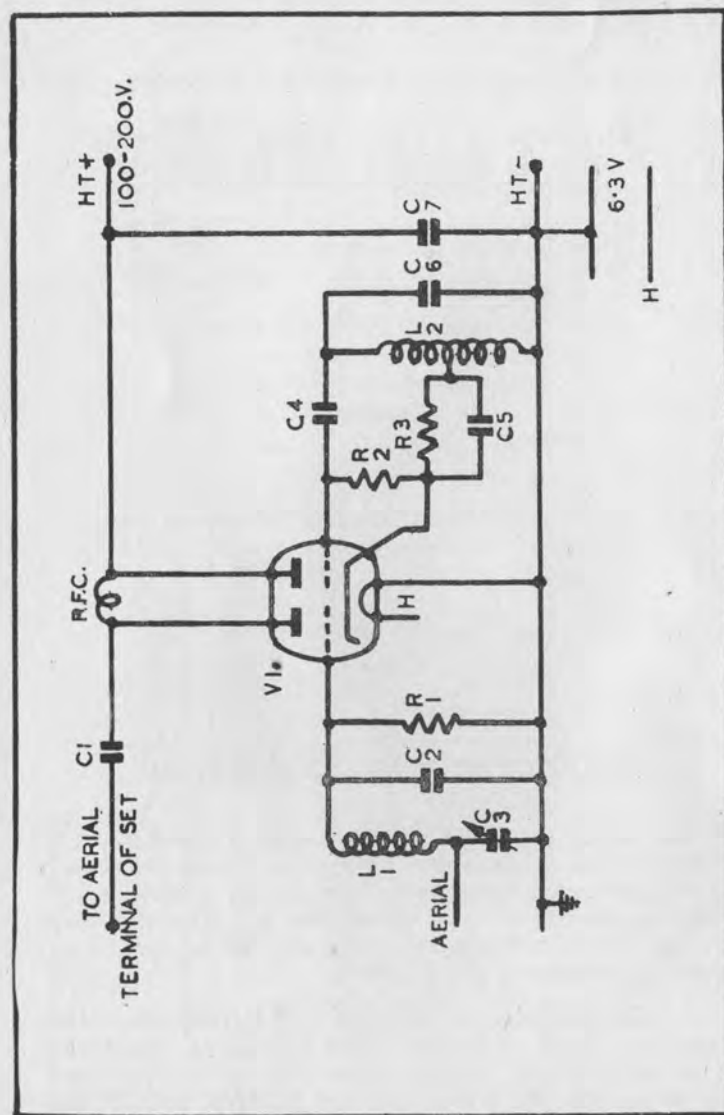


Fig. 9.—An Efficient 30 M/c. Converter.

input should now be aligned by means of L.1 and C.3, and this is best done by injecting a signal in the middle of the 30 Mc/s. band and adjusting for maximum. The circuit is flatly tuned and the adjustments are not critical.

Fig. 9.—COMPONENTS LIST

R.1.	6,800 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	68,000 ohms.	"
R.3.	470 ohms.	"
C.1.	100 mmfds.	Ceramic condenser. T.C.C. S.C.H.1.
C.2.	4.7 mmfds.	Ceramic condenser. T.C.C. S.C.D.1.
C.3.	3 to 30 mmfds.	Trimmer. Mullard Concentric.
C.4.	47 mmfds.	Ceramic condenser. T.C.C. S.C.D.6.
C.5.	0.002 mfd.	Mica condenser. T.C.C. M.2N.
C.6.	100 mmfds.	Ceramic condenser. T.C.C. S.C.H.1.
C.7.	0.01 mfd.	500 volt condenser. T.C.C. 543.
R.F.C.	2.5 milli-henry.	R.F. Choke. Eddystone 737.
L.1.	See coil data.	
L.2.	See coil data.	
V.1.	ECC91 or 6J6 valve.	
	One B7G valve holder.	

COIL DATA

- L1 15 turns on $\frac{3}{8}$ in. slug tuned former or 12 turns on $\frac{1}{2}$ in. slug tuned former.
 L2 9 turns on $\frac{3}{8}$ in. slug tuned former tapped at 3 turns from earthed end or 5 turns on $\frac{1}{2}$ in. slug tuned former tapped at 2 turns. Both coils wound with 28 or 30 S.W.G. silk covered wire.

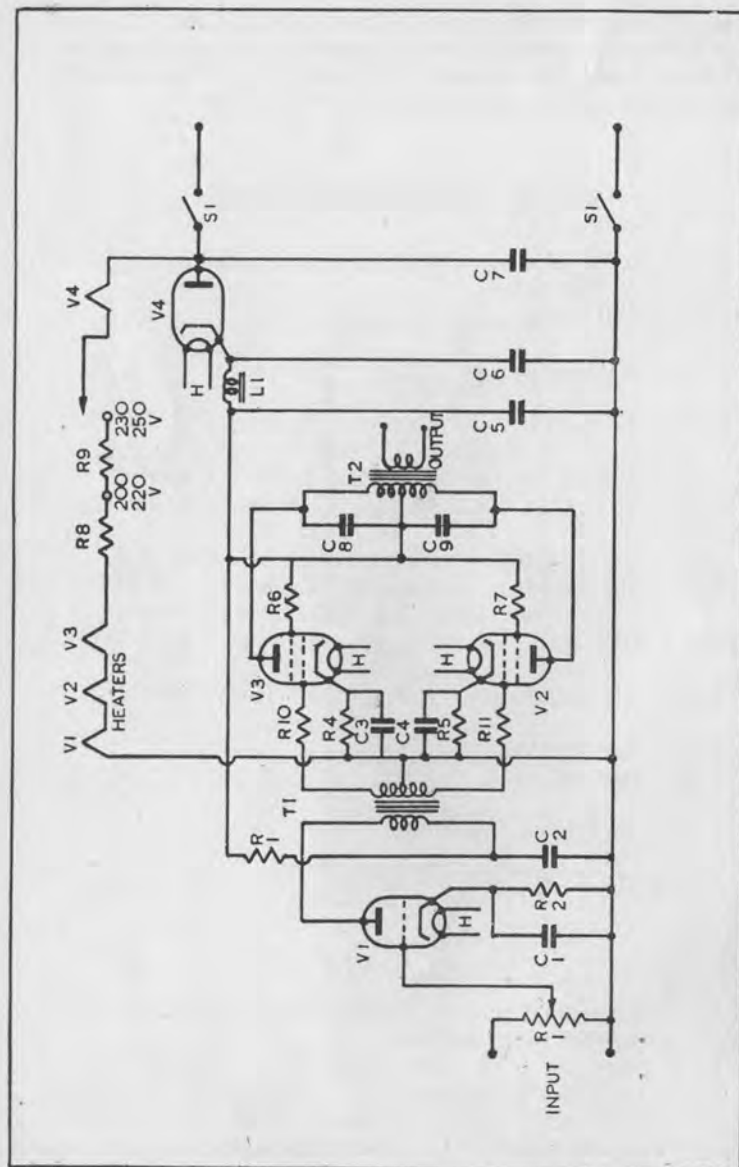


Fig. 10.—A 15 watt AC/DC Amplifier.

A 15 WATT AC/DC AMPLIFIER

This is a straightforward AC/DC amplifier but, as in all equipment of this kind, care must be taken to avoid touching the chassis and any other metal parts which may be alive.

Fig. 10.—COMPONENTS LIST

- | | | |
|-------|------------------------------|--|
| R.1. | 1 meg-ohm. | Potentiometer. |
| R.2. | 1,000 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.3. | 10,000 ohms. | 1 watt carbon resistor. |
| R.4. | 220 ohms. | $\frac{1}{2}$ watt carbon resistor. 10% tol. |
| R.5. | 220 ohms. | $\frac{1}{2}$ watt carbon resistor. 10% tol. |
| R.6. | 100 ohms. | $\frac{1}{2}$ watt carbon resistor. 10% tol. |
| R.7. | 100 ohms. | $\frac{1}{2}$ watt carbon resistor. 10% tol. |
| R.8. | 500 ohms. | 50 watt wire wound (.3 amp. mains dropper). |
| R.9. | 100 ohms. | 10 watt wire wound. |
| R.10. | 47,000 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.11. | 47,000 ohms. | " |
| C.1. | 25 mfd. | 25 v.wg. T.C.C. C.E.32C. |
| C.2. | 8 mfd. | 350 v.wg. T.C.C. C.E.11L. |
| C.3. | 25 mfd. | 25 v.wg. T.C.C. C.E.32C. |
| C.4. | 25 mfd. | 25 v.wg. T.C.C. C.E.32C. |
| C.5. | 16 mfd. | 350 v.wg. T.C.C. C.E.19L. |
| C.6. | 32 mfd. | 450 v.wg. T.C.C. C.E.37P. |
| C.7. | 0.1 mfd. | 500 v.wg. T.C.C. 543 |
| C.8. | 0.001 mfd. | 1,000 v.wg. T.C.C. 2043. |
| C.9. | 0.001 mfd. | 1,000 v.wg. T.C.C. 2043. |
| V.1. | L63 valve. | |
| V.2. | KT33C valve. | |
| V.3. | KT33C valve. | |
| V.4. | U31 valve. | |
| T.1. | Inter-valve transformer. | Single valve to push-pull grids. |
| T.2. | Push-pull output transformer | 5,000 ohms. to desired output impedance. |
| L.1. | 15 henries. | 120 m/As. |
| S.1. | Double pole On-Off switch. | |

Four international octal valve holders.

All resistors 20% tol. unless otherwise stated.

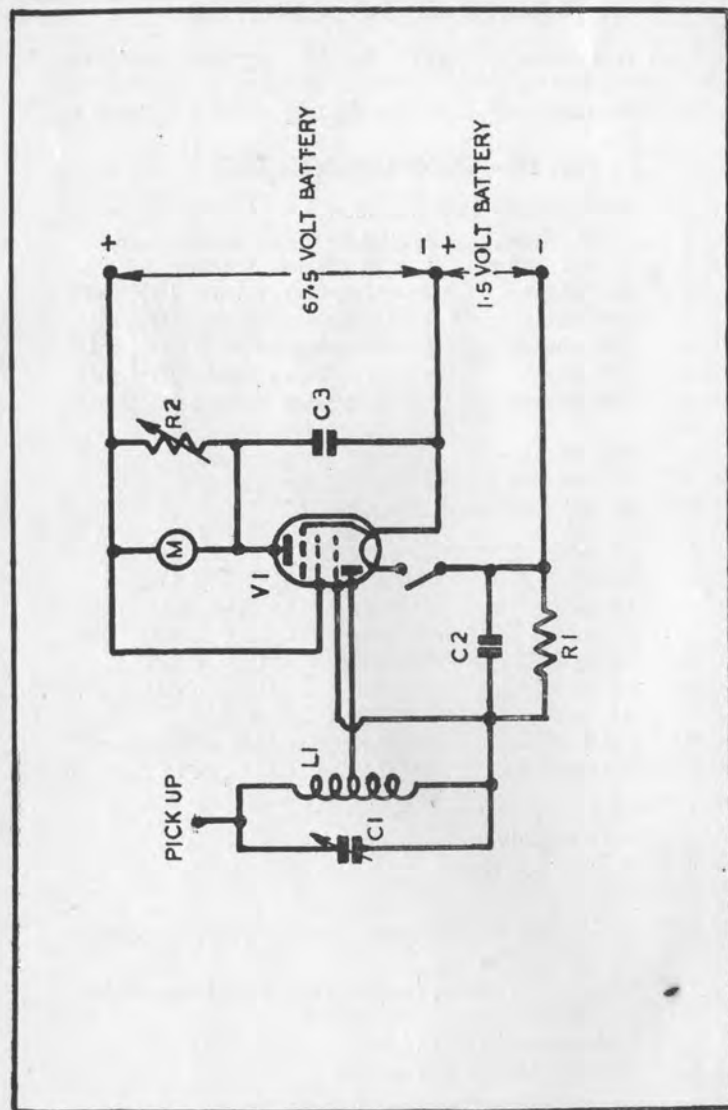


Fig. 11.—A Portable Field Strength Meter.

A PORTABLE FIELD STRENGTH METER

Resistance R.2 should be adjusted so that the 0-1 m/A meter reads full scale with no input. Then, with a short piece of wire used as aerial, the meter will show a decrease in reading. This decrease is proportional to signal strength over the majority of the scale.

Fig. 11.—COMPONENTS LIST

- | | | |
|-----------------------------|---------------------|-------------------------------------|
| R.1. | 1 meg-ohm. | $\frac{1}{2}$ watt carbon resistor. |
| R.2. | 500 ohms. | Potentiometer. |
| C.1. | 50 mmfds. | Variable condenser. |
| C.2. | 220 mmfds. | Ceramic condenser. T.C.C. S.C.H.2. |
| C.3. | 0.01 mfd. | Mica condenser. T.C.C. M.3N. |
| M. | 0—1 m/A meter. | |
| L.1. | See coil data. | |
| V.1. | 1S5 or DAF91 valve. | |
| One B7G valve holder. | | |
| One 67.5 volt H.T. Battery. | | |
| One 1.5 volt L.T. Battery. | | |

COIL DATA L1.

All coils wound with 20 SWG silk covered on $1\frac{1}{2}$ in. formers.

1.5—3 Megacycles 60 turns centre tapped.

3—6	"	30	"	"	"
6—12	"	15	"	"	"
10—20	"	8	"	"	"
20—40	"	4	"	"	"

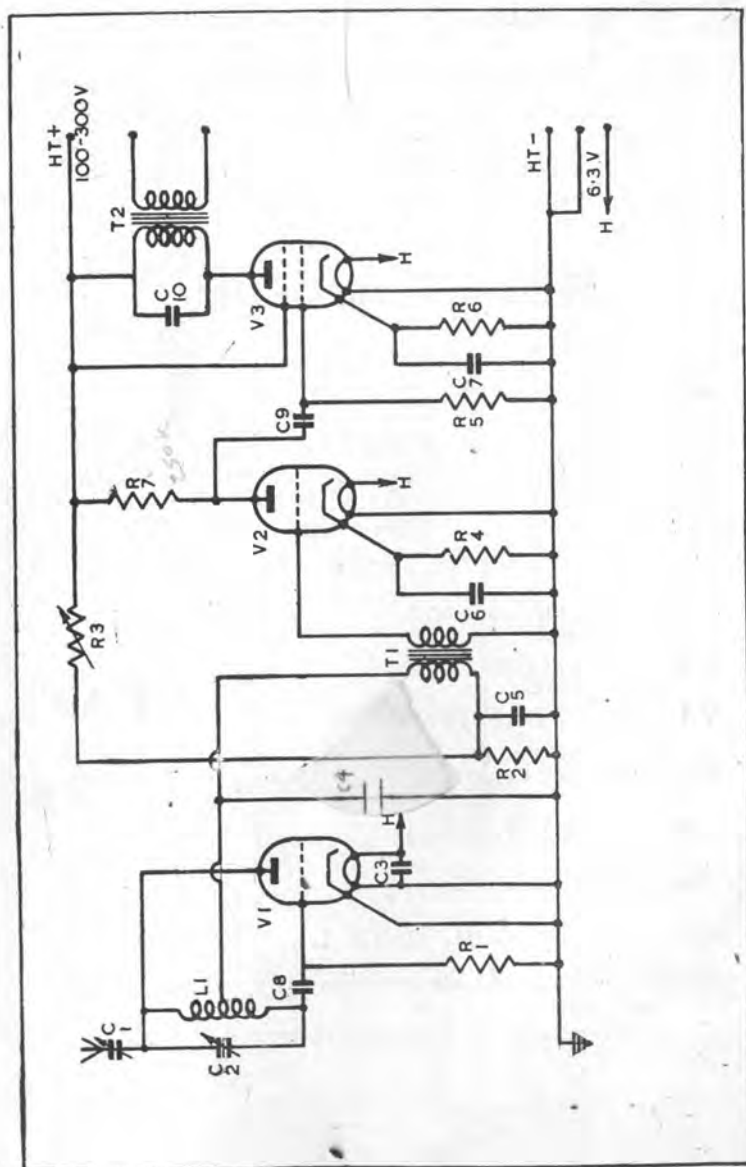


Fig. 12.—A Super-regenerative Receiver for V.H.F.

A SUPER-REGENERATIVE RECEIVER FOR V.H.F.

Care must be taken in building all V.H.F. units if good results are to be obtained. All R.F. wiring must be very short and as a general rule the earths for each stage should be taken to a single point.

The General Purpose Power Unit detailed later in this manual is suitable for use with this receiver.

FIG. 12.—COMPONENTS LIST

R.1.	4.7 meg-ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	22,000 ohms.	2 watt carbon resistor.
R.3.	68,000 ohms.	Potentiometer.
R.4.	2,200 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.5.	470,000 ohms.	"
R.6.	330 ohms.	"
C.1.	3 to 30 mmfds.	Variable trimmer.
C.2.	10 mmfds.	Variable condenser preferably split stator.
C.3.	470 mmfds.	Ceramic condenser
C.4.	470 mmfds.	Ceramic condenser
C.5.	8 mfd.	350 v.wg. T.C.C. C.E.11L.
C.6.	25 mfd.	25 v.wg.
C.7.	25 mfd.	25 v.wg.
C.8.	10 mmfds.	Ceramic condenser. T.C.C. S.C.D.2.
C.9.	0.005 mfd.	Mica condenser. T.C.C. M.3N.
C.10.	0.005 mfd.	1,000 v.wg. T.C.C. 2043.
T.1.	Intervalve transformer.	
T.2.	Output transformer 5,000 ohms to speaker.	53'
V.1.	955 Acorn valve, or HA2.	
V.2.	6J5 or L63 valve.	
V.3.	6V6 valve.	

Three international octal valve holders.

Continued on page 29.

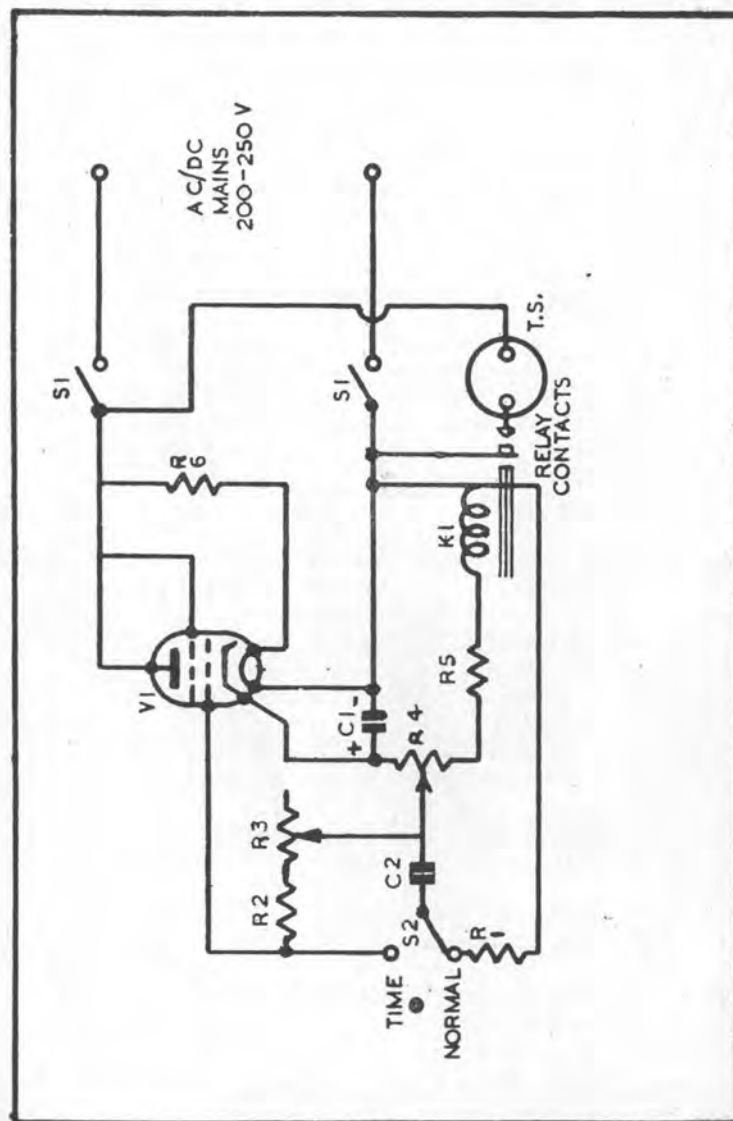


Fig. 13.—A Process or Photographic Timer.

L.1. See coil data.

COIL DATA

All coils wound with 16 SWG enamelled centre tapped.

20—40 Mc/s. 17 turns of $\frac{1}{2}$ in. diameter.

30—60 Mc/s. 12 " " $\frac{1}{2}$ " "

60—120 Mc/s. 6 " " $\frac{1}{3}$ " "

100—200 Mc/s. 9 " " $\frac{1}{4}$ " "

150—300 Mc/s. 5 " " $\frac{1}{4}$ " "

A PROCESS OR PHOTOGRAPHIC TIMER

After switching on the unit plug in the enlarger, printer or other apparatus to be timed. Switch S.2 to "Time" and condenser C.2 biases the valve to cut off, releases the relay, and applies the mains to the timing socket. After the operation is complete S.2 should be returned to "Normal."

The time is directly proportional to the product of C.1 and the sum of R.2 and R.3. Resistance R.3 should be calibrated in seconds with a stop-watch. With the values given the maximum time will be about 30 seconds; but to increase the time it is only necessary to increase either C.2 or C.3 or both.

The type of relay is not critical, and G.P.O. relays work quite well. Almost any coil value between 1,000 and 20,000 ohms will do, but some adjustment of R.5 may be needed.

R.4 is an adjustment provided to correct for ageing valves, etc.

Fig. 13.—COMPONENTS LIST

R.1.	10,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	10,000 ohms.	"
R.3.	1 meg-ohms.	Potentiometer.
R.4.	1,000 ohms.	"
R.5.	15,000 ohms.	5 watt wire wound resistor.
R.6.	600 ohms.	Heater dropper .3 amp.

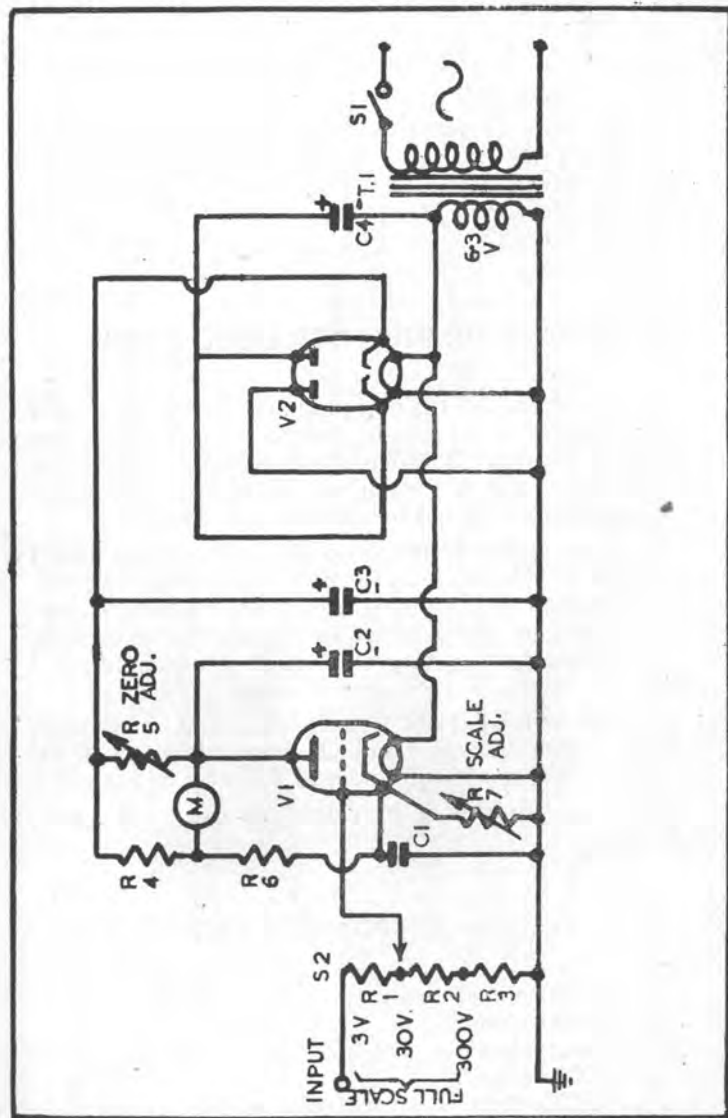


Fig. 14.—Mains Operated Valve Voltmeter.

- C.1. 8 mfd. 350 v.wg. electrolytic T.C.C. CE11L.
 C.2. 8 mfd. 250 v.wg. paper condenser.
 S.1. Double pole On-Off switch.
 V.1. 25L6-GT/G valve.
 S.2. Single pole change-over switch.
 K.1. 2,000 ohm relay, with a pair of break contacts.
 T.S. Mains socket for timing.
 One international octal valve holder.

A MAINS OPERATED VALVE VOLTMETER

This valve voltmeter gives reliable performance on D.C. at audio frequencies and at lower radio frequencies. The upper limit of frequency is determined by the stray capacity of the input circuit.

The H.T. for the voltmeter is obtained from a 6H6 used as a voltage doubler and working from the 6.3 volt heater supply. This simplifies both the size and cost problems associated with power supplies.

The unit may be calibrated at 50 cps. with a good AC meter. Accuracy depends on the ratios of R.1, R.2 and R.3, but for many uses great accuracy is not required and 5 per cent. resistors should suffice in most cases.

Fig. 14.—COMPONENTS LIST

- | | | |
|------|---------------|-------------------------------------|
| R.1. | 10 meg-ohms. | Precision carbon resistor. |
| R.2. | 1 meg-ohm. | " |
| R.3. | 100,000 ohms. | " |
| R.4. | 470 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.5. | 5,000 ohms. | Potentiometer. |
| R.6. | 10,000 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.7. | 2,000 ohms. | Potentiometer. |

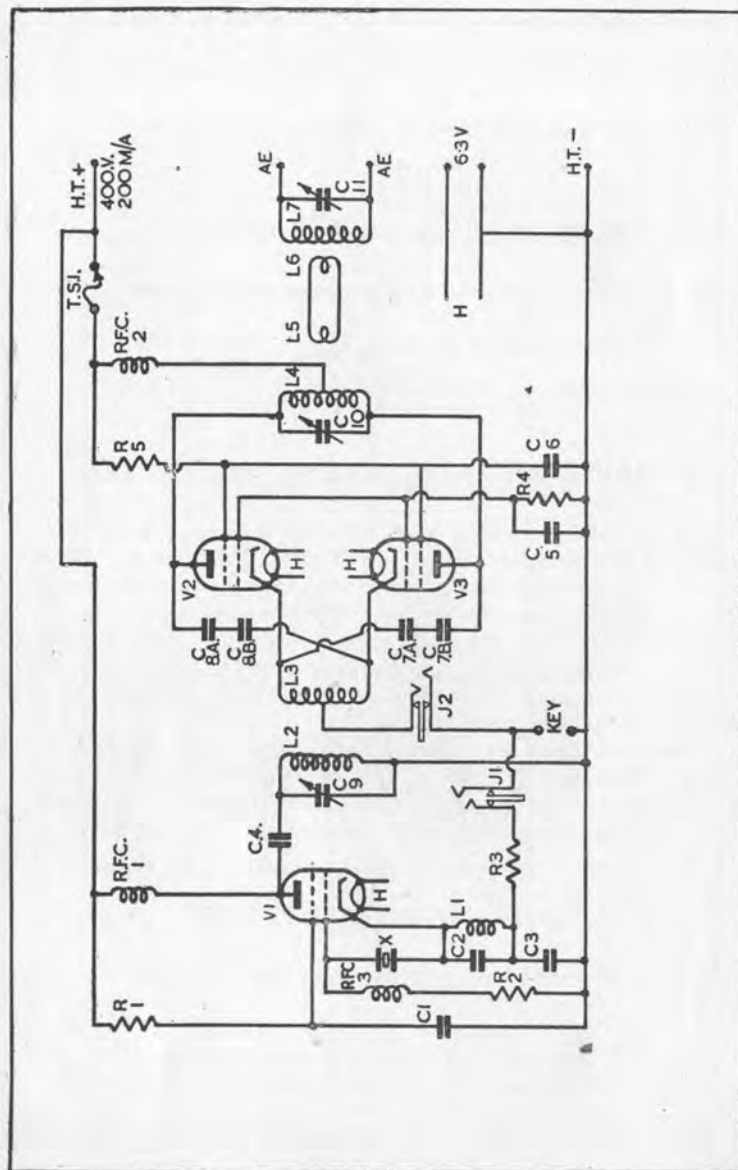


Fig. 15.—A 75 watt Push-Pull Transmitter.

- C.1-4. 25 mfd. 25 v.wg. T.C.C. CE32C.

- S.1. On-Off switch.
S.2. 3-position rotary switch.

- V.1. 6J5, 6C4, L63, or EC91, valve.
V.2. 6H6 valve.

- T.1. Heater transformer 6.3 volts at 1 amp.

Two international octal valve holders, or one with one B7G, depending on valves used.

One 0-1 mA. meter.

A 75 WATT PUSH-PULL TRANSMITTER

Transmitters must not be used without G.P.O. permission, and then only at such frequencies and powers as are laid down in the licence issued. This circuit may be used as a basis of design. The power may be increased or decreased by changing the H.T. voltage up to a maximum of about 100 watts.

Circuits of a power pack and modulator for this transmitter follow.

FIG. 15.—COMPONENTS LIST

- | | | |
|----------|---------------|-------------------------------------|
| R.1. | 47,000 ohms. | 2 watt carbon resistor. |
| R.2. | 100,000 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.3. | 470 ohms. | " |
| R.4. | 22,000 ohms. | " |
| R.5. | 10,000 ohms. | 10 watt wire wound resistor. |
| | | |
| C.1. | 0.01 mfd. | 500 v.wg. T.C.C. 543. |
| C.2. | 100 mmfds. | Ceramic T.C.C. SCH1. |
| C.3. | 0.01 mfd. | 500 v.wg. T.C.C. 543. |
| C.4. | 0.001 mfd. | Mica. 750 v.wg. T.C.C. M3U. |
| C.5. | 0.001 mfd. | Mica. 350 v.wg. T.C.C.
CM20N. |
| C.6. | 0.001 mfd. | Mica. 750 v.wg. T.C.C. M3U. |
| C.7 a-b. | 22 mmfds. | Ceramic |
| C.8 a-b. | 22 mmfds. | Ceramic } T.C.C. SCD4. |

- C.9. 250 mmfds. Variable.
 C.10. 150 mmfds. Variable high voltage.
 C.11. 150 mmfds. Variable high voltage.
 J.1. Meter jack.
 J.2. Meter jack.
- RFC.1. 2.5 milli-henry choke. Eddystone 737.
 RFC.2. 1.5 " " " 1022.
 RFC.3. 2.5 " " " 737.
- TS.1. Tag strip or terminals and shorting wire for modulation.
- V.1-3. 6L6/G or KT66 valves.
 Three international ceramic octal valve holders.
- X. Crystal and holder.
- L.1. 1.75 Mc/s. band. Crystal 32 turns 26 S.W.G.
 3.5 " " 10 " 24 S.W.G.
 7.0 " " 6 " 22 S.W.G.
- L.2. 1.75 and 3.5 Mc/s. bands. 38 turns 26 S.W.G.
 7.0 Mc/s. band. 20 turns 24 S.W.G.
 14.0 " 10 " 22 S.W.G.
- L.3. 1.75 and 3.5 Mc/s. bands 20 turns 26 S.W.G. centre tapped on same, former as L.2.
 7.0 Mc/s. bands 14 turns 24 S.W.G. centre tapped on same, former as L.2.
 14.0 Mc/s bands 8 turns 22 S.W.G. centre tapped on same, former as L.2.
- L.4. 1.75 Mc/s. band 60 turns 26 S.W.G. centre tapped.
 3.5 Mc/s. band 40 turns, 24 S.W.G. centre tapped.
 7.0 Mc/s. band 25 turns 22 S.W.G. centre tapped.
 14.0 Mc/s. band 15 turns 22 S.W.G. centre tapped.
- Coils wound on 1½ in. diameter formers.*
- L.5. Link coupling 3 turns at centre of L.4.
 L.6. Link coupling 3 turns at centre of L.7.
 L.7. Same as L.4, but not centre tapped.

A HEAVY DUTY POWER PACK

This unit has excellent regulation and is suitable for use with the 75 watt transmitter and other equipment requiring similar power supplies.

Fig. 16.—COMPONENTS LIST

- R.1. 22,000 ohms. 10 watt wire wound resistor.
- C.1. 8 mfd. 600 v.wg. T.C.C. 922.
 C.2. 8 mfd. " "
- L.1. 5 henries minimum at 200 m/As. Resistance 150 ohms or less.
 L.2. 10 henries at 200 m/As. Resistance 150 ohms or less.
- S.1. Double pole On-Off switch.
 S.2. Single pole On-Off switch.
- F.1. 5 amp. fuse and holder.
 F.2. "
- V.1. 53 KU valve.
- T.1. Mains transformer. Primary to suit mains.
 Secondary 500-0-500 volts at 200 milliamps,
 5 volts at 3 amps. and 6.3 volts at 3 amps.
- One international octal valve holder.

A 75 WATT MODULATION OR PUBLIC ADDRESS AMPLIFIER

This amplifier has two inputs: one suitable for microphones and the other for use with a pick-up.

It is suitable for use as a modulator for the preceding transmitter or as a high-power public address amplifier.

A special power unit is required and a suitable circuit follows.

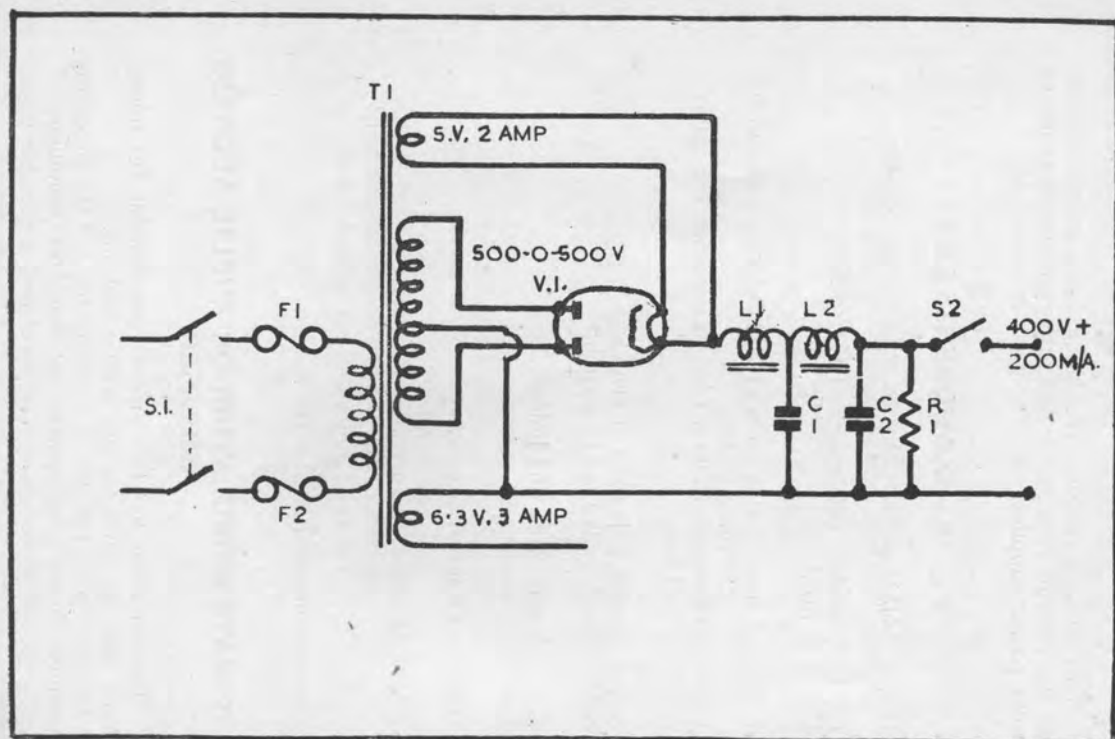


Fig. 16.—A Heavy Duty Power Pack.

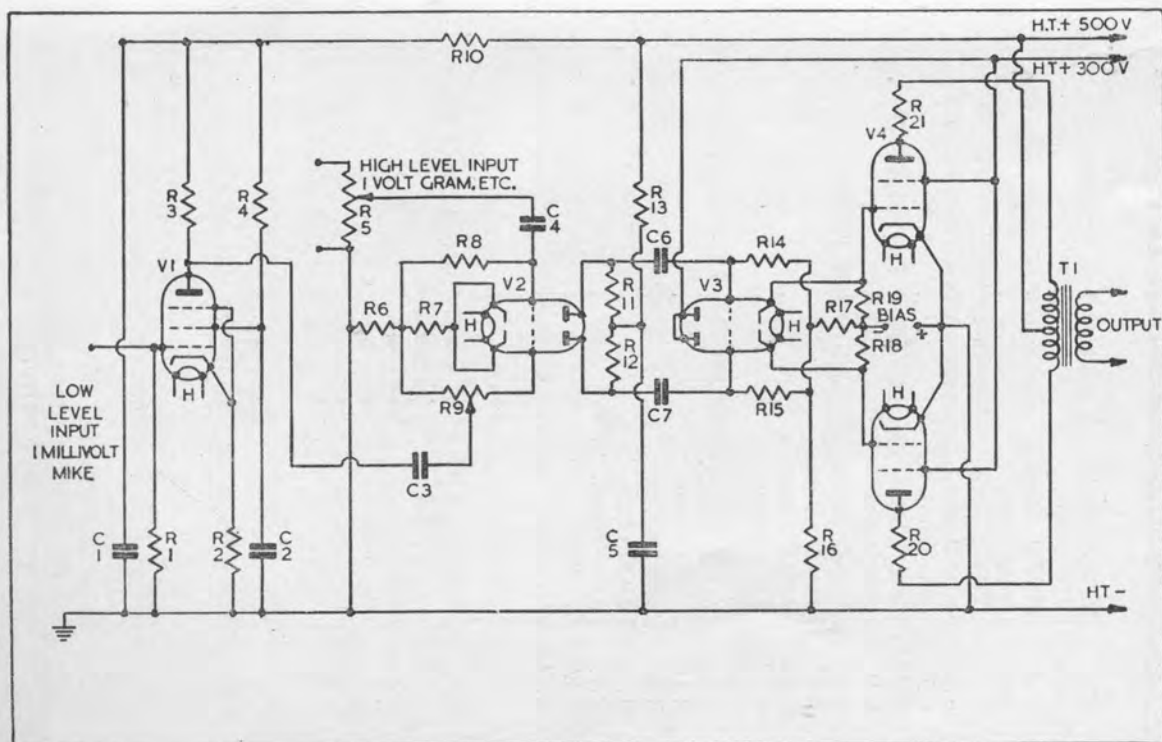


Fig. 17.—A 75 watt Modulation or Public Address Amplifier.

Fig. 17.—COMPONENTS LIST

R.1.	2.2 meg-ohms.	$\frac{1}{2}$ watt carbon resistor.
R.2.	1,500 ohms.	"
R.3.	220,000 ohms.	"
R.4.	1 meg-ohm.	"
R.5.	100,000 ohms.	Potentiometer.
R.6.	330,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.7.	2,200 ohms.	"
R.8.	1 meg-ohm.	"
R.9.	1 meg-ohm.	Potentiometer.
R.10.	220,000 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.11.	100,000 ohms.	"
R.12.	100,000 ohms.	"
R.13.	33,000 ohms.	"
R.14.	470,000 ohms.	"
R.15.	470,000 ohms.	"
R.16.	22,000 ohms.	"
R.17.	22,000 ohms.	"
R.18.	10,000 ohms.	"
R.19.	10,000 ohms.	"
R.20.	68 ohms.	"
R.21.	68 ohms.	"
C.1.	8 mfd.	500 v.wg. Electrolytic T.C.C. C.E.10PA.
C.2.	0.5 mfd.	500 v.wg. T.C.C. 543.
C.3.	0.01 mfd.	500 v.wg. "
C.4.	0.01 mfd.	500 v.wg. "
C.5.	8 mfd.	500 v.wg. Electrolytic T.C.C. C.E.10PA.
C.6.	0.01 mfd.	500 v.wg. T.C.C. 543.
C.7.	0.01 mfd.	500 v.wg. "
V.1.	6J7 or EF 37 valve.	
V.2.	6SL7 valve.	
V.3.	6SN7 or B65 valve.	
V.4.	807 or QV05-25 valve.	
V.5.	807 or QV05-25 valve.	

T.1. 75 watt output transformer push-pull, 4,500 ohms anode to anode to required output impedance. (2,500 ohms when used to modulate the 75 watt transmitter.)

Three international octal valve holders.

Two 5-pin UX valve holders.

A POWER UNIT FOR THE 75 WATT AMPLIFIER

This unit supplies the H.T. and bias required for the 75 watt amplifier.

Fig. 18.—COMPONENTS LIST

R.1.	22,000 ohms.	20 watt wire wound.
R.2.	22,000 ohms.	10 " " "
R.3.	10,000 ohms.	Variable resistor.
R.4.	10,000 ohms.	5 watt wire wound.
R.5.	10,000 ohms.	1 watt carbon resistor.
C.1.	4 mfd.	600 v.wg. T.C.C. type 92.
C.2.	8 mfd.	600 v.wg. T.C.C. type 92.
C.3.	8 mfd.	450 v.wg. T.C.C. C.E.25P.
C.4.	16 mfd.	450 v.wg. T.C.C. C.E.29P.
C.5.	16 mfd.	450 v.wg. T.C.C. C.E.29P.
C.6.	16 mfd.	350 v.wg. T.C.C. C.E.26L.
C.7.	16 mfd.	350 v.wg. T.C.C. C.E.26L.
L.1.	5 henries minimum at 250 m/As.	Resistance less than 150 ohms.
L.2.	10 henries at 250 m/As.	Resistance less than 150 ohms.
L.3.	10 henries at 50 m/As.	
L.4.	20 henries at 50 m/As.	
S.1.	Double pole On-Off switch.	
F.1.	Double pole fuse holder with 5 amp. fuses.	

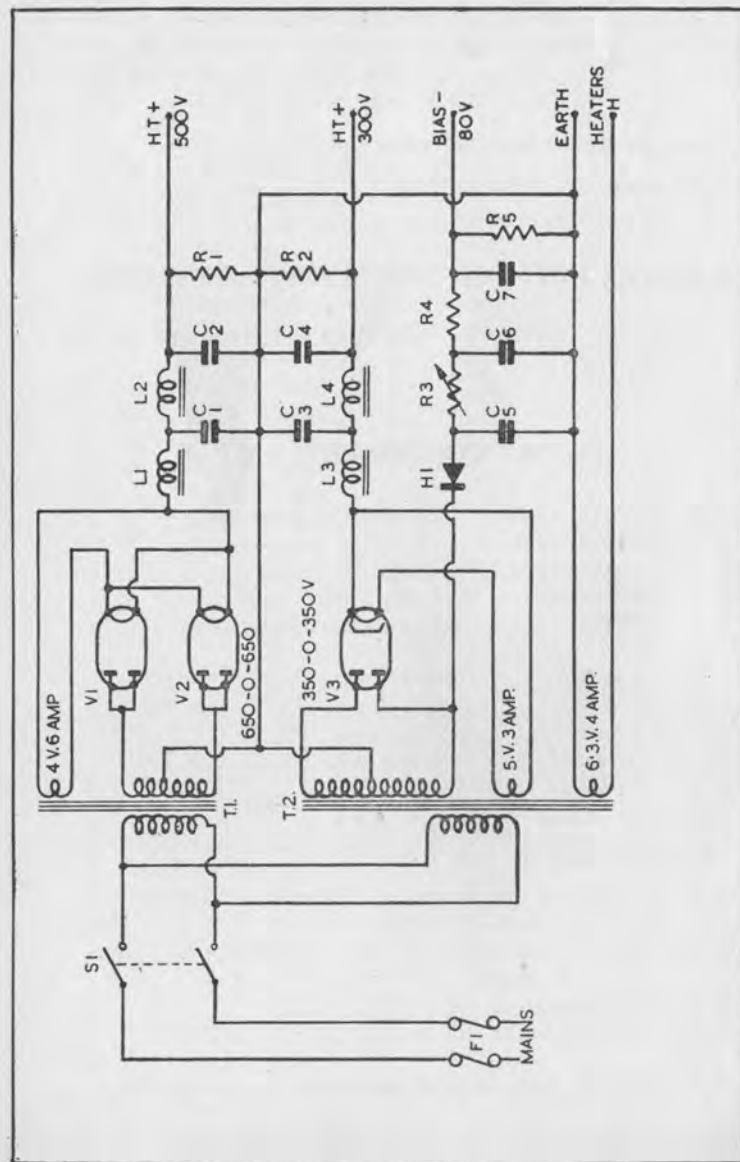


Fig. 18.—A Power Unit for the 75 watt Amplifier.

H.1. Half-wave selenium rectifier.

T.1. Mains transformer, primary to suit mains, secondaries 4 volts 6 amps and 650-0-650 volts 250 m/As.

T.2. Mains transformer primary to suit mains, secondaries 5 volts 2 amps, 6.3 volts 4 amps, 350-0-350 volts 50 m/As.

V.1. U18 valve.

V.2. U18 valve.

V.3. 5Z4G valve.

One international octal valve holder.

Two British 4-pin valve holders.

A CAPACITANCE AND INDUCTANCE BRIDGE

The accuracy of the bridge depends on accuracy of C.1, R.3, R.4, R.5, R.6 and R.7, and in the worst case may be equal to the sum of the inaccuracies of C.1, R.3, and whichever of the range resistors is in use. The constructor must decide on the degree of accuracy he requires and order his components accordingly.

If a condenser calibrated in mmfds. is used its reading when multiplied by the condenser range factor will give the value of the unknown capacity, and on the inductance ranges the condenser reading times the inductance range factor gives the value of the inductance in micro-henries.

If a calibrated condenser is not used a 2 or 3 gang radio tuning condenser with its sections in parallel may be used and the bridge calibrated with known capacities.

The bridge is independent of frequency and the oscillator may be of any frequency or a buzzer may be used. The detector may be 'phones or an amplified null detector.

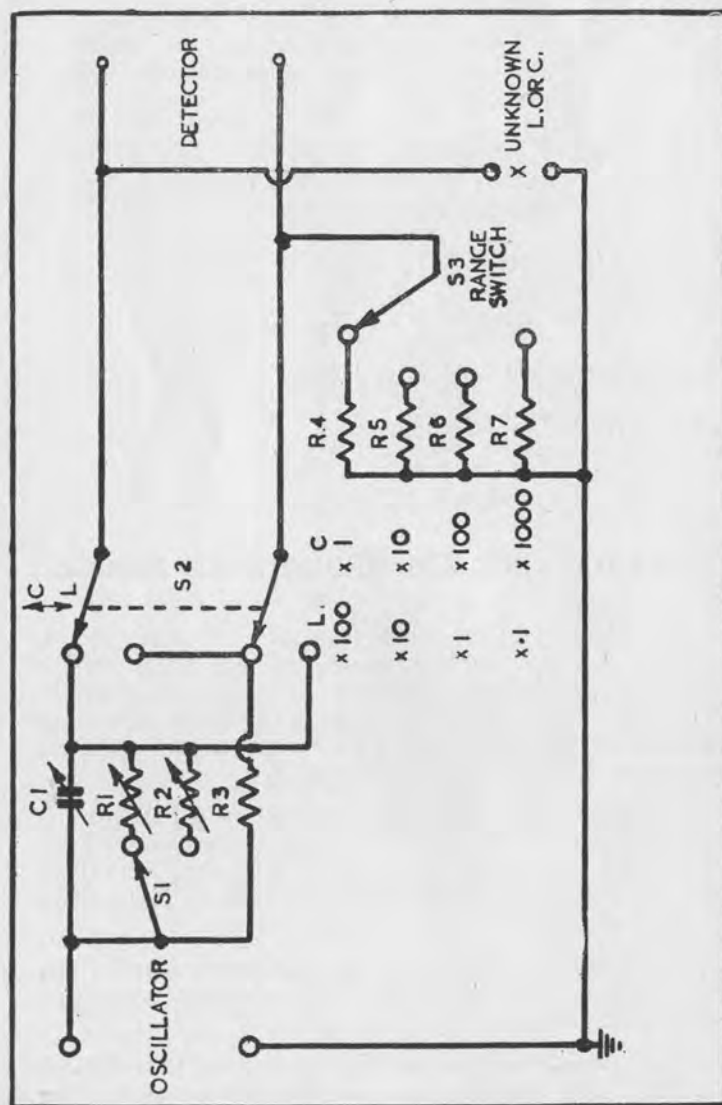


Fig. 19.—Capacitance and Inductance Bridge.

Fig. 19.—COMPONENTS LIST

R.1.	4.7 meg-ohms.	Potentiometer.
R.2.	220,000 ohms.	Potentiometer.
R.3.	10,000 ohms.	Precision resistor.
R.4.	10,000 ohms.	"
R.5.	1,000 ohms.	"
R.6.	100 ohms.	"
R.7.	10 ohms.	"
C.1.	0.001 mfd.	Variable condenser.
S.1.	Single pole two-position switch.	
S.2.	Double pole change-over switch.	
S.3.	Single pole four-position switch.	

STABLE AUDIO FREQUENCY OSCILLATORS

This simple oscillator uses positive feedback from anode to grid but is controlled by negative feedback in the cathode circuit. Resistance R.1 controls the negative feedback and hence the output voltage of the oscillator. When adjusted so that oscillation just starts, a very pure note is obtained even at very low audio frequencies.

In the simplest circuit (A) changes in load may affect the frequency and circuits (B) and (C), which overcome this, are therefore included.

The frequency of the oscillator is determined by the inductance of the grid winding of the transformer and the capacity of C.1. A series of condensers may be switched in to give a set of predetermined frequencies or C.1 may be variable as required.

Circuit (B) is particularly suitable for use with bridges and a frequency of either 400 or 1,000 cps. is usual. Some advantage is obtained by increasing C.3 to 1 mfd. when using this circuit with bridges.

This circuit may be used with the bridge described on page 45.

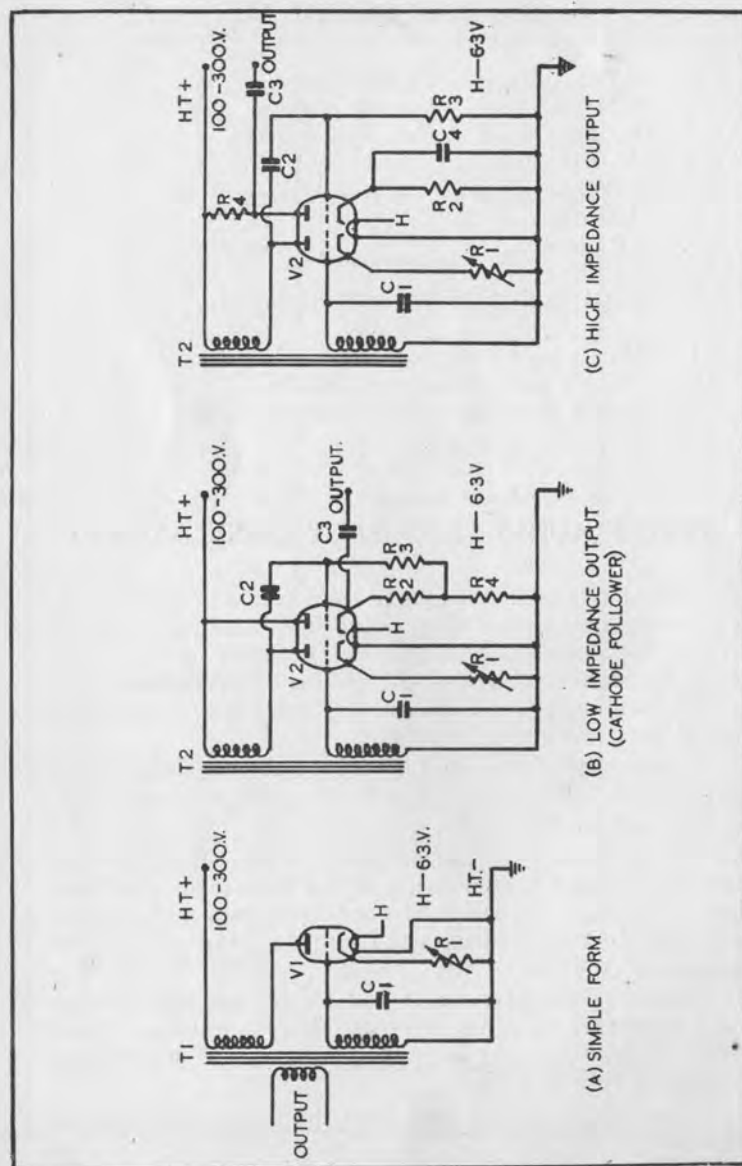


Fig. 20.—Stable Audio Frequency Oscillators.

Fig. 20.—COMPONENTS LIST

R.1.	50,000 ohms.	Variable resistor.
R.2.	1,500 ohms.	$\frac{1}{2}$ watt carbon resistor.
R.3.	470,000 ohms.	"
R.4.	47,000 ohms.	"
C.1.	0.001 mfd.	Condenser (or to suit required frequency).
C.2.	0.01 mfd.	Mica condenser. T.C.C. M3N.
C.3.	0.1 mfd.	25 v.wg. T.C.C. C.E.32C.
C.4.	25 mfd.	350 v.wg. T.C.C. 343.
V.1.	6C5G, 6J5G or L63 valve.	
V.2.	6SN7 or B65 valve.	
T.1.	Intervalve transformer with additional winding.	
T.2.	Intervalve transformer.	

One international valve holder.

AN AMPLIFIED BRIDGE NULL DETECTOR

This detector may be used in place of 'phones in almost any bridge circuit.

Resistance R.4 is adjusted so that the meter reads full scale with the input shorted. Any signal will cause a reduction in reading so that the bridge should be adjusted for maximum reading on the meter.

With S.1 closed the detector is most sensitive at the frequency of the parallel resonance of the grid winding of T.1 and C.1. If used in conjunction with the oscillator described in this manual the frequency of the two units should match, provided similar transformers are used in each circuit and the same capacitor value is chosen.

With S.1 open the detector responds at all frequencies within the range of the input transformer.

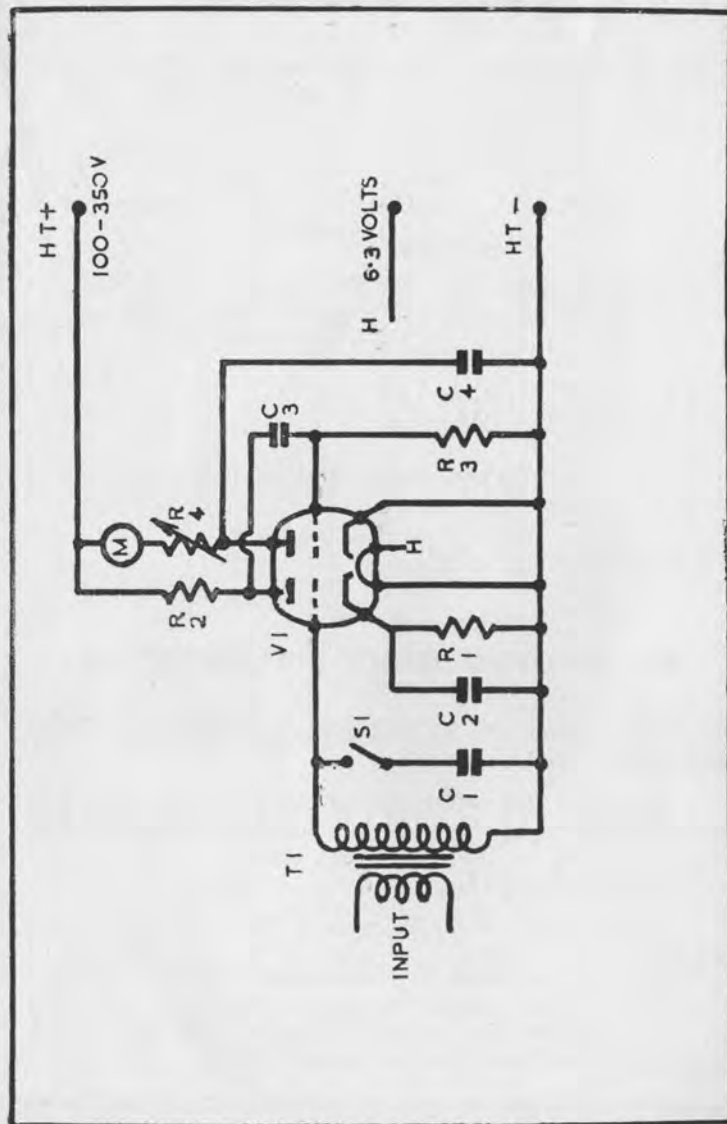


Fig. 21.—An Amplified Bridge Null Detector.

Fig. 21.—COMPONENTS LIST

- | | | |
|---------------------------------------|-------------------------|--|
| R.1. | 3,300 ohms. | $\frac{1}{2}$ watt carbon resistor. |
| R.2. | 330,000 ohms. | " |
| R.3. | 4.7 meg-ohms. | " |
| R.4. | 330,000 ohms. | Potentiometer. |
| C.1. | 0.001 mfd. | Mica condenser (or to suit frequency). |
| C.2. | 25 mfd. | 25 v.wg. T.C.C. C.E.32C. |
| C.3. | 0.01 mfd. | Mica condenser. T.C.C. M.3N. |
| C.4. | 4 mfd. | 350 v.wg. Electrolytic T.C.C. C.E.18L. |
| S.1. | Single pole switch. | |
| T.1. | Intervalve transformer. | |
| M. | 0-1 m/A meter. | |
| V.1. | 6SL7 valve. | |
| One international octal valve holder. | | |

A GENERAL PURPOSE POWER UNIT

This unit has an output of 120 m/As. at 350 volts and gives heater supplies at 6.3 and 4 volts. By switching from condenser input to choke input the output is lowered to 250 volts and the regulation improved.

This unit is suitable for use with many circuits in this manual and is a useful addition to the equipment of any home constructor's laboratory.

The 4 volt heater winding may be omitted if it is not required.

Fig. 22.—COMPONENTS LIST

- | | | |
|------|--------------|---|
| R.1. | 47,000 ohms. | 2 watt carbon resistor. |
| C.1. | 8 mfd. | 450 v.wg. T.C.C. C.E.19P. |
| C.2. | 16 mfd. | 450 v.wg. T.C.C. 16+16 type
C.E.37P.A. |
| C.3. | 16 mfd. | |

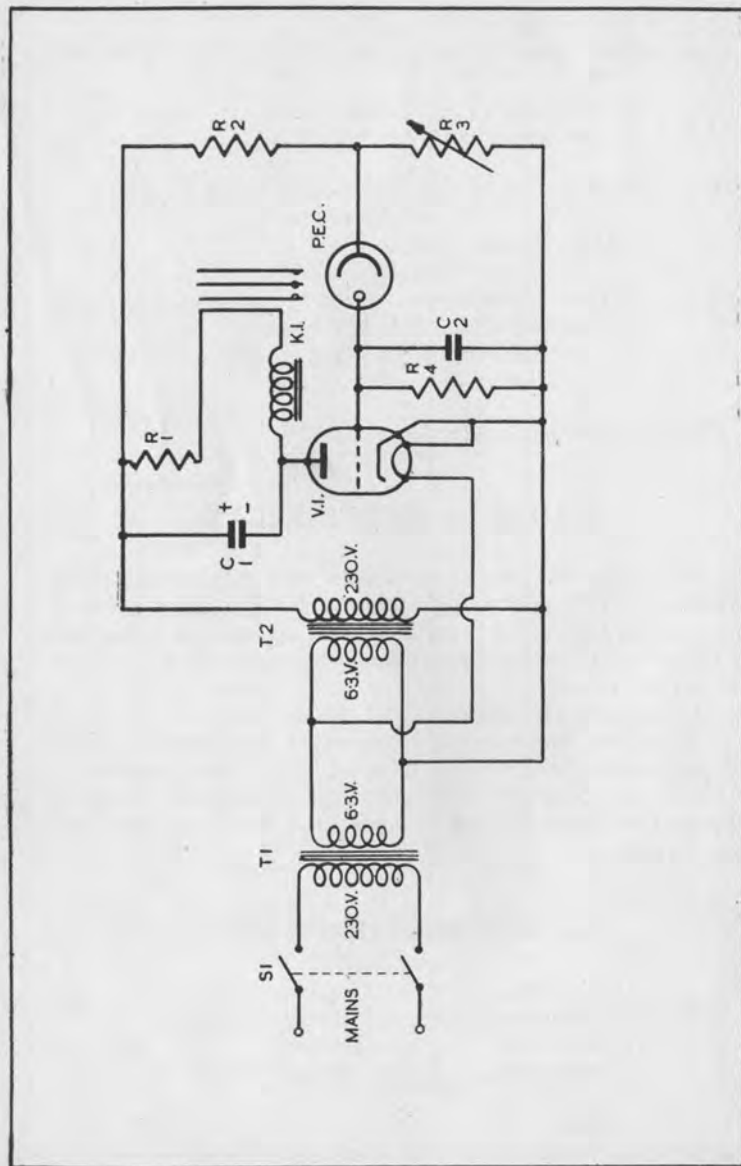


Fig. 23.—A light-Sensitive Relay.

- K.1. 2,000 ohm. relay.
- S.1. Double pole On-Off switch.
- V.1. 6J5-G/GT or L63.
- T.1. Mains transformer, 230 volts to 6.3 volts 1 amp.
- T.2. „
- P.F.C. Cesium gas-filled photo-electric cell.
- One international octal valve holder.

A CONSTANT CURRENT DEVICE FOR FEEDING TELEVISION FOCUS COILS

Pentodes are well known as constant current devices. This circuit shows how one may be used to control the current through a focus coil on a television set. Most focus coils increase in resistance considerably as they warm up, and this reduces the current and necessitates the picture being refocused. This circuit overcomes this trouble.

R.1 replaces the normal focus control.

Fig. 24.—COMPONENTS LIST

- | | | |
|------|--|-------------------------------|
| R.1. | 2,000 ohms. | Variable wire wound resistor. |
| R.2. | 22,000 ohms. | 5 watt wire wound resistor. |
| N.1. | Neon lamp (with series resistor if any removed). | |
| V.1. | 6F6-G/GT or KT63 valve. | |
| L.1. | Focus coil or other load requiring constant current. | |

One international octal valve holder.

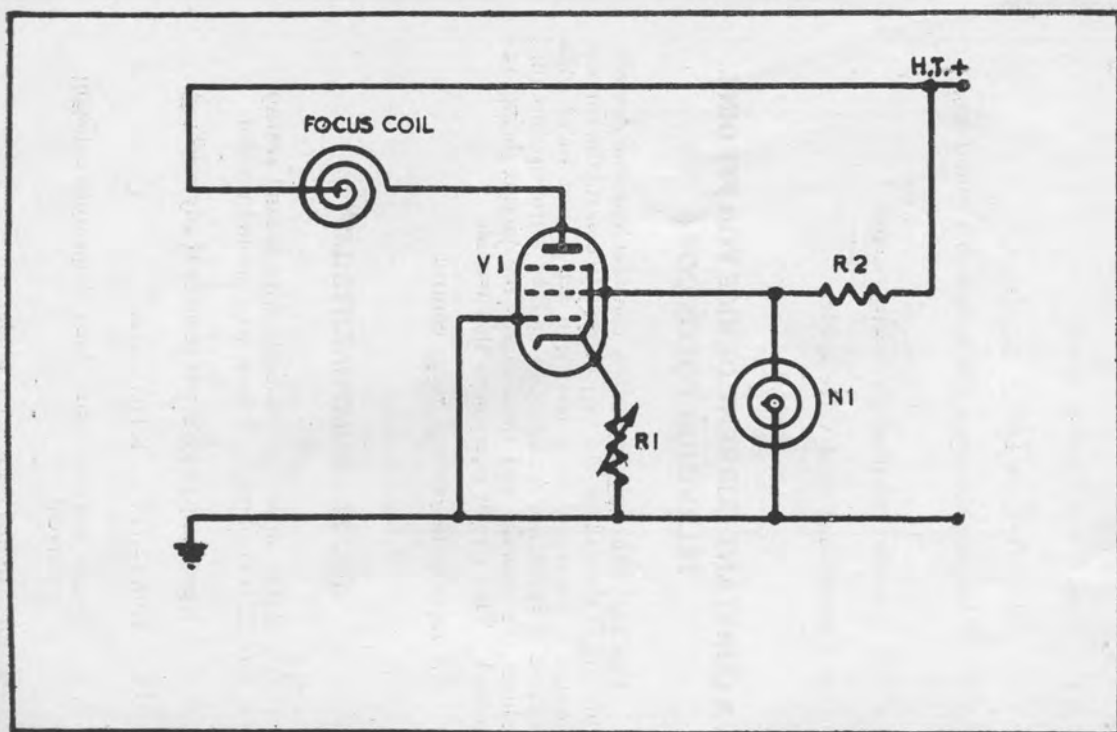


Fig. 24.—A Constant Current Device for Feeding Television Focus Coils.

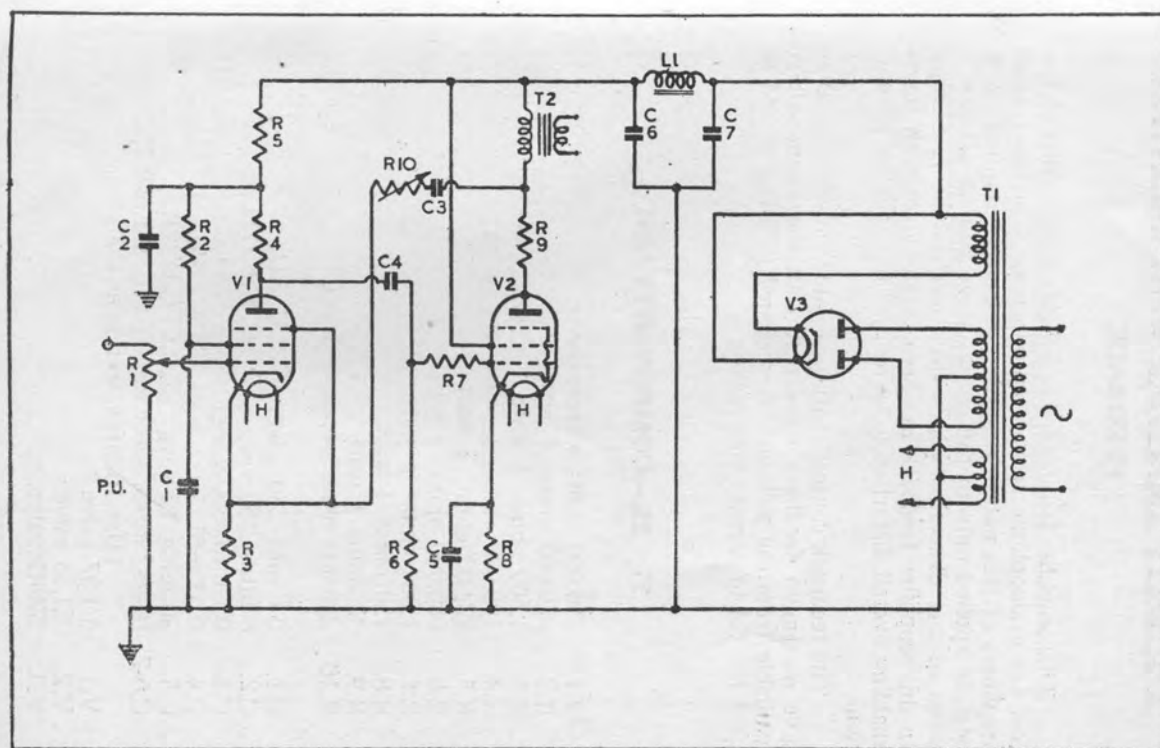


Fig. 25.—A 3.5 watt Amplifier with Negative Feedback.

A 3½ WATT AMPLIFIER WITH NEGATIVE FEEDBACK

This amplifier is intended to provide good quality at low cost for gramophone record reproduction. On many small amplifiers of this nature negative feedback is omitted or, at best, is applied only to the output stage and no account is taken of any distortion which may arise in the first stage. In this amplifier feedback has been carried over both stages enabling overall distortion to be reduced to negligible proportions.

The feedback control R.10 is variable and may be set to give maximum feedback consistent with the input voltage available from the pick-up. A screened grid cap should be used for V.1 to prevent hum pick-up.

Fig. 25.—COMPONENTS LIST

- R.1. 250,000 ohms potentiometer.
- R.2. 270,000 ohms. ½ watt.
- R.3. 1,500 ohms. ½ watt.
- R.4. 100,000 ohms. ½ watt.
- R.5. 22,000 ohms. ½ watt.
- R.6. 680,000 ohms. ½ watt.
- R.7. 1,000 ohms. ½ watt.
- R.8. 150 ohms ½ watt.
- R.9. 47 ohms ½ watt.
- R.10. 250,000 ohms potentiometer.

- C.1. 0.1 mfd. 350 v.wg. T.C.C. 343.
- C.2. 8 mfd. 350 v.wg. T.C.C. C.E. 11L.
- C.3. 0.1 mfd. 350 v.wg. T.C.C. 343.
- C.4. 0.02 mfd. 350 v.wg. T.C.C. 346.
- C.5. 50 mfd. 12 v.wg. T.C.C. C.E.32B.
- C.6-7. 16+32 mfd. 350 v.wg. T.C.C. C.E.28LE.
(Use 16 mfd. section as C.7.)
- V.1. EF37 valve.
- V.2. EL33 valve.
- V.3. 5Z4G valve.

- T.1. Power transformer: Pri. 200-250 v. or to suit mains, sec. 250-0-250 v.
6.3 v. 2 amps. C.T.
5.0 v. 2 amps.
- T.2. Output transformer to match speaker to 7,000 ohms. load.
- L.1. 10 henries at 60 m/As.
- Three international octal valve holders.

SCHEMATIC SYMBOLS

DIODE
OR
H.W. RECTIFIERDOUBLE DIODE
OR
F.W. RECTIFIERCOLD CATHODE
RECTIFIER

TRIODE

GAS
TRIODEDOUBLE DIODE
TRIODEDOUBLE
TRIODE

R.F. TETRODE



R.F. PENTODE



BEAM TETRODE

OUTPUT
PENTODE

HEPTODE

ALTERNATIVE
HEPTODETRIODE
PENTODE

TRIODE-HEXOIDE

ALTERNATIVE
TRIODE-HEXOIDETRIODE
HEPTODE

OCTODE

TUNING
INDICATOR

BARRETTTER

SCHEMATIC SYMBOLS



AERIAL



EARTH

FIXED
CAPACITORVARIABLE
CAPACITOR

RESISTOR

VARIABLE
RESISTORVARIABLE
POTENTIOMETERR.F. COIL
OR CHOKEIRON CORED
R.F. COIL

L.F. CHOKE



L.F. TRANSFORMER

WIRING DIAGRAM DEVICES
A-CROSSOVER
B-CONNECTION

R.F. TRANSFORMER



BATTERY

SINGLE
CELL

A



B



C



D



E



F

VALVE ELECTRODE SYMBOLS

A. FILAMENT
OR HEATER

D. ANODE

B. CATHODE

E. DIODE ANODE

C. GRID

F. COLD CATHODE

METAL
RECTIFIERLOUD
SPEAKERHEAD
PHONES

A



B



C



D

SWITCHES

A. S.P.S.T.

B. S.P.D.T.

C. D.P.S.T.

D. MULTIWAY
ROTARY SWITCHA.C.
MAINSD.C.
MAINS

A.C./D.C.



FUSE



JACK



METER

PIEZOELECTRIC
CRYSTAL

BERNARDS RADIO BOOKS

37.	MANUAL OF DIRECT DISC RECORDING	...	...	2/-
42.	SHORTWAVE RADIO HANDBOOK	...	...	2/-
43.	MODERN RADIO TEST GEAR CONSTRUCTION	...	...	1/6
44.	RADIO SERVICE MANUAL	...	...	2/6
45.	RADIO REFERENCE HANDBOOK	...	...	12/6
48.	RADIO COIL AND TRANSFORMER MANUAL	...	...	2/-
52.	RADIO TUNER UNIT MANUAL	...	...	2/6
53.	RADIO CONSTRUCTORS' MANUAL	...	...	3/4
54.	RADIO RESISTOR CHART	...	...	1/6 & 1/-
55.	HANDBOOK OF RADIO CIRCUITS No. 2	...	...	2/6
56.	RADIO AERIAL HANDBOOK	...	...	2/6
57.	ULTRA SHORTWAVE HANDBOOK	...	...	2/6
58.	RADIO HINTS MANUAL	...	...	2/6
59.	TELEVISION CONSTRUCTION MANUAL	...	...	3/6
60.	RADIO REPAIRS MANUAL	...	...	2/6
61.	AMATEUR TRANSMITTERS' CONSTRUCTION MANUAL	...	...	2/6
62.	CAR AND PORTABLE RADIO CONSTRUCTORS' MANUAL	...	...	2/6
63.	RADIO CALCULATIONS MANUAL	...	...	3/6
64.	SOUND EQUIPMENT MANUAL	...	...	2/6
65.	RADIO DESIGNS MANUAL	...	...	2/6
66.	COMMUNICATIONS RECEIVERS' MANUAL	...	...	2/6
67.	RADIO VALVE EQUIVALENTS MANUAL	...	...	2/6
68.	FREQUENCY MODULATION RECEIVERS' MANUAL	...	...	2/6
69.	RADIO INDUCTANCE MANUAL	...	...	2/6
70.	LOUDSPEAKER MANUAL	...	...	2/6
71.	MODERN BATTERY RECEIVERS' MANUAL	...	...	2/6
72.	EXPERIMENTAL CIRCUITS MANUAL	...	...	2/6
73.	RADIO TEST EQUIPMENT MANUAL	...	...	2/6
74.	RADIO VALVE APPLICATIONS MANUAL	...	...	5/-
75.	INTERNATIONAL RADIO TUBE ENCYCLOPEDIA	...	...	42/-
76.	RADIO ANTI-INTERFERENCE MANUAL	...	...	2/6
77.	WALKIE-TALKIE CONSTRUCTION MANUAL	...	...	2/6
78.	RADIO AND TELEVISION LABORATORY MANUAL	...	...	2/6
79.	THE RADIO MODERNISATION MANUAL	...	...	3/6
80.	TELEVISION SERVICING MANUAL	...	...	4/6
81.	USING EX-SERVICE RADIO APPARATUS	...	...	2/6
82.	AC/DC RECEIVER CONSTRUCTION MANUAL	...	...	2/6
84.	INTERNATIONAL WORLD RADIO STATION LIST	...	...	1/6
85.	MINIATURE RADIO EQUIPMENT CONSTRUCTION MANUAL	...	...	2/6
86.	MIDGET RADIO CONSTRUCTION MANUAL	...	...	2/6
87.	THE OSCILLOSCOPE: DESIGN AND CONSTRUCTION	...	...	2/6
88.	WIRE RECORDER CONSTRUCTION MANUAL	...	...	2/6
89.	HIGH DEFINITION TELEVISION CONSTRUCTION MANUAL	...	...	3/6
	HAM NOTES FOR THE HOME CONSTRUCTOR (Nos. 1 to 4) ea.	...	...	1/-

In Preparation

RADIO INSTRUMENTS AND THEIR CONSTRUCTION
 AN INTRODUCTION TO "HAM" RADIO
 CIRCUITS MANUAL No. 3
 HANDBOOK OF AUDIO DESIGNS
 LOW FREQUENCY EQUIPMENT MANUAL
 VALVE DATA MANUAL
 HAM NOTES (continuation of series)